DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SBIR 22.2 Program Broad Agency Announcement (BAA)

April 20, 2022: DoD BAA issued for pre-release
May 18, 2022: DoD begins accepting proposals
June 15, 2022: Deadline for receipt of proposals no later than **12:00 p.m. ET**

Participating DoD Components:

- Department of the Army (Army)
- Department of the Navy (Navy)
- Department of Air Force (Air Force)
- Chemical and Biological Defense (CBD)
- Defense Logistics Agency (DLA)
- Defense Threat Reduction Agency (DTRA)
- Office of the Secretary of Defense – Defense Human Resources Activity (OSD – DHRA)
- Office of the Secretary of Defense – National Geospatial-Intelligence Agency (OSD – NGA)
- United States Special Operations Command (USSOCOM)

IMPORTANT

Congressional authorization of the SBIR and STTR programs is set to expire on September 30, 2022. If the programs are not reauthorized by September 30, 2022, the DoD cannot continue to publish SBIR or STTR Broad Agency Announcements (BAAs)/Commercial Solutions Openings (CSOs), and cannot continue funding new or ongoing SBIR/STTR projects after that date, including projects resulting from this BAA.

Deadline for Receipt: Complete proposals must be certified and submitted in DSIP no later than **12:00 PM** ET on **June 15, 2022**. Proposals submitted after 12:00 p.m. ET will not be evaluated. The final proposal submission includes successful completion of all firm level forms, all required volumes, and electronic corporate official certification. Please plan to submit proposals as early as possible in order to avoid unexpected delays due to high volume of traffic during the final hours before the BAA close. DoD is not responsible for missed proposal submission due to system latency.

Classified proposals will not be accepted under the DoD SBIR Program.

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. Firms are required to register for a Login.gov account and link it to their DSIP account. See section 4.14 for more information regarding registration.

The Small Business Administration (SBA), through its SBIR/STTR Policy Directive, purposely departs from normal Government solicitation formats and requirements, thus authorizing agencies to simplify the SBIR/STTR award process and minimize the regulatory burden on small business. Therefore, consistent with the SBA SBIR/STTR Policy Directive, the Department of Defense is soliciting proposals as a Broad Agency Announcement.

SBIR/STTR Updates and Notices: To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, you are invited to subscribe to our Listserv by visiting https://www.dodsbirsttr.mil/submissions/login and clicking "DSIP Listserv" located under Quick Links.

On April 4, 2022, the DUNS Number will be replaced by the Unique Entity ID (SAM) to identify organizations doing business with the Government. If the firm has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. **For firms with established DSIP accounts, update the firm profile with the UEI (SAM) as soon as possible.** See section 4.15 for more information.

Questions: Please refer to the DSIP Customer Support Document for general information regarding the DoD SBIR/STTR process in DSIP. For additional assistance with the DSIP application, please visit the Learning & Support section of the DSIP at https://www.dodsbirsttr.mil/submissions/learning-support/. Email DSIP Support at DoDSBIRSupport@reisystems.com only for further assistance with issues pertaining directly to the DSIP application. Questions submitted to DSIP Support will be addressed in the order received during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). **See section 4.14 for further information on where to direct questions regarding instructions and topics in this BAA**.

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ATTACHMENTS

1.0 INTRODUCTION

Army, Navy, Air Force, CBD, DHA, DLA, DTRA, OSD – DHRA, OSD – NGA, and USSOCOM, hereafter referred to as DoD Components, invite small business firms to submit proposals under this BAA for the Small Business Innovation Research (SBIR) Program. Firms with the capability to conduct research and development (R&D) in any of the defense-related topic areas described in this BAA and to commercialize the results of that R&D are encouraged to participate.

This BAA is for Phase I proposals only unless the Component is participating in the **Direct to Phase II Program**. Air Force, DLA, and OSD - NGA are offering Direct to Phase II topics for this BAA – see the Component-specific instructions for more information.

A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All firms that receive a Phase I award originating from this BAA will be eligible to participate in Phase II competitions and potential Phase III awards. DoD Components will notify Phase I awardees of the Phase II proposal submission requirements. Submission of Phase II proposals will be in accordance with instructions provided by individual Components. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the awarding DoD Component either in the Phase I award or by subsequent notification. If a firm submits their Phase II proposal prior to the dates provided by the individual Components, it may be rejected without evaluation.

DoD is not obligated to make any awards under Phase I, Phase II, or Phase III, and all awards are subject to the availability of funds. DoD is not responsible for any monies expended by the proposer before the issuance of any award.

2.0 PROGRAM DESCRIPTION

2.1 Objectives

The objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development results.

2.2 Technology and Program Protection to Maintain Technological Advantage

In accordance with DoD Instruction 5000.83, Technology and Program Protection to Maintain Technological Advantage, dated July 20, 2020, and as a means to counter the threat from strategic competitor nations, the DoD will employ risk-based measures to protect systems and technologies from adversarial exploitation and compromise of U.S. military vulnerabilities and weaknesses in: (1) systems, (2) components, (3) software, (4) hardware, and (5) supply chains. Any offeror submitting a proposal under this BAA will be required to disclose via self-report any foreign ownership or control. Offerors shall also require any proposed subcontractors included in their proposal under this BAA to disclose via self-report any foreign ownership or control. Reporting and disclosing such information will enable the DoD to identify national security risks posed by foreign participation, through investment, ownership, or influence, in the defense industrial base. This information will be used by DoD program offices to determine risks posed by SBIR contract awardees and their subcontractors to the DoD and the defense industrial base.

OUSD(R&E) Modernization Priorities

Focus Area	Description
5G	Technologies enabling the 5G spectrum to increase speed over current networks, to be more resilient and less susceptible to attacks, and to improve military communication and situational awareness.
Artificial Intelligence (AI)/ Machine Learning (ML)	Systems that perceive, learn, decide, and act on their own. Machine-learning systems with the ability to explain their rationale, characterize their strengths and weaknesses, and convey understanding of how they will behave in the future.
Autonomy	Technology that can deliver value by mitigating operational challenges such as: rapid decision making; high heterogeneity and/or volume of data; intermittent communications; high complexity of coordinated action; danger to mission; and high persistence and endurance.
Biotechnology	Biotechnology is any technological application that harnesses cellular and biomolecular processes. Most current biotech research focuses on agent detection, vaccines, and treatment. Future advances in biotechnology will improve the protection of both the general public and military personnel from biological agents, among numerous other potential applications.
Cybersecurity	Prevention of damage to, protection of, and restoration of computers, electronic communications systems, electronic communications services, wire communication, and electronic communications, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and nonrepudiation.
Directed Energy (DE)	Technologies related to production of a beam of concentrated electromagnetic energy, atomic, or subatomic particles.
Hypersonics	Innovative concepts or technologies that enable, or directly support, weapons or aircraft that fly at or near hypersonic speeds and/or innovation that allows for enhancing defensive capability against such systems.
Microelectronics	Critical microcircuits used in covered systems, custom-designed, custom-manufactured, or tailored for specific military application, system, or environment.
Networked Command, Control, and Communications (C3)	Fully networked command control and communications including: command and control (C2) interfaces, architectures, and techniques (e.g., common software interfaces and functional architectures and improved C2 processing/decision making techniques); communications terminals (e.g., software-defined radio (SDRs)/apertures with multiple networks on the same band and multi-functional systems); and apertures and networking technologies (e.g., leveraging/managing a diverse set of links across multiple band and software defined networking/ network slicing).
Nuclear	Technologies supporting the nuclear triad-including nuclear command, control, and communications, and supporting infrastructure. Modernization of the nuclear force includes developing options to counter competitors' coercive strategies, predicated on the threatened use of nuclear or strategic non-nuclear attacks.
Quantum Science	Technologies related to matter and energy on the atomic and subatomic level. Areas of interest: clocks and sensors; networks; computing enabling technologies (e.g., low temperature amplifiers, cryogenics, superconducting circuits, photon detectors); communications (i.e., sending/receiving individual photons); and manufacturing improvements.
Space	Technologies supporting space, or applied to a space environment.
General Warfighting Requirements (GWR)	Warfighting requirements not meeting the descriptions above; may be categorized into Reliance 21 areas of interest.

The DoD SBIR/STTR Programs follow the policies and practices of the Small Business Administration (SBA) SBIR/STTR Policy Directive updated on October 1, 2020. The guidelines presented in this BAA incorporate and make use of the flexibility of the SBA SBIR/STTR Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to the DoD and the private sector. The SBIR/STTR Policy Directive is available at: https://www.sbir.gov/sites/default/files/SBA_SBIR_STTR_POLICY_DIRECTIVE_OCT_2020_0.pdf.

2.3 Three Phase Program

The SBIR Program is a three-phase program. Phase I is to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted under the SBIR Program. Phase I awards are made in accordance with the SBA Policy Directive guidelines, current version. The period of performance is generally between six to twelve months with twelve months being the maximum period allowable. Proposals should concentrate on research or research and development which will significantly contribute to proving the scientific and technical feasibility, and commercialization potential of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. Proposers are encouraged to consider whether the research or research and development being proposed to DoD Components also has private sector potential, either for the proposed application or as a base for other applications.

Phase II awards will be made to firms on the basis of results of their Phase I effort and/or the scientific merit, technical merit, and commercialization potential of the Phase II proposal. Phase II awards are made in accordance with the SBA Policy Directive guidelines, current version. The period of performance is generally 24 months. Phase II is the principal research or research and development effort and is expected to produce a well-defined deliverable prototype. A Phase II contractor may receive up to one additional, sequential Phase II award for continued work on the project.

Under Phase III, the Proposer is required to obtain funding from either the private sector, a non-SBIR Government source, or both, to develop the prototype into a viable product or non-R&D service for sale in military or private sector markets. SBIR Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Phase III work is typically oriented towards commercialization of SBIR research or technology.

3.0 DEFINITIONS

The following definitions from the SBA SBIR/STTR Policy Directive, the Federal Acquisition Regulation (FAR), and other cited regulations apply for the purposes of this BAA:

Commercialization

The process of developing products, processes, technologies, or services and the production and delivery (whether by the originating party or others) of the products, processes, technologies, or services for sale to or use by the Federal government or commercial markets.

Cooperative Research and Development

Research and development conducted jointly by a small business concern and a research institution. For purposes of the STTR Program, 40% of the work is performed by the small business concern, and not less than 30% of the work is performed by the single research institution. For purposes of the SBIR Program, this refers to work conducted by a research institution as a subcontractor to the small business concern. At least two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing firm.

Essentially Equivalent Work

Work that is substantially the same research, which is proposed for funding in more than one contract proposal or grant application submitted to the same Federal agency or submitted to two or more different Federal agencies for review and funding consideration; or work where a specific research objective and the research design for accomplishing the objective are the same or closely related to another proposal or award, regardless of the funding source.

Export Control

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

NOTE: Export control compliance statements found in the individual Component-specific proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

Federal Laboratory

As defined in 15 U.S.C. §3703, means any laboratory, any federally funded research and development center (FFRDC), or any center established under 15 U.S.C. §§ 3705 & 3707 that is owned, leased, or otherwise used by a Federal agency and funded by the Federal Government, whether operated by the Government or by a contractor.

Foreign Entity

Foreign entity means any branch, partnership, group or sub-group, association, estate, trust, corporation or division of a corporation, non-profit, academic institution, research center, or organization established, directed, or controlled by foreign owners, foreign investors, foreign management, or a foreign government.

Foreign Government

Foreign government means any government or governmental body, organization, or instrumentality, including government owned-corporations, other than the United States Government or United States state, territorial, tribal, or jurisdictional governments or governmental bodies. The term includes, but is not limited to, non-United States national and subnational governments, including their respective departments, agencies, and instrumentalities.

Foreign Nationals

Foreign Nationals (also known as Foreign Persons) as defined by 22 CFR 120.16 means any natural person who is not a lawful permanent resident as defined by 8 U.S.C. § 1101(a)(20) or who is not a protected individual as defined by 8 U.S.C. § 1324b(a)(3). It also means any foreign corporation, business association, partnership, trust, society or any other entity or group that is not incorporated or organized to do business in the United States, as well as international organizations, foreign governments and any agency or subdivision of foreign governments (e.g., diplomatic missions).

“Lawfully admitted for permanent residence” means the status of having been lawfully accorded the privilege of residing permanently in the United States as an immigrant in accordance with the immigration laws, such status not having changed.

"Protected individual'' means an individual who (A) is a citizen or national of the United States, or (B) is an alien who is lawfully admitted for permanent residence, is granted the status of an alien lawfully admitted for temporary residence under 8 U.S.C. § 1160(a) or 8 U.S.C. § 1255a(a)(1), is admitted as a refugee under 8 U.S.C. § 1157, or is granted asylum under Section 8 U.S.C. § 1158; but does not include (i) an alien who fails to apply for naturalization within six months of the date the alien first becomes eligible (by virtue of period of lawful permanent residence) to apply for naturalization or, if later, within six months after November 6, 1986, and (ii) an alien who has applied on a timely basis, but has not been naturalized as a citizen within 2 years after the date of the application, unless the alien can establish that the alien is actively pursuing naturalization, except that time consumed in the Service's processing the application shall not be counted toward the 2-year period.

Fraud, Waste and Abuse

a. **Fraud** includes any false representation about a material fact or any intentional deception designed to deprive the United States unlawfully of something of value or to secure from the United States a benefit, privilege, allowance, or consideration to which an individual or business is not entitled.
b. **Waste** includes extravagant, careless or needless expenditure of Government funds, or the consumption of Government property, that results from deficient practices, systems, controls, or decisions.
c. **Abuse** includes any intentional or improper use of Government resources, such as misuse of rank, position, or authority or resources.
d. The SBIR Program training related to Fraud, Waste and Abuse is available at: https://www.sbir.gov/tutorials/fraud-waste-abuse/tutorial-1. See Section 4.17 for reporting Fraud, Waste and Abuse.

Funding Agreement

Any contract, grant, or cooperative agreement entered into between any Federal Agency and any small business concern for the performance of experimental, developmental, or research work, including products or services, funded in whole or in part by the Federal Government. Only the contract method will be used by DoD Components for all SBIR awards.

Historically Black Colleges and Universities and Minority Institutions (HBCU/MI)

Listings for the Historically Black Colleges and Universities (HBCU) and Minority Institutions (MI) are available through the Department of Education Web site, http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

Certified HUBZone Small Business Concern

An SBC that has been certified by SBA under the Historically Underutilized Business Zones (HUBZone) Program (13 C.F.R. § 126) as a HUBZone firm listed in the Dynamic Small Business Search (DSBS).

Performance Benchmark Requirements for Phase I

Companies with multiple SBIR/STTR awards must meet minimum performance requirements to be eligible to apply for a new Phase I or Direct-to-Phase II award. The purpose of these requirements is to ensure that Phase I applicants that have won multiple prior SBIR/STTR awards are making progress towards commercializing the work done under those awards. The Phase I to Phase II Transition Rate addresses the extent to which an awardee progresses a project from Phase I to Phase II. The Commercialization Benchmark addresses the extent to which an awardee has moved past Phase II work towards commercialization. Additional information on performance benchmarking for Phase I applicants can be found at https://www.sbir.gov/performance-benchmarks.

Principal Investigator

The principal investigator/project manager is the one individual designated by the applicant to provide the scientific and technical direction to a project supported by the funding agreement.

For both Phase I and Phase II, the primary employment of the principal investigator must be with the small business firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the principal investigator's time is spent in the employ of the small business. This precludes full-time employment with another organization. Occasionally, deviations from this requirement may occur, and must be approved in writing by the contracting officer after consultation with the agency SBIR/STTR Program Manager/Coordinator. Further, a small business firm or research institution may replace the principal investigator on an SBIR/STTR Phase I or Phase II award, subject to approval in writing by the contracting officer.

Proprietary Information

Proprietary information is information that you provide which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security.

Research Institution

Any organization located in the United States that is:

a. A university.
b. A nonprofit institution as defined in Section 4(5) of the Stevenson-Wydler Technology Innovation Act of 1980.
c. A contractor-operated federally funded research and development center, as identified by the National Science Foundation in accordance with the government-wide Federal Acquisition Regulation issued in accordance with Section 35(c)(1) of the Office of Federal Procurement Policy Act. A list of eligible FFRDCs is available at: https://www.nsf.gov/statistics/ffrdclist/.

Research or Research and Development

Any activity that is:

a. A systematic, intensive study directed toward greater knowledge or understanding of the subject studied.
b. A systematic study directed specifically toward applying new knowledge to meet a recognized need; or

c. A systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

Research Involving Animal Subjects

All activities involving animal subjects shall be conducted in accordance with DoDI 3216.01 “Use of Animals in DoD Programs,” 9 C.F.R. parts 1-4 “Animal Welfare Regulations,” National Academy of Sciences Publication “Guide for the Care & Use of Laboratory Animals,” as amended, and the Department of Agriculture rules implementing the Animal Welfare Act (7 U.S.C. §§ 2131-2159), as well as other applicable federal and state law and regulation and DoD instructions.

“Animal use” protocols apply to all activities that meet any of the following criteria:

a. Any research, development, test, evaluation or training, (including experimentation) involving an animal or animals.
b. An animal is defined as any living or dead, vertebrate organism (non-human) that is being used or is intended for use in research, development, test, evaluation or training.
c. A vertebrate is a member of the subphylum Vertebrata (within the phylum Chordata), including birds and cold-blooded animals.

See DoDI 3216.01 for definitions of these terms and more information about the applicability of DoDI 3216.01 to work involving animals.

Research Involving Human Subjects

All research involving human subjects shall be conducted in accordance with 32 C.F.R. § 219 “The Common Rule,” 10 U.S.C. § 980 “Limitation on Use of Humans as Experimental Subjects,” and DoDI 3216.02 “Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research,” as well as other applicable federal and state law and regulations, and DoD component guidance. Proposers must be cognizant of and abide by the additional restrictions and limitations imposed on the DoD regarding research involving human subjects, specifically as they regard vulnerable populations (DoDI 3216.02), recruitment of military research subjects (DoDI 3216.02), and informed consent and surrogate consent (10 U.S.C. § 980) and chemical and biological agent research (DoDI 3216.02). Food and Drug Administration regulation and policies may also apply.

“Human use” protocols apply to all research that meets any of the following criteria:

a. Any research involving an intervention or an interaction with a living person that would not be occurring or would be occurring in some other fashion but for this research.
b. Any research involving identifiable private information. This may include data/information/specimens collected originally from living individuals (broadcast video, web-use logs, tissue, blood, medical or personnel records, health data repositories, etc.) in which the identity of the subject is known, or the identity may be readily ascertained by the investigator or associated with the data/information/specimens.

See DoDI 3216.02 for definitions of these terms and more information about the applicability of DoDI 3216.02 to research involving human subjects.

Research Involving Recombinant DNA Molecules

Any recipient performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with the National Institutes of Health Guidelines for Research Involving Recombinant DNA Molecules, dated January 2011, as amended. The guidelines can be found at: https://osp.od.nih.gov/wp-content/uploads/2016/05/NIH_Guidelines.pdf. Recombinant DNA is defined as (i) molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in living cells or (ii) molecules that result from the replication of those described in (i) above.

Service-Disabled Veteran-Owned Small Business (SDVOSB)

A small business concern owned and controlled by a Service-Disabled Veteran or Service-Disabled Veterans, as defined in Small Business Act 15 USC § 632(q)(2) and SBA's implementing SDVOSB regulations (13 CFR 125).

Small Business Concern (SBC)

A concern that meets the requirements set forth in 13 C.F.R. § 121.702 (available here).

An SBC must satisfy the following conditions on the date of award:

a. Is organized for profit, with a place of business located in the United States, which operates primarily within the United States or which makes a significant contribution to the United States economy through payment of taxes or use of American products, materials or labor;
b. Is in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that if the concern is a joint venture, each entity to the venture must meet the requirements set forth in paragraph (c) below;
c. Is more than 50% directly owned and controlled by one or more individuals (who are citizens or permanent resident aliens of the United States), other small business concerns (each of which is more than 50% directly owned and controlled by individuals who are citizens or permanent resident aliens of the United States), or any combination of these; and
d. Has, including its affiliates, not more than 500 employees. (For explanation of affiliate, see www.sba.gov/size.)

Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by an awardee of a funding agreement calling for supplies or services for the performance of the original funding agreement. This includes consultants.

Subcontractor

Subcontractor means any supplier, distributor, vendor, firm, academic institution, research center, or other person or entity that furnishes supplies or services pursuant to a subcontract, at any tier.

United States

"United States" means the fifty states, the territories and possessions of the Federal Government, the Commonwealth of Puerto Rico, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Palau, and the District of Columbia.

Women-Owned Small Business Concern

An SBC that is at least 51% owned by one or more women, or in the case of any publicly owned business, at least 51% of the stock is owned by women, and women control the management and daily business operations.

4.0 PROPOSAL FUNDAMENTALS

4.1 Introduction

The proposal must provide sufficient information to demonstrate to the evaluator(s) that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria. The proposed research or research and development must be responsive to the chosen topic, although it need not use the exact approach specified in the topic. Anyone contemplating a proposal for work on any specific topic should determine:

a. The technical approach has a reasonable chance of meeting the topic objective,
b. This approach is innovative, not routine, with potential for commercialization and
c. The proposing firm has the capability to implement the technical approach, i.e., has or can obtain people and equipment suitable to the task.

Please note, **this BAA is for Phase I proposals only** unless the Component is participating in the **Direct to Phase II Program**.

a. Direct to Phase II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019,Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small business concern was provided an award under Phase I of the SBIR program with respect to such project. Missile Defense Agency (MDA), Joint Service Small Arms Program (OSD-JSSAP), SCO, and USSOCOM are conducting a "Direct to Phase II" implementation of this authority for select topics under this BAA. DoD does not guarantee Direct to Phase II opportunities will be offered in future BAAs.

Each eligible topic requires that proposers provide documentation to demonstrate feasibility described in the Phase I section of the topic has been met. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.** Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposer must either own the IP, or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work.

If the proposer fails to demonstrate technical merit and feasibility equivalent to the Phase I level as described in the associated topic, the related Phase II proposal will not be accepted or evaluated, in accordance with the Component-specific Direct to Phase II instructions.

Please refer to the Component-specific Direct to Phase II instructions for full details regarding Component Direct to Phase II processes and proposal preparation requirements.

4.2 Proposer Eligibility and Performance Requirements

a. Each proposer must qualify as a small business concern as defined by 13 C.F.R §§ 701-705 at time of award and certify to this in the Cover Sheet section of the proposal. The eligibility requirements for the SBIR/STTR programs are unique and do not correspond to those of other small business programs (see Section 3 of this BAA). Proposers must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702 and Section 4.4 of this BAA).
b. A minimum of two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing firm. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing firm. The percentage of work is measured by both direct and indirect costs.
c. For both Phase I and II, the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Primary employment with a small business concern precludes full-time employment at another organization.
d. For both Phase I and Phase II, all research or research and development work must be performed by the small business concern and its subcontractors in the United States.
e. **Benchmarks**. Proposers with prior SBIR/STTR awards must meet two benchmark requirements for Progress towards Commercialization as determined by the Small Business Administration (SBA) on June 1 each year.

    (1) Phase I to Phase II Transition Rate: For all proposers with greater than 20 Phase I awards over the past five fiscal years excluding the most recent year, the ratio of Phase II awards to Phase I awards must be at least 0.25.

    (2) Commercialization Benchmark: For all proposers with greater than 15 Phase II awards over the last ten fiscal years excluding the last two years, the proposer must have received, to date, an average of at least $100,000 of sales and/or investments per Phase II award received or have received a number of patents resulting from the SBIR work equal to or greater than 15% of the number of Phase II awards received during the period.

    Consequence of failure to meet the benchmarks:

    - SBA will identify and notify Agencies on June 1st of each year the list of companies which fail to meet minimum performance requirements. These companies will not be eligible to submit a proposal for a Phase I or Direct to Phase II award for a period of one year from that date.
    - Because this requirement only affects a company's eligibility for new Phase I or Direct to Phase II awards, a company that fails to meet minimum performance requirements may continue working on its current ongoing SBIR/STTR awards and may apply for and receive new Phase II and Phase III awards.
    - To provide companies with advance warning, SBA notifies companies on April 1st if they are failing the benchmarks. If a company believes that the information used was not complete or accurate, it may provide feedback through the SBA Company Registry at www.sbir.gov.
    - In addition, SBA has posted a Guide to SBIR/STTR Program Eligibility to help small businesses understand program eligibility requirements, determine if they will be eligible at the time of award, and accurately complete necessary certifications.

- The benchmark information on the companies will not be available to the public.
- More detail is available at https://www.sbir.gov/performance-benchmarks.

4.3 Joint Ventures

Joint ventures and limited partnerships are permitted, provided that the entity created qualifies as a small business in accordance with the Small Business Act, 13 U.S.C. § 121.701. Proposers must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies.

4.4 Majority Ownership in Part by Multiple Venture Capital, Hedge Fund, and Private Equity Firms

Unless otherwise noted in the participating Component instructions, small businesses that are owned in majority part by multiple venture capital operating companies (VCOCs), hedge funds, or private equity funds are ineligible to submit applications or receive awards for opportunities in this BAA. Component instructions will specify if participation by a small business majority owned in part by VCOCs, hedge funds, or private equity funds is allowable for a specific topic in the BAA. If a Component authorizes such participation, any proposer that is owned, in whole or in part, by any VCOC, hedge fund, and/or private equity fund must identify each foreign national, foreign entity, or foreign government holding or controlling greater than a 5% equity stake in the proposer, whether such equity stake is directly or indirectly held. The proposer must also identify any and all of its ultimate parent owner(s) and any other entities and/or individuals owning more than a 5% equity stake in its chain of ownership.

4.5 Conflicts of Interest

Contract awards to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees, which may be a violation of federal law.

4.6 Organizational Conflicts of Interest

FAR 9.5 Requirements
In accordance with FAR 9.5, proposers are required to identify and disclose all facts relevant to potential OCIs involving the proposer's organization and any proposed team member (sub-awardee, consultant). Under this Section, the proposer is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposer's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposer has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposer's judgment and to prevent the proposer from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy
In addition, DoD Components may have a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposer must affirm whether the proposer or any proposed team member (sub-awardee, consultant) is providing SETA, A&AS, or similar support to any DoD Component office(s) under: (a) a current award or sub-award; or (b) a past award or sub-award that ended within one calendar year prior to the proposal's submission date.

If SETA, A&AS, or similar support is being or was provided to any DoD Component office(s), the proposal must include:

- The name of the DoD Component office receiving the support;
- The prime contract number;
- Identification of proposed team member (sub-awardee, consultant) providing the support; and
- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures
In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the BAA evaluation criteria and funding availability.

The Government may require proposers to provide additional information to assist the Government in evaluating the proposer's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of Government support as described above; or failed to reasonably provide additional information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

4.7 Classified Proposals

Classified proposals will not be accepted under the DoD SBIR Program. If topics will require classified work during Phase II, the proposing firm must have a facility clearance in order to perform the Phase II work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency (DCSA) website at: https://www.dcsa.mil/mc/ctp/fc/.

4.8 Research Involving Human Subjects

All research involving human subjects, to include use of human biological specimens and human data, shall comply with the applicable federal and state laws and agency policy/guidelines for human subject protection (see Section 3).

Institutions to be awarded funding for research involving human subjects must provide documentation of a current Federal Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office for Human Research Protections Federal-wide Assurance (http://www.hhs.gov/ohrp). Additional Federal Assurance documentation may also be requested by the awarding DoD Component. All institutions engaged in human subject research, to include subcontractors, must also have a valid Assurance. In addition, personnel involved in human subjects research must provide documentation of completing appropriate training for the protection of human subjects. Institutions proposing to conduct human subject research that meets one of the exemption criteria in 32 CFR 219.101 are not required to have a Federal Assurance of Compliance. Proposers should clearly segregate research activities involving human subjects from other research and development activities in their proposal.

If selected, institutions must also provide documentation of Institutional Review Board (IRB) approval or a determination from an appropriate official in the institution that the work meets one of the exemption criteria with 32 CFR 219. As part of the IRB review process, evidence of appropriate training for all investigators should accompany the protocol. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection and data analysis.

The amount of time required for the IRB to review and approve the protocol will vary depending on such things as the IRB's procedures, the complexity of the research, the level of risk to study participants and the responsiveness of the Investigator. The average IRB approval process can last between one and three months. Once the IRB has approved the research, the awarding DoD Component will review the protocol and the IRB's determination to ensure that the research will be conducted in compliance with DoD and DoD Component policies. The DoD review process can last between three to six months. Ample time should be allotted to complete both the IRB and DoD approval processes prior to recruiting subjects. **No funding can be used towards human subject research until ALL approvals are granted. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

4.9 Research Involving Animal Subjects

All research, development, testing, experimentation, education or training involving the use of animals shall comply with the applicable federal and agency rules on animal acquisition, transport, care, handling, and use (see Section 3).

For submissions containing animal use, proposals should briefly describe plans for their Institutional Animal Care and Use Committee (IACUC) review and approval.

All Recipients must receive their IACUC's approval as well as secondary or headquarters-level approval by a DoD veterinarian who is trained or experienced in laboratory animal medicine and science. **No animal research may be conducted using DoD funding until all the appropriate DoD office(s) grant approval. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

4.10 Research Involving Recombinant DNA Molecules

All research involving recombinant DNA molecules shall comply with the applicable federal and state law, regulation and any additional agency guidance. Research shall be approved by an Institutional Biosafety Committee.

4.11 Debriefing/Technical Evaluation Narrative

After final award decisions have been announced, the technical evaluations of the submitter's proposal may be provided to the submitter. Please refer to the Component-specific instructions of your topics of interest for Component debriefing processes.

4.12 Pre-Award and Post Award BAA Protests

Interested parties have the right to protest as prescribed in FAR 33.106(b) and FAR 52.233-2. For purposes of pre-award protests related to the terms of this BAA, protests should be served to the Contracting Officer (listed below).

Ms. Chrissandra Smith
DoD SBIR/STTR BAA Contracting Officer
E-mail: chrissandra.smith.civ@mail. mil

NOTE: CONTACT FOR PROTESTS ONLY. All other inquiries will not be answered or considered.

Washington Headquarters Services (WHS)
Acquisition Directorate
1155 Defense Pentagon
Washington, DC 20301-1155

For the purposes of a protest related to a selection or award decision, protests should be served to the point-of-contact (POC) listed in the instructions of the DoD Component that authored the topic.

For protests filed with the Government Accountability Office (GAO), a copy of the protest shall be submitted to the Contracting Officer listed above (pre-award ONLY) or DoD Component POC (selection/award decision ONLY) within one day of filing with the GAO. Protests of small business status of a selected firm may also be made to the Small Business Administration.

4.13 Phase I Award Information

All Phase I proposals will be evaluated and judged on a competitive basis in terms of technical capability and technical value. Proposals will be initially screened to determine responsiveness to the topic objective. Proposals passing this initial screening will be technically evaluated by engineers or scientists to determine the most promising technical and scientific approaches. As a common statement of work does not exist, each proposal will be assessed on the merit of the approach in achieving the technical objectives established in the topic. DoD is under no obligation to fund any proposal or any specific number of proposals in a given topic. It also may elect to fund several or none of the proposed approaches to the same topic.

a. **Number of Phase I Awards**. The number of Phase I awards will be consistent with the Component's RDT&E budget. No Phase I contracts will be awarded until evaluation of all qualified proposals for a specific topic is completed.

b. **Type of Funding Agreement**. Each Phase I proposal selected for award will be funded under negotiated contracts or purchase orders and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making firms for R/R&D work. Firm-Fixed-Price, Firm-Fixed-Price Level of Effort, Labor Hour, Time & Material, or Cost-Plus-Fixed-Fee type contracts can be negotiated and are at the discretion of the Component Contracting Officer.

c. **Dollar Value**. The Phase I contract value varies among the DoD Components; it is therefore important for proposing firms to review Component-specific instructions regarding award size.

d. **Timing**. Proposing firms will be notified of selection or non-selection status for a Phase I award by the DoD Component that originated the topic within 90 days of the closing date for this BAA. Please refer to the Component-specific instructions for details.

   The SBA SBIR/STTR Policy Directive, Section 7(c)(1)(ii), states that agencies should issue the Phase I award no more than 180 days after the closing date of the BAA. However, across DoD, the median time between the date that the SBIR BAA closes and the award of a Phase I contract is approximately four months.

This information in this section is applicable to Phase I proposals only. If the Component is participating in the **Direct to Phase II Program**, refer to the Component-specific Direct to Phase II instructions for award information.

4.14 Questions about this BAA and BAA Topics

a. **General SBIR Questions/Information**.

(1) **DSIP Support**:
Email DSIP Support at DoDSBIRSupport@reisystems.com only for assistance with using the DSIP application. Questions regarding DSIP can be emailed to DSIP Support and will be addressed in the order received, during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). Please include information on your firm, a proposal number (if applicable), and screenshots of any pertinent errors or issues encountered.

DSIP Support cannot provide updates to proposal status after submission, such as proposal selection/non-selection status or contract award status. Contact the DoD Component that originated the topic in accordance with the Component-specific instructions given at the beginning of that Component's topics.

(2) **Websites**:
The Defense SBIR/STTR Innovation Portal (DSIP) at https://www.dodsbirsttr.mil/submissions/login, which provides the following resources:

- SBIR and STTR Program Opportunities
- Topics Search Engine
- Topic Q&A
- All Electronic Proposal Submission for Phase I and Phase II Proposals. Firms submitting through this site for the first time will be asked to register on https://www.dodsbirsttr.mil/submissions.

DoD SBIR/STTR website at https://rt.cto.mil/rtl-small-business-resources/sbir-sttr/, which provides the following resources:

- Customer Support Information
- SBIR and STTR Program Opportunities
- Dates for Current and Upcoming Opportunities
- Past SBIR and STTR Program Opportunities

(3) **SBIR/STTR Updates and Notices**:
To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, subscribe to the Listserv by selecting “DSIP Listserv” under Quick Links on the DSIP login page.

b. **General Questions about a DoD Component.** Questions pertaining to a particular DoD Component or the Component-specific BAA instructions should be submitted in accordance with the instructions given at the beginning of that Component's topics.

c. **Direct Contact with Topic Authors**. From **April 20, 2022 to May 18, 2022**, this BAA is issued for pre-release with the names of the topic authors and their phone numbers and e-mail addresses. During the pre-release period, proposing firms have an opportunity to contact topic authors by telephone or e-mail to ask technical questions about specific BAA topics. Questions should be limited to specific information related to improving the understanding of a particular topic's requirements. Proposing firms may not ask for advice or guidance on solution approach and you may not submit additional material to the topic author. If information provided during an exchange with the topic author is deemed necessary for proposal preparation, that information will be made available to all parties through Topic Q&A. After this period questions must be asked through Topic Q&A as described below.

d. **Topic Q&A.** Once DoD begins accepting proposals on **May 18, 2022**, no further direct contact between proposers and topic authors is allowed unless the Topic Author is responding to a question submitted during the pre-release period. However, proposers may submit written questions through Topic Q&A at https://www.dodsbirsttr.mil/submissions/login. In Topic Q&A, all questions and answers are posted electronically for general viewing. Identifying information for the questioner and respondent is not posted.

   Questions submitted through the Topic Q&A are limited to technical information related to improving the understanding of a topic's requirements. Any other questions, such as those asking for advice or guidance on solution approach, or administrative questions, such as SBIR or STTR program eligibility, technical proposal/cost proposal structure and page count, budget and duration limitations, or proposal due date WILL NOT receive a response. Refer to the Component-specific instructions given at the beginning of that Component's topics for help with an administrative question.

   Proposing firms may use the Topic Search feature on DSIP to locate a topic of interest. Then, using the form at the bottom of the topic description, enter and submit the question. Answers are generally posted within seven (7) business days of question submission (answers will also be e-mailed directly to the inquirer).

   The Topic Q&A for this BAA opens on **April 20, 2022** and closes to new questions on **June 1, 2022 at 12:00 PM ET**. Once the BAA closes to proposal submission, no communication of any kind with the topic author or through Topic Q&A regarding your submitted proposal is allowed.

   Proposing firms are advised to monitor Topic Q&A during the BAA period for questions and answers. Proposing firms should also frequently monitor DSIP for updates and amendments to the topics.

4.15 Registrations and Certifications

Proposing firms must be registered in the Defense SBIR/STTR Innovation Portal (DSIP) in order to prepare and submit proposals. All users will be required to register for a login.gov account and link it to their DSIP account. To register in Login.gov, click the Login/Register button in the top right corner on the DSIP Submissions homepage and follow the steps to register. If you already have a Login.gov account, you can link your existing Login.gov account with your DSIP account. Job Aids and Help Videos to walk you through the process are in the Learning & Support section of DSIP, here: https://www.dodsbirsttr.mil/submissions/learning-support/training-materials.

Please note that the email address you use for Login.gov should match the email address associated with your existing DSIP account. If you do not recall the email address associated with your DSIP account, or if you already have an existing Login.gov account using a different email address, you will need your Firm's DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. If the email address associated with your existing DSIP account has been used for multiple DSIP accounts within your Firm, you will also need your Firm's DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. The Firm PIN can be obtained from your Firm Admin. You can view the Firm Admin's contact information by entering your Firm's DUNS number when prompted. If you are the Firm Admin, please ensure that you contact all DSIP users in your Firm and provide them with the Firm PIN.

Firms should complete the Login.gov setup as soon as possible to avoid any delays in proposal submissions.

Before the DoD Components can award a contract, proposing firms must be registered in the System for Award Management (SAM). SAM allows firms interested in conducting business with the federal government to provide basic information on business structure and capabilities as well as financial and payment information. To register, visit www.sam.gov. Firms should login to SAM and ensure the firm's registration is active and representations and certifications are up-to-date to avoid delay in award.

On April 4, 2022, the DUNS Number was replaced by the Unique Entity ID (SAM). The Federal Government will use the UEI (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the firm has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. **For firms with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the firm profile with the UEI (SAM) as soon as possible.**

For new firm registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the firm's profile on the DSIP at https://www.dodsbirsttr.mil/submissions/.

In addition to the standard federal and DoD procurement certifications, the SBA SBIR Policy Directive requires the collection of certain information from firms at time of award and during the award life cycle. Each firm must provide this additional information at the time of the Phase I and Phase II award, prior to final payment on the Phase I award, prior to receiving 50% of the total award amount for a Phase II award, and prior to final payment on the Phase II award.

4.16 Promotional Materials

Promotional and non-project related discussion is discouraged, and additional information provided via Universal Resource Locator (URL) links or on computer disks, CDs, DVDs, video tapes or any other medium will not be accepted or considered in the proposal evaluation.

4.17 Prior, Current, or Pending Support of Similar Proposals or Awards

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work (see Section 3) for consideration under numerous federal program BAAs or solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible. See Section 5.4.c(11).

4.18 Fraud and Fraud Reporting

Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to $10,000, up to five years in prison, or both.

The Department of Defense, Office of Inspector General Hotline ("Defense Hotline") is an important avenue for reporting fraud, waste, abuse, and mismanagement within the Department of Defense. The Office of Inspector General operates this hotline to receive and investigate complaints or information from contractor employees, DoD civilians, military service members and public citizens. Individuals who wish to report fraud, waste or abuse may contact the Defense Hotline at (800) 424-9098 between 8:00 a.m. and 5:00 p.m. Eastern Time or visit https://www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/Hotline-Complaint/ to submit a complaint. Mailed correspondence should be addressed to the Defense Hotline, The Pentagon, Washington, DC 20301-1900, or e-mail addressed to hotline@dodig.mil.

4.19 State and Other Assistance Available

Many states have established programs to provide services to those small business firms and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to SBIR recipients;
- Assistance in obtaining Phase III funding.

Contact your State SBIR/STTR Support office at https://www.sbir.gov/state_services?state=105813# for further information. Small Businesses may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States.

4.20 Discretionary Technical and Business Assistance (TABA)

DoD has not mandated the use of TABA pending further SBA guidance and establishment of a limit on the amount of technical and business assistance services that may be received or purchased by a small business concern that has received multiple Phase II SBIR or STTR awards for a fiscal year. However, proposers should carefully review individual component instructions to determine if TABA is being offered and follow specific proposal requirements for requesting TABA funding.

5.0 PHASE I PROPOSAL

5.1 Introduction

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

This information in this section is applicable to Phase I proposals only. If the Component is participating in the **Direct to Phase II Program**, refer to the Component-specific Direct to Phase II instructions for more information on proposal preparation.

Guidance on allowable proposal content may vary by Component. A completed proposal submission in DSIP does NOT indicate that each proposal volume has been completed in accordance with the Component-specific instructions. Accordingly, it is the proposing firm's responsibility to consult the Component-specific instructions for detailed guidance, including required proposal documentation and structure, cost and duration limitations, budget structure, TABA allowance and proposal page limits.

DSIP provides a structure for providing the following proposal volumes:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents

a. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
b. Foreign Ownership or Control Disclosure (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability.)
c. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

Volume 6: Fraud, Waste and Abuse Training

All proposers must complete the following:

- Volume 4: Company Commercialization Report (upload of CCR from SBIR.gov to DSIP is required for proposers with prior Federal SBIR or STTR awards)
- Volume 5(a): Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
- Volume 5(b): Foreign Ownership or Control Disclosure (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability)
- Volume 6: Fraud, Waste and Abuse training.

Refer to Section 5.3 below for full details on these proposal requirements.

A Phase I Proposal Template is available to provide helpful guidelines for completing each section of your Phase I technical proposal. This can be found at https://www.dodsbirsttr.mil/submissions/learning-support/firm-templates.

Detailed guidance on registering in DSIP and using DSIP to submit a proposal can be found at https://www.dodsbirsttr.mil/submissions/learning-support/training-materials. If the proposal status is "In Progress" or "Ready to Certify" it will NOT be considered submitted, even if all volumes are added prior to the BAA close date. The proposer may modify all proposal volumes prior to the BAA close date.

Although signatures are not required on the electronic forms at the time of submission the proposal must be certified electronically by the corporate official for it to be considered submitted. If the proposal is selected for award, the DoD Component program will contact the proposer for signatures at the time of award.

5.2 Marking Proprietary Proposal Information

Proposers that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall:

(1) Mark the first page of each Volume of the proposal submission with the following legend:

> "This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed-in whole or in part-for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this proposer as a result of-or in connection with-the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in pages [insert numbers or other identification of sheets]"; and

(2) Mark each sheet of data it wishes to restrict with the following legend:

> "Use or disclosure of data contained on this page is subject to the restriction on the first page of this volume."

The DoD assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

Restrictive notices notwithstanding, proposals and final reports submitted through the Defense SBIR/STTR Innovation Portal (DSIP) may be handled, for administrative purposes only, by support contractors. All support contractors are bound by appropriate non-disclosure agreements.

5.3 Phase I Proposal Instructions

a. **Proposal Cover Sheet (Volume 1)**

On the Defense SBIR/STTR Innovation Portal (DSIP) at https://www.dodsbirsttr.mil/submissions/, prepare the Proposal Cover Sheet.

The Cover Sheet must include a brief technical abstract that describes the proposed R&D project and a discussion of anticipated benefits and potential commercial applications. Each section should be no more than 200 words. **<u>Do not include proprietary or classified information in the Proposal Cover Sheet</u>**. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released on the Internet. Once the Cover Sheet is saved, the system will assign a proposal number. You may modify the cover sheet as often as necessary until the BAA closes.

b. **Format of Technical Volume (Volume 2)**

(1) **Type of file**: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. **Do <u>not</u> lock or encrypt the**

uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document.

(2) **Length**: It is the proposing firm's responsibility to verify that the Technical Volume does not exceed the page limit after upload to DSIP. Please refer to Component-specific instructions for how a technical volume is handled if the stated page count is exceeded. Some Components will reject the entire technical proposal if the proposal exceeds the stated page count.

(3) **Layout:** Number all pages of your proposal consecutively. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal (no type smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins). The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by the Defense SBIR/STTR Innovation Portal (DSIP) when the Cover Sheet was created. The header may be included in the one-inch margin.

c. **Content of the Technical Volume (Volume 2)**

The Technical Volume should cover the following items <u>in the order given below</u>:

(1) **Identification and Significance of the Problem or Opportunity.** Define the specific technical problem or opportunity addressed and its importance.

(2) **Phase I Technical Objectives.** Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(3) **Phase I Statement of Work (including Subcontractors' Efforts)**

a. Provide an explicit, detailed description of the Phase I approach. If a Phase I option is required or allowed by the Component, describe appropriate research activities which would commence at the end of Phase I base period should the Component elect to exercise the option. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

b. This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained (see Sections 4.7 - 4.9). **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(4) **Related Work.** Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or

others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

a. Short description,
b. Client for which work was performed (including individual to be contacted and phone number), and
c. Date of completion.

(5) **Relationship with Future Research or Research and Development**

a. State the anticipated results of the proposed approach if the project is successful.
b. Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.
c. Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(6) **Commercialization Strategy.** Describe in approximately one page your company's strategy for commercializing this technology in DoD, other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(7) **Key Personnel.** Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(8) **Foreign Citizens.** Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in Section 3 of the BAA. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(9) **Facilities/Equipment.** Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings:

airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(10) **Subcontractors/Consultants.** Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two- thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposers must certify their use of such facilities on the Cover Sheet of the proposal.

(11) **Prior, Current, or Pending Support of Similar Proposals or Awards.** If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information:

a. Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
b. Date of proposal submission or date of award.
c. Title of proposal.
d. Name and title of principal investigator for each proposal submitted or award received.
e. Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
f. If award was received, state contract number.
g. Specify the applicable topics for each SBIR proposal submitted or award received.

Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."

d. **Content of the Cost Volume (Volume 3)**

Complete the Cost Volume by using the on-line cost volume form on the Defense SBIR/STTR Innovation Portal (DSIP). Some items in the cost breakdown may not apply to the proposed project. If that is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow us to understand how you plan to use the requested funds if a contract is awarded.

(1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.

(2) While special tooling and test equipment and material cost may be included under Phases I, the inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Component Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD

Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

(3) Cost for travel funds must be justified and related to the needs of the project.

(4) Cost sharing is permitted for proposals under this BAA; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a Phase I proposal.

(5) A Phase I Option (if applicable) should be fully costed separately from the Phase I (base) approach.

(6) All subcontractor costs and consultant costs, such as labor, travel, equipment, materials, must be detailed at the same level as prime contractor costs. Provide detailed substantiation of subcontractor costs in your cost proposal. Volume 5, Supporting Documents, may be used if additional space is needed.

When a proposal is selected for award, you must be prepared to submit further documentation to the Component Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors). For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit-Process-Overview/.

e. **Company Commercialization Report (Volume 4)**

The Company Commercialization Report (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. SBIR and STTR awardees are required by SBA to update and maintain their organization’s CCR on SBIR.gov. Commercialization information is required upon completion of the last deliverable under the funding agreement. Thereafter, SBIR and STTR awardees are requested to voluntarily update the information in the database annually for a minimum period of 5 years.

If the proposing firm has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, regardless of whether the project has any commercialization to date, a PDF of the CCR must be downloaded from SBIR.gov and uploaded to the Firm Forms section of DSIP by the Firm Admin. Firm Forms are completed by the DSIP Firm Admin and are applied across all proposals the firm submits. The DSIP CCR requirement is fulfilled by completing the following:

1. Log into the firm account at https://www.sbir.gov/.
2. Navigate to My Dashboard > My Documents to view or print the information currently contained in the Company Registry Commercialization Report.
3. Create or update the commercialization record, from the company dashboard, by scrolling to the “My Commercialization” section, and clicking the create/update Commercialization tab under “Current Report Version”. Please refer to the “Instructions” and “Guide” documents contained in this section of the Dashboard for more detail on completing and updating the CCR. **Ensure the report is certified and submitted.**
4. Click the “Company Commercialization Report” PDF under the My Documents section of the dashboard to download a PDF of the CCR.
5. Upload the PDF of the CCR (downloaded from SBIR.gov in previous step) to the Company Commercialization Report in the Firm Forms section of DSIP. This upload action must be completed by the Firm Admin.

This version of the CCR, uploaded to DSIP from SBIR.gov, is inserted into all proposal submissions as Volume 4.

During proposal submission, the proposer will be prompted with the question: "Do you have a new or revised Company Commercialization Report to upload?". There are three possible courses of action:

a. If the proposing firm has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **DOES have a new or revised CCR from SBIR.gov to upload to DSIP**, select YES.
    - If the user is the Firm Admin, they can upload the PDF of the CCR from SBIR.gov directly on this page. It will also be updated in the Firm Forms and be associated with all new or in-progress proposals submitted by the firm. If the user is not the Firm Admin, they will receive a message that they do not have access and must contact the Firm Admin to complete this action.
    - **WARNING:** Uploading a new CCR under the Firm Forms section of DSIP or clicking "Save" or "Submit" in Volume 4 of one proposal submission is considered a change for ALL proposals under any open BAAs or CSOs. If a proposing firm has previously certified and submitted any Phase I or Direct to Phase II proposals under ***any*** BAA or CSO ***that is still open***, those proposals will be automatically reopened. Proposing firms will have to recertify and resubmit such proposals. If a proposing firm does not recertify or resubmit such proposals, they will not be considered fully submitted and will not be evaluated.

b. If the proposing firm has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **DOES NOT have a new or revised CCR from SBIR.gov to upload to DSIP**, select NO.
    - If a prior CCR was uploaded to the Firm Forms, the proposer will see a file dialog box at the bottom of the page and can view the previously uploaded CCR. This read-only access allows the proposer to confirm that the CCR has been uploaded by the Firm Admin.
    - If no file dialog box is present at the bottom of the page that is an indication that **there is no previously uploaded CCR in the DSIP Firm Forms**. To fulfill the DSIP CCR requirement the Firm Admin must follow steps 1-5 listed above to download a PDF of the CCR from SBIR.gov and upload it to the DSIP Firm Forms to be included with all proposal submissions.

c. If the proposing firm has **NO** prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, the upload of the CCR from SBIR.gov is not required and firm will select NO. The CCR section of the proposal will be marked complete.

While all proposing firms with prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards must report funding outcomes resulting from these awards through the CCR from SBIR.gov and upload a copy of this report to their Firm Forms in DSIP, **please refer to the Component-specific instructions for details on how this information will be considered during proposal evaluations.**

f. **Supporting Documents (Volume 5)**

Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

All proposers are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1) (REQUIRED)
2. Foreign Ownership or Control Disclosure (BAA Attachment 2) (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability)

Any of the following documents may be included in Volume 5 if applicable to the proposal. Refer to Component-specific instructions for additional Volume 5 requirements.

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights
7. Other

g. **Contractor Certification Regarding Provision of** Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment

The DoD must comply with Section 889(a)(1)(B) of the National Defense Authorization Act (NDAA) for Fiscal Year 2019, and is working to reduce or eliminate contracts with entities that use any equipment, system, or service that uses covered telecommunications equipment or services (as defined in BAA Attachment 1) as a substantial or essential component of any system, or as critical technology as part of any system.

All proposals must include certifications in Defense Federal Acquisition Regulation Supplement (DFARS) provisions 252.204-7016, 252.204-7017, and clause 252.204-7018, executed by the proposer's authorized company representative. The DFARS provisions and clause may be found in BAA Attachment 1. **These certifications must be signed by the authorized company representative and uploaded as a separate PDF file in the supporting documents sections of Volume 5 for all proposal submissions.**

The effort to complete the required certification clauses includes due diligence on the part of the proposer and for any contractors that may be proposed as a part of the submission including research partners and suppliers. Therefore, proposers are strongly encouraged to review the requirements of these certifications early in the proposal development process. Failure to submit or complete the required certifications as a part of the proposal submission process may be cause for rejection of the proposal submission without evaluation.

h. **Foreign Ownership or Control Disclosure**

Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability. If applicable, an authorized firm representative must complete the Foreign Ownership or Control Disclosure (BAA Attachment 2). The completed and signed disclosure must be uploaded to Volume 5 of the proposal submission.

i. **Fraud, Waste and Abuse Training (Volume 6)**

The Fraud, Waste and Abuse (FWA) training is **required** for Phase I and Direct to Phase II proposals. FWA training provides information on what represents FWA in the SBIR/STTR program, the most common mistakes that lead to FWA, as well as the penalties and ways to prevent FWA in your firm. This training material can be found in the Volume 6 section of the proposal submission module in DSIP and must be thoroughly reviewed once per year. Plan ahead and leave ample time to complete this training based on the proposal submission deadline. FWA training must be completed by one DSIP firm user with read/write access (Proposal Owner, Corporate Official or Firm Admin) on behalf of the firm.

6.0 PHASE I EVALUATION CRITERIA

Proposals will be evaluated based on the criteria outlined below, unless otherwise specified in the Component-specific instructions. Selections will be based on a determination of the overall technical value of each proposal and an evaluation of the cost volume, with the appropriate method of analysis given the contract type to be awarded, in order for selection of the proposal(s) most advantageous to the Government, considering the following factors which are listed in descending order of importance:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

Cost or budget data submitted with the proposals will be considered during evaluation.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be included based on requirements provided in Component-specific instructions.

7.0 PHASE II PROPOSAL INFORMATION

7.1 Introduction

Unless the Component is participating in Direct to Phase II, Phase II proposals may only be submitted by Phase I awardees. Submission of Phase II proposals are not permitted at this time, and if submitted, may be rejected without evaluation. Phase II proposal preparation and submission instructions will be provided by the DoD Components to Phase I awardees. See Component-specific instructions for more information on Direct to Phase II Program preparation and submission instructions.

7.2 Proposal Provisions

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous federal program BAAs and solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies as early as possible. If a proposal submitted for a Phase II effort is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Cover Sheet and provide the information required in Section 5.4.c(11).

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular firm per topic using SBIR/STTR program funds, Head of Agency Determinations are now required before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact your original sponsoring agency before submitting a Phase II proposal to an agency other than the one who sponsored the original topic.

Section 4(b)(1)(i) of the SBIR/STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A firm wishing to transfer from one program to another must contact their designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs shall not be grounds for granting relief from any contractual performance requirement. All approved transitions between programs must be noted in the Phase II award or award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

7.3 Commercialization Strategy

At a minimum, your commercialization strategy must address the following five questions:

(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?
(3) How much money will be needed to bring the technology to market, and how will that money be raised?
(4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
(5) Who are the proposing firm's competitors, and what is the price and/or quality advantage over those competitors?

The commercialization strategy must also include a schedule showing the anticipated quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.). After Phase II award, the company is required to report actual sales and investment data in its SBA Company Commercialization Report via "My Dashboard" on SBIR.gov at least annually. For information on formatting, page count and other details, please refer to the Component-specific instructions.

7.4 Phase II Evaluation Criteria

Phase II proposals will be evaluated based on the criteria outlined above in section 6.0, unless otherwise specified in the Component-specific instructions.

7.5 Phase II Award Information

DoD Components will notify Phase I awardees of the Phase II proposal submission requirements. Submission of Phase II proposals will be in accordance with instructions provided by individual Components. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the awarding DoD Component either in the Phase I award or by subsequent notification.

7.6 Adequate Accounting System

In order to reduce risk to the small business and avoid potential contracting delays, it is suggested that companies interested in pursuing Phase II SBIR contracts and other contracts of similar size with the Department of Defense (DoD), have an adequate accounting system per General Accepted Accounting Principles (GAAP), Generally Accepted Government Auditing Standards (GAGAS), Federal Acquisition Regulation (FAR) and Cost Accounting Standards (CAS) in place. The accounting system will be audited by the Defense Contract Audit Agency (DCAA). DCAA's requirements and standards are available on their Website at https://www.dcaa.mil/Guidance/Audit-Process-Overview/ and https://www.dcaa.mil/Checklists-Tools/Pre-award-Accounting-System-Adequacy-Checklist/.

7.7 Phase II Enhancement Policy

To further encourage the transition of SBIR research into DoD acquisition programs as well as the private sector, certain DoD Components have developed their own Phase II Enhancement policy. Under this policy, the Component will provide a Phase II awardee with additional Phase II SBIR funding if the company can match the additional SBIR funds with non-SBIR funds from DoD acquisition programs or the private sector.

See component instructions for more details on Phase II Enhancement opportunities.

7.8 Commercialization Readiness Program (CRP)

The SBIR/STTR Reauthorization Act of 2011 established the Commercialization Pilot Program (CPP) as a long-term program titled the Commercialization Readiness Program (CRP).

Each Military Department (Army, Navy, and Air Force) has established a Commercialization Readiness Program. Please check the Component instructions for further information.

The Small Business and Technology Partnerships Office has established the OSD Transitions SBIR Technology (OTST) Pilot Program. The OTST pilot program is an interim technology maturity phase (Phase II), inserted into the SBIR development.

For more information contact osd.ncr.ousd-r-e.mbx.sbir-sttr@mail.mil.

8.0 CONTRACTUAL REQUIREMENTS

8.1 Additional Contract Requirements

Small Business Concerns (SBCs) are strongly encouraged to engage with their Contracting/Agreements Office to determine what measures can be taken in the event contract performance is affected due to the COVID-19 situation. SBCs are encouraged to monitor the CDC Website, engage with your employees to share information and discuss COVID-19 concerns employees may have. Please identify to your Contracting/Agreements Officer potential impacts to the welfare and safety of your workforce and any contract/OT performance issues. Most importantly, keep in mind that only your Contracting/Agreements Officer can affect changes to your contract/OT.

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of Government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulation that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

Examples of general provisions:

a. **Standards of Work**. Work performed under the contract must conform to high professional standards.
b. **Inspection**. Work performed under the contract is subject to Government inspection and evaluation at all reasonable times.
c. **Examination of Records**. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.
d. **Default**. The Government may terminate the contract if the contractor fails to perform the work contracted.
e. **Termination for Convenience**. The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.
f. **Disputes**. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.
g. **Contract Work Hours**. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).
h. **Equal Opportunity**. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
i. **Affirmative Action for Veterans**. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran.
j. **Affirmative Action for Handicapped**. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
k. **Officials Not to Benefit**. No member of or delegate to Congress shall benefit from the contract.
l. **Covenant Against Contingent Fees**. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.
m. **Gratuities**. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.

n. **Patent Infringement**. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
o. **Military Security Requirements**. The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.
p. **American Made Equipment and Products**. When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.

Applicable Federal Acquisition Regulation (FAR) and/or Defense Federal Acquisition Regulation Supplement (DFARS) Clauses:

q. **Unique Identification (UID)**. If your proposal identifies hardware that will be delivered to the government, be aware of the possible requirement for unique item identification in accordance with DFARS 252.211-7003.
r. **Disclosure of Information.** In accordance with FAR 252.204-7000, Government review and approval will be required prior to any dissemination or publication, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract except within and between the Contractor and any subcontractors, of unclassified and non-fundamental information developed under this contract or contained in the reports to be furnished pursuant to this contract.
s. **Animal Welfare**. Contracts involving research, development, test, evaluation, or training on vertebrate animals will incorporate DFARS clause 252.235-7002.
t. **Protection of Human Subjects**. Effective 29 July 2009, contracts that include or may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02 and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b), will incorporate DFARS clause 252.235-7004.
u. **E-Verify**. Contracts exceeding the simplified acquisition threshold may include the FAR clause 52.222-54 "Employment Eligibility Verification" unless exempted by the conditions listed at FAR 22.2803.
v. **ITAR**. In accordance with DFARS 225.7901-4, Export Control Contract Clauses, the clause found at DFARS 252.225-7048, Export-Controlled Items (June 2013), must be included in all BAAs/solicitations and contracts. Therefore, all awards resulting from this BAA will include DFARS 252.225-7048. Full text of the clause may be found at https://www.govinfo.gov/content/pkg/CFR-2013-title48-vol3/pdf/CFR-2013-title48-vol3-sec252-225-7048.pdf.
w. **Cybersecurity**. Any SBC receiving an SBIR/STTR award is required to provide adequate security on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. Compliance is mandatory.
x. **Safeguarding Covered Defense Information Controls.** As prescribed in DFARS 252.204-7008, for covered contractor information systems that are not part of an information technology service or system operated on behalf of the Government, the SBC represents that it will implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, "Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations".
y. **Limitations on the Use or Disclosure of Third- Party Contractor Reported Cyber Incident Information.** As required in DFARS 252.204-7009, the Contractor must agree that certain conditions apply to any information it receives or creates in the performance of a resulting contract that is information obtained from a third-party's reporting of a cyber incident pursuant to DFARS clause 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting (or derived from such information obtained under that clause).

z. **Notice of NIST SP 800-171 DoD Assessment Requirements.** As prescribed by DFARS 252.204-7019, in order to be considered for award, the SBC is required to implement NIST SP 800-171. The SBC shall have a current assessment (see 252.204-7020) for each covered contractor information system that is relevant to the offer, contract, task order, or delivery order. The Basic, Medium, and High NIST SP 800-171 DoD Assessments are described in the NIST SP 800-171 DoD Assessment Methodology located at https://www.acq.osd.mil/dpap/pdi/cyber/strategically_assessing_contractor_implementation_of_NIST_SP_800-171.html. In accordance with DFARS 252.204-7020, the SBC shall provide access to its facilities, systems, and personnel necessary for the Government to conduct a Medium or High NIST SP 800-171 DoD Assessment, as described in NIST SP 800-171 DoD Assessment Methodology, linked above. Notification of specific requirements for NIST SP 800-171 DoD assessments and assessment level will be provided as part of the component instructions, topic, or award.

aa. **Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.** In accordance with DFARS Subpart 204.21, DFARS provisions 252.204-7016, 252.204-7017, and clause 252.204-7018 are incorporated into this solicitation. This subpart implements section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) and section 889(a)(1)(A) of the National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232). Full text of the provisions and clause and required offeror representations can be found in Attachment 1 of this BAA.

bb. **Disclosure of Ownership or Control by a Foreign Government**. DFARS 252.209-7002, Disclosure of Ownership or Control by a Foreign Government (JUN 2010), is incorporated into this solicitation. In accordance with DFARS 252.209-7002, any SBC submitting a proposal in response to this solicitation is required to disclose, by completing Attachment 2 to this solicitation, Foreign Ownership or Control Disclosure, any interest a foreign government has in the SBC when that interest constitutes control by a foreign government, as defined in DFARS provision 252.209-7002. If the SBC is a subsidiary, it is also required to disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the SBC's immediate parent, intermediate parents, and the ultimate parent.

8.2 Ensuring Adequate COVID-19 Safety Protocols for Federal Contractors

In accordance with Class Deviation 2021-O0009 implementing the direction provided by Executive Order 14042, the following clause 252.223-7999 will be incorporated into awards that: (a) exceed the simplified acquisition threshold of $250,000; and, (b) have been identified by the awarding DoD Component as meeting the applicability requirements as outlined in E.O. 14042 to ensure that contractors comply with all guidance for contractor and subcontractor workplace locations published by the Safer Federal Workforce Task Force at: https://www.saferfederalworkforce.gov/contractors/.

Covered contractors are cautioned to pay particular attention to "COVID 19 Workplace Safety: Guidance for Federal Contractors and Subcontractors" dated 24 September 2021 as promulgated by the Safer Federal Workforce Task Force.

252.223-7999 Ensuring Adequate COVID-19 Safety Protocols for Federal Contractors (Deviation 2021-O0009)

(a) *Definition*. As used in this clause –

United States or its outlying areas means—

(1) The fifty States;

(2) The District of Columbia;

(3) The commonwealths of Puerto Rico and the Northern Mariana Islands;
(4) The territories of American Samoa, Guam, and the United States Virgin Islands; and
(5) The minor outlying islands of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Midway Islands, Navassa Island, Palmyra Atoll, and Wake Atoll.

(b) *Authority*. This clause implements Executive Order 14042, Ensuring Adequate COVID Safety Protocols for Federal Contractors, dated September 9, 2021 (published in the *Federal Register* on September 14, 2021, 86 FR 50985).

(c) *Compliance*. The Contractor shall comply with all guidance, including guidance conveyed through Frequently Asked Questions, as amended during the performance of this contract, for contractor or subcontractor workplace locations published by the Safer Federal Workforce Task Force (Task Force Guidance) at *https:/www.saferfederalworkforce.gov/contractors/*.

(d) *Subcontracts*. The Contractor shall include the substance of this clause, including this paragraph (d), in subcontracts at any tier that exceed the simplified acquisition threshold, as defined in Federal Acquisition Regulation 2.101 on the date of subcontract award, and are for services, including construction, performed in whole or in part within the United States or its outlying areas.

8.3 Basic Safeguarding of Covered Contractor Information Systems

FAR 52.204-21, Basic Safeguarding of Covered Contractor Information Systems, is incorporated into this solicitation. In accordance with FAR 52.204-21, the contractor shall apply basic safeguarding requirements and procedures when the contractor or a subcontractor at any tier may have Federal contract information residing in or transiting through its information system.

FAR 52.204-21 Basic Safeguarding of Covered Contractor Information Systems (JUN 2016)

(a) Definitions. As used in this clause -

Covered contractor information system means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

Federal contract information means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public Web sites) or simple transactional information, such as necessary to process payments.

Information means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

Information system means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

Safeguarding means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

(1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:

(i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).

(ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.

(iii) Verify and control/limit connections to and use of external information systems.

(iv) Control information posted or processed on publicly accessible information systems.

(v) Identify information system users, processes acting on behalf of users, or devices.

(vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.

(vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.

(viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.

(ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and control and manage physical access devices.

(x) Monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.

(xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.

(xii) Identify, report, and correct information and information system flaws in a timely manner.

(xiii) Provide protection from malicious code at appropriate locations within organizational information systems.

(xiv) Update malicious code protection mechanisms when new releases are available.

(xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) **Other requirements**. This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered

contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial items, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

8.4 Prohibition on Contracting with Persons that have Business Operations with the Maduro Regime

Section 890 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2020 prohibits entering into a contract for the procurement of products or services with any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the United States Government, unless an exception applies. See provision 252.225-7974 Class Deviation 2020-O0005 “Prohibition on Contracting with Persons that have Business Operations with the Maduro Regime.

8.5 Copyrights

With prior written permission of the Contracting Officer, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgment and disclaimer statement.

8.6 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the Government will not make public any information disclosing a Government-supported invention for a period of five years to allow the awardee to pursue a patent. See also Invention Reporting in Section 8.6.

8.7 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this BAA generally remain with the contractor, except that the Government obtains a royalty-free license to use such technical data only for Government purposes during the period commencing with contract award and ending twenty years after completion of the project under which the data were generated. This data should be marked with the restrictive legend specified in DFARS 252.227-7018 Class Deviation 2020-O0007. Upon expiration of the twenty-year restrictive license, the Government has unlimited rights in the SBIR data. During the license period, the Government may not release or disclose SBIR data to any person other than its support services contractors except: (1) For evaluation purposes; (2) As expressly permitted by the contractor; or (3) A use, release, or disclosure that is necessary for emergency repair or overhaul of items operated by the Government. See DFARS clause 252.227-7018 Class Deviation 2020-O0007 "Rights in Noncommercial Technical Data and Computer Software – Small Business Innovation Research (SBIR) Program."

If a proposer plans to submit assertions in accordance with DFARS 252.227-7017 Class Deviation 2020-O0007, those assertions must be identified and assertion of use, release, or disclosure restriction MUST be included with your proposal submission, at the end of the technical volume. The contract cannot be awarded until assertions have been approved.

8.8 Invention Reporting

SBIR awardees must report inventions to the Component within two months of the inventor's report to the awardee. The reporting of inventions may be accomplished by submitting paper documentation, including fax, or through the Edison Invention Reporting System at www.iedison.gov for those agencies participating in iEdison.

8.9 Final Technical Reports - Phase I through Phase III

a. **Content**: A final report is required for each project phase. The reports must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page," will be used as the first page of the report. Submission resources are available at https://discover.dtic.mil/submit-documents/. In addition, monthly status and progress reports may be required by the DoD Component.

b. **SF 298 Form "Report Documentation Page" Preparation**:

(1) If desirable, language used by the company in its Phase II proposal to report Phase I progress may also be used in the final report.

(2) For each unclassified report, the company submitting the report should fill in Block 12 (Distribution/Availability Statement) of the SF 298, "Report Documentation Page," with the following statement: "Distribution authorized to U.S. Government only; Proprietary Information, (Date of Determination). Other requests for this document shall be referred to the Component SBIR Program Office."

Note: Data developed under a SBIR contract is subject to SBIR Data Rights which allow for protection under DFARS 252.227-7018 Class Deviation 2020-O0007 (see Section 8.5, Technical Data Rights). The sponsoring DoD activity, after reviewing the company's entry in Block 12, has final responsibility for assigning a distribution statement.

For additional information on distribution statements see the following Defense Technical Information Center (DTIC) Web site: https://discover.dtic.mil/wp-content/uploads/2018/09/distribution_statements_and_reasonsSept2018.pdf

(3) Block 14 (Abstract) of the SF 298, "Report Documentation Page" must include as the first sentence, "Report developed under SBIR contract for topic [insert BAA topic number. [Follow with the topic title, if possible.]" The abstract must identify the purpose of the work and briefly describe the work conducted, the findings or results and the potential applications of the effort. **Since the abstract will be published by the DoD, it must not contain any proprietary or classified data and type "UU" in Block 17.**

(4) Block 15 (Subject Terms) of the SF 298 must include the term "SBIR Report".

c. **Submission**: In accordance with DoD Directive 3200.12 and DFARS clause 252.235-7011, a copy of the final report shall be submitted (electronically or on disc) to:
Defense Technical Information Center

ATTN: DTIC-OA (SBIR)
8725 John J Kingman Road, Suite 0944
Ft. Belvoir, VA 22060-6218

Delivery will normally be within 30 days after completion of the Phase I technical effort.

Other requirements regarding submission of reports and/or other deliverables will be defined in the Contract Data Requirements List (CDRL) of each contract. Special instructions for the submission of CLASSIFIED reports will be defined in the delivery schedule of the contract.

DO NOT E-MAIL Classified or controlled unclassified reports, or reports containing SBIR Data Rights protected under DFARS 252.227-7018 Class Deviation 2020-O0007.

ATTACHMENT 1

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

CONTRACTOR CERTIFICATION REGARDING PROVISION OF PROHIBITION ON CONTRACTING FOR CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (DFARS SUBPART 204.21)

Contractor's Name	
Company Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ____________________

The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

DFARS PROVISIONS INCORPORATED IN FULL TEXT:

252.204-7016 Covered Defense Telecommunications Equipment or Services—Representation

COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (DEC 2019)

(a) *Definitions*. As used in this provision, "covered defense telecommunications equipment or services" has the meaning provided in the clause 252.204-7018 , Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services.

(b) *Procedures*. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (https://www.sam.gov/) for entities excluded from receiving federal awards for "covered defense telecommunications equipment or services".

(c) *Representation*. The Offeror represents that it ☐ does, ☐ does not provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument.

252.204-7017 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services—Representation

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (MAY 2021)

*The Offeror is not required to complete the representation in this provision if the Offeror has represented in the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "**does not** provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument."*

(a) *Definitions*. "Covered defense telecommunications equipment or services," "covered mission," "critical technology," and "substantial or essential component," as used in this provision, have the meanings given in the 252.204-7018 clause, Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services, of this solicitation.

(b) *Prohibition*. Section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) prohibits agencies from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

(c) *Procedures*. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

Representation. If in its annual representations and certifications in SAM the Offeror has represented in paragraph (c) of the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "does" provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument, then the Offeror shall complete the following additional representation:

The Offeror represents that it ☐will ☐will not provide covered defense telecommunications equipment or services as a part of its offered products or services to DoD in the performance of any award resulting from this solicitation.

(e) *Disclosures*. If the Offeror has represented in paragraph (d) of this provision that it “will provide covered defense telecommunications equipment or services,” the Offeror shall provide the following information as part of the offer:

(1) A description of all covered defense telecommunications equipment and services offered (include brand or manufacturer; product, such as model number, original equipment manufacturer (OEM) number, manufacturer part number, or wholesaler number; and item description, as applicable).

(2) An explanation of the proposed use of covered defense telecommunications equipment and services and any factors relevant to determining if such use would be permissible under the prohibition referenced in paragraph (b) of this provision.

(3) For services, the entity providing the covered defense telecommunications services (include entity name, unique entity identifier, and Commercial and Government Entity (CAGE) code, if known).

(4) For equipment, the entity that produced or provided the covered defense telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known).

(End of provision)

252.204-7018 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES (JAN 2021)

Definitions. As used in this clause—

“Covered defense telecommunications equipment or services” means—

(1) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation, or any subsidiary or affiliate of such entities;

(2) Telecommunications services provided by such entities or using such equipment; or

(3) Telecommunications equipment or services produced or provided by an entity that the Secretary of Defense reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

“Covered foreign country” means—

(1) The People’s Republic of China; or

(2) The Russian Federation.

“Covered missions” means—

(1) The nuclear deterrence mission of DoD, including with respect to nuclear command, control, and communications, integrated tactical warning and attack assessment, and continuity of Government; or

(2) The homeland defense mission of DoD, including with respect to ballistic missile defense.

“Critical technology” means—

(1) Defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations;

(2) Items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations, and controlled—

(i) Pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology; or

(ii) For reasons relating to regional stability or surreptitious listening;

(3) Specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities);

(4) Nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material);

(5) Select agents and toxins covered by part 331 of title 7, Code of Federal Regulations, part 121 of title 9 of such Code, or part 73 of title 42 of such Code; or

(6) Emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. 4817).

“Substantial or essential component” means any component necessary for the proper function or performance of a piece of equipment, system, or service.

(b) *Prohibition*. In accordance with section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91), the contractor shall not provide to the Government any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless the covered defense telecommunication equipment or services are covered by a waiver described in Defense Federal Acquisition Regulation Supplement 204.2104 .

(c) *Procedures*. The Contractor shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service, to carry out covered missions, that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

(d) *Reporting*.

(1) In the event the Contractor identifies covered defense telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, the Contractor shall report at https://dibnet.dod.mil the information in paragraph (d)(2) of this clause.

(2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:

(i) Within 3 business days from the date of such identification or notification: the contract number; the order number(s), if applicable; supplier name; brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 30 business days of submitting the information in paragraph (d)(2)(i) of this clause: any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of a covered defense telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.

(e) *Subcontracts*. The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial items.

(End of clause)

ATTACHMENT 2

OMB No. 0704-0187
OMB approval expires
October 31, 2024

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

DISCLOSURE OF OFFEROR'S OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT

In accordance with DFARS provision 252.209-7002, an offeror is required to disclose, by completing this form (and adding additional pages, as necessary), any interest a foreign government has in the offeror when that interest constitutes control by a foreign government, as defined in DFARS provision 252.209-7002. If the offeror is a subsidiary, it is also required to disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the offeror's immediate parent, intermediate parents, and the ultimate parent.

DISCLOSURE		
Offeror's Point of Contact for Questions about Disclosure	Name:	
	Phone Number:	
Offeror	Name:	
	Address:	
Entity Controlled by a Foreign Government	Name:	
	Address:	
Description of Foreign Government's Interest in the Offeror		
Foreign Government's Ownership Percentage in Offeror		
Identification of Foreign Government(s) with Ownership or Control		

DFARS 252.209-7002 Disclosure of Ownership or Control by a Foreign Government (JUN 2010)

(a) Definitions. As used in this provision—

(1) "Effectively owned or controlled" means that a foreign government or any entity controlled by a foreign government has the power, either directly or indirectly, whether exercised or exercisable, to control the election, appointment, or tenure of the Offeror's officers or a majority of the Offeror's board of directors by any means, e.g., ownership, contract, or operation of law (or equivalent power for unincorporated organizations).

(2) "Entity controlled by a foreign government"—

(i) Means—

(A) Any domestic or foreign organization or corporation that is effectively owned or controlled by a foreign government; or

(B) Any individual acting on behalf of a foreign government.

(ii) Does not include an organization or corporation that is owned, but is not controlled, either directly or indirectly, by a foreign government if the ownership of that organization or corporation by that foreign government was effective before October 23, 1992.

(3) "Foreign government" includes the state and the government of any country (other than the United States and its outlying areas) as well as any political subdivision, agency, or instrumentality thereof.

(4) "Proscribed information" means—

(i) Top Secret information;

(ii) Communications security (COMSEC) material, excluding controlled cryptographic items when unkeyed or utilized with unclassified keys;

(iii) Restricted Data as defined in the U.S. Atomic Energy Act of 1954, as amended;

(iv) Special Access Program (SAP) information; or

(v) Sensitive Compartmented Information (SCI).

(b) Prohibition on award. No contract under a national security program may be awarded to an entity controlled by a foreign government if that entity requires access to proscribed information to perform the contract, unless the Secretary of Defense or a designee has waived application of 10 U.S.C. 2536(a).

(c) Disclosure. The Offeror shall disclose any interest a foreign government has in the Offeror when that interest constitutes control by a foreign government as defined in this provision. If the Offeror is a subsidiary, it shall also disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the Offeror's immediate parent, intermediate parents, and the ultimate parent. Use separate paper as needed, and provide the information in the following format:

Offeror's Point of Contact for Questions about Disclosure
(Name and Phone Number with Country Code, City Code and Area Code, as applicable)

Name and Address of Offeror

Name and Address of Entity Controlled by a Foreign Government

Description of Interest, Ownership Percentage, and Identification of Foreign Government

(End of provision)

VERSION 3

ARMY
22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The U.S. Army Combat Capabilities Development Command (CCDC) is responsible for execution of theArmy SBIR Program. Information on the Army SBIR Program can be found at the following Website: https://www.armysbir.army.mil/.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. Army requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the Army SBIR Program should be submitted to:

Monroe Harden
Fundamental Portfolio Manager, Army SBIR
usarmy.apg.ccdc.mbx.sbir-program-managers-helpdesk@mail.mil
U.S. Army Combat Capabilities Development
Command6662 Gunner Circle
Aberdeen Proving Ground, MD
21005-1322TEL: 866-570-7247

The Army participates in up to three DOD SBIR BAAs each year. Proposals not conforming to the terms this BAA will not be considered. Only Government personnel will evaluate proposals.

PHASE I PROPOSAL SUBMISSION

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD Program BAA.

The Technical Volume (Volume 2) .pdf document has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. DSIP contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, the Cost Volume, and how to upload the Technical Volume. For questions regarding proposal electronic submission, contact DSIP Support at DoDSBIRSupport@reisystems.com.

The small business will also need to register at the Army SBIR Small Business website: https://sbir.army.mil/SmallBusiness/ in order to receive information regarding proposal status/debriefings, summary reports, impact/transition stories, and Phase III plans. PLEASE NOTE: If this is your first time submitting an Army SBIR proposal, you will not be able to register your firm at the Army SBIR Small Business website until after all of the proposals have been downloaded and we have transferred your company information to the Army Small Business website. This can takeup to one week after the end of the proposal submission period.

Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent in other sections of the proposal as these will count toward the 20-page limit. Note; information put into the Volume 5 will not be viewed for evaluation.

Only the electronically generated Cover Sheets and Cost Volume are excluded from the 20-page limit. **Army Phase I proposals submitted containing a Technical Volume .pdf document containing over 20 pages will be deemed NON-COMPLIANT and will not be evaluated. It is theresponsibility of the Small Business to ensure that once the proposal is submitted and uploaded into the system that the technical volume .pdf document complies with the 20 page limit.**

Phase I proposals must describe the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or moreArmy operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

Phase I proposals will be reviewed for overall merit based upon the criteria in the DOD Program BAA.

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implements the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which **must** be included as part of the Phase I proposal, should cover activities over a period of up to four months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limitfor the Phase I proposal. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent, in other sections of the proposal as these will count toward the 20 page limit.

PHASE I COST VOLUME

A firm fixed price or cost plus fixed fee Phase I Cost Volume with maximum dollar amount of **$167,500** must be submitted in detail online. Proposers that participate in this BAA must complete a Phase I Cost Volume not to exceed a maximum dollar amount of **$111,500** for the six month base period and a Phase I Option Cost Volume not to exceed a maximum dollar amount of **$56,000** for the four month option period. The Phase I and Phase I Option costs must be shown separately but may be presented side-by-side in a single Cost Volume. The system generated Cost Volume DOES NOT count toward the 20-page Phase I proposal limitation when submitted via the submission site's on-line form. When submitting the Cost Volume, complete the Cost Volume form on the DOD Submission site, versus submitting it within the body of the uploaded proposal.

COMPANY COMMERCIALIZATION REPORT (CCR) (VOLUME 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by the Army during proposal evaluations.

VERSION 3

PHASE II PROPOSAL SUBMISSION

Only Small Businesses that have been awarded a Phase I contract for a specific topic can submit a Phase II proposal for that topic. Small businesses submitting a Phase II Proposal must use The Defense SBIR/STTR Innovation Portal (DSIP) (https://www.dodsbirsttr.mil/submissions/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, the Cost Volume, and how to upload the Technical Volume. For questions regarding proposal electronic submission, contact DSIP Support at DoDSBIRSupport@reisystems.com.

For projects awarded in cycle 22.2, there will be **ONE window for submission** of Phase II proposals. A single Phase II proposal can be submitted by a Phase I awardee within one, and only one, Phase II submission window. The submission window opens at 0001hrs (12:01 AM) eastern time on the first day and closes at 2359 hrs (11:59 PM) eastern time on the last day. Any subsequent or Sequential Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by Army SBIR PM in advance.

The 2024(a) Phase II proposal submission window for Phase I contracts awarded under the 22.2 cycle opens for submission on 16 October 2023 and closes on 15 November 2023.

The Phase II Technical Volume .pdf document has a 38-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes), data assertions and any attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 38 page limit. As with Phase I proposals, it is the proposing firm's responsibility to verify that the Technical Volume .pdf document does not exceed the page limit after upload. Note; information put into the Volume 5 will not be viewed for evaluation.

Only the electronically generated Cover Sheet and Cost Volume are excluded from the 38-pageTechnical Volume.

Army Phase II Proposals submitted containing a Technical Volume .pdf document over 38 pageswill be deemed NON-COMPLIANT and will not be evaluated.

Army Phase II Cost Volumes must contain a budget for the entire 24 month Phase II period not to exceedthe maximum dollar amount of **$1,100,000.** During contract negotiation, the contracting officer may require a Cost Volume for year one and year two. The proposal cost volumes must be submitted using the Cost Volume format (accessible electronically on the DOD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the first year prior toextending funding for the second year.

Small businesses submitting a proposal are required to develop and submit a technology transition andcommercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal.

DOD is not obligated to make any awards under Phase I, II, or III. For specifics regarding the evaluationand award of Phase I or II contracts, please read the DOD Program BAA very carefully. Phase II proposals will be reviewed for overall merit based upon the criteria the DoD Program BAA.

BIO HAZARD MATERIAL AND RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Volume whetherthe contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access togovernment resources of any kind. Animal or human research must be based on formal protocols that arereviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

FOREIGN NATIONALS

If the offeror proposes to use a foreign national(s) [any person who is NOT a citizen or national of the United States, a lawful permanent resident, or a protected individual as defined by 8 U.S.C. 1324b (a) (3)
– refer to Section 3.5 of this BAA for definitions of “lawful permanent resident” and “protected individual”] as key personnel, they must be clearly identified. **For foreign nationals, you must providecountry of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Please ensure no Privacy Act information is included in this submittal.**

OZONE CHEMICALS

Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances are prohibited and will not be allowedfor use in this procurement without prior Government approval.

CONTRACTOR MANPOWER REPORTING APPLICATION (CMRA)

The Contractor Manpower Reporting Application (CMRA) is a Department of Defense Business Initiative Council (BIC) sponsored program to obtain better visibility of the contractor service workforce.This reporting requirement applies to all Army SBIR contracts.

Offerors are instructed to include an estimate for the cost of complying with CMRA as part of the Cost Volume for Phase I (**$111,500 maximum**), Phase I Option (**$56,000 maximum**), and Phase II (**$1,100,000 maximum**), under “CMRA Compliance” in Other Direct Costs. This is an estimated total cost (if any) that would be incurred to comply with the CMRA requirement. Only proposals that receivean award will be required to deliver CMRA reporting, i.e. if the proposal is selected and an award is made, the contract will include a deliverable for CMRA.

To date, there has been a wide range of estimated costs for CMRA. While most final negotiated costs have been minimal, there appears to be some higher cost estimates that can often be attributed to misunderstanding the requirement. The SBIR Program desires for the Government to pay a fair and reasonable price. This technical analysis is intended to help determine this fair and reasonable price forCMRA as it applies to SBIR contracts.

- The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains the secure CMRA System. The CMRA Web site is located here: https://www.ecmra.mil/.

- The CMRA requirement consists of the following items, which are located within the contractdocument, the contractor's existing cost accounting system (i.e. estimated direct labor hours, estimated direct labor dollars), or obtained from the contracting officer representative:

  (1) Contract number, including task and delivery order number;
  (2) Contractor name, address, phone number, e-mail address, identity of contractor employeeentering data;
  (3) Estimated direct labor hours (including sub-contractors);
  (4) Estimated direct labor dollars paid this reporting period (including sub-contractors);
  (5) Predominant Federal Service Code (FSC) reflecting services provided by contractor (andseparate predominant FSC for each sub-contractor if different);
  (6) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (The Army Requiring Activity is responsible for providing the contractorwith its UIC for the purposes of reporting this information);
  (7) Locations where contractor and sub-contractors perform the work (specified by zip code inthe United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on Web site);
- The reporting period will be the period of performance not to exceed 12 months ending September30 of each government fiscal year and must be reported by 31 October of each calendar year.

- According to the required CMRA contract language, the contractor may use a direct XML data transfer to the Contractor Manpower Reporting System database server or fill in the fields on theGovernment Web site. The CMRA Web site also has a no-cost CMRA XML Converter Tool.

Given the small size of our SBIR contracts and companies, it is our opinion that the modification of contractor payroll systems for automatic XML data transfer is not in the best interest of the Government. CMRA is an annual reporting requirement that can be achieved through multiple means to include manualentry, MS Excel spreadsheet development, or use of the free Government XML converter tool. The annual reporting should take less than a few hours annually by an administrative level employee.

Depending on labor rates, we would expect the total annual cost for SBIR companies to not exceed $500.00 annually, or to be included in overhead rates.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA) (FORMERLY KNOWN AS DISCRETIONARY TECHNICAL ASSISTANCE)

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientistsand engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has stationed two Technical Assistance Advocates (TAAs) across the Army to provide technical assistance to small businesses that have Phase I and Phase II projects with the participatingorganizations within their regions.

For more information go to: https://www.armysbir.army.mil, then click the "SBIR" tab, and then click on Transition Assistance/Technical Assistance.

This technical and business assistance to SBIR awardees to assist in:

- Making better technical decisions on SBIR projects Solving technical problems that
- arise during SBIR projects;
- Minimizing technical risks associated with SBIR projects; and Developing and
- commercializing new commercial products and processesresulting from such projects including intellectual property protections.

Army may provide up to $5,000 of SBIR funds for the technical assistance described abovefor each Phase I award, and $10,000 per Phase II project to these vendors for direct supportto SBIR awardees.

Alternatively, an SBIR firm may directly acquire the technical assistance services describedabove and not through the vendor selected by the Components. Firms must request this authority from the agency and clearly identify the need for assistance (purpose and objectiveof required assistance). Provide details on the provider of the assistance (name and point of contact for performers) and why the proposed TABA providers are uniquely skilled to conduct the work (specific experience in providing the assistance proposed), and the cost of the required assistance (costs and hours proposed or other details on arrangement). This information must be included in the Explanatory Material section of the firm's cost proposalspecifically identified as "Discretionary Technical and Business Assistance."

If the awardee demonstrates this requirement sufficiently, the agency shall permit the awardee to acquire such technical assistance itself, in an amount up to $5,000 for each Phase I award and $10,000 for each Phase II project, as an allowable cost of the SBIR award. The per year amount will be in addition to the award and is not subject to any profitor fee by the requesting (SBIR) firm and is inclusive of all indirect rates.

The TABA provider may not be the requesting firm, an affiliate of the requesting firm, aninvestor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

Failure to include the required information in the Phase I and/or Phase II proposal will result in the request for discretionary technical and business assistance being disapproved. Requests for TABA funding outside of the Phase I or Phase II proposal submission will not be considered. If the firm is approved for TABA from a source other than that provided by the agency, the firm may not be eligible for the technical assistance services normally provided by those organizations. Small business concerns that receive technical or business assistance as described in this section are required to submit a description of the assistance provided, and the benefits and results achieved.

Contact the Army SBIR Program Office forany other considerations.

NOTE: The Small Business Administration (SBA) is currently developing regulationsgoverning TABA. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized.

It should also be noted that if approved for discretionary technical and business assistancefrom an outside source, the firm will not be eligible for the Army's Technical Assistance Advocate support. All details of the TABA agency and what services they will provide must be listed in the technical proposal under "consultants". The request for TABA must include details on what qualifies the TABA firm to provide the services that you are requesting, the firm name, a point of contact for the firm, and a web site for the firm. Listall services that the firm will provide and why they are uniquely qualified to provide theseservices. The award of TABA funds is not automatic and must be approved by the Army SBIR Program Manager. The maximum TABA dollar amount that can be requested in a Phase I Army SBIR proposal is $5,000. The maximum TABA dollar amount that can be requested in a Phase II Army SBIR proposal is $5,000 per year (for a total of $10,000 for two years).

COMMERCIALIZATION READINESS PROGRAM (CRP)

The objective of the CRP effort is to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The CRP: 1) assesses and identifies SBIRprojects and companies with high transition potential that meet high priority requirements. 2) Matches SBIR companies to customers and facilitates collaboration. 3) Facilitates detailed technology transition plans and agreements. 4) Makes recommendations for additional funding for select SBIR projects that meet the criteria identified above. 5) Tracks metrics and measures results for the SBIR projects withinthe CRP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army utilizes a CRP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. TheCRP investment fund must be expended according to all applicable SBIR policy on existing Phase II availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a non-proprietary summary report at the end of their Phase I project andany subsequent Phase II project. The summary report is unclassified, non-sensitive and non-proprietary and should include:

- A summation of Phase I results
- A description of the technology being developed
- The anticipated DOD and/or non-DOD customer
- The plan to transition the SBIR developed technology to the customer
- The anticipated applications/benefits for government and/or private sector use
- An image depicting the developed technology

The non-proprietary summary report should not exceed 700 words, and is intended for public viewing on the Army SBIR/STTR Small Business area. This summary report is in addition to the required final technical report and should require minimal work because most of this information is required in the finaltechnical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at: https://sbir.army.mil/SmallBusiness/ and is due within 30 days of the contract end date.

ARMY SBIR PROGRAM COORDINATORS (PCs) for Army SBIR PHASE 22.2

Participating Organizations	Program Coordinator	Phone
Army Futures Command (AFC)	Casey Perley	716-754-6311
Armaments Center (AC)	Ben Call	973-724-6275
Aviation and Missile Center (AvMC-A)	Dawn Gratz	256-842-3272
Aviation and Missile Center (AvMC-M)	Dawn Gratz	256-842-3272
Army Research Laboratory (ARL)	Francis Rush Nicole Fox	919-549-4347 919-549-4395
Army Test & Evaluation Command (ATEC)	Kendra Raab	443-861-9344
Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR)	Tamarisk Gillespie	410-395-4665
Chemical Biological Center (CBC)	Martha Weeks	410-436-5391
Engineer Research & Development (ERDC)	Melonise Wills	703-428-6281
Ground Vehicle Systems Center	George Pappageorge	586-282-4915
PEO Aviation	Alivio Mangieri	256-313-4975
PEO Command, Control and Communications Tactical (PEO C3T)	Meisi Amaral	443-395-6725
PEO Intelligence, Electronic Warfare& Sensors (PEO IEW&S)	Michael Voit	443-861-7851
PEO Missiles & Space	David Tritt	256-313-3431
PEO Soldier	Carl Linnington	703-704-0211
PEO STRI	James Todd	407-384-3884
Space and Missile Defense Command (SMDC)	Jason Calvert	256-955-5630
Soldier Center (SC)	Cathy Polito	508-206-3497

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

A final technical report is required for each project. Per DFARS clause 252.235-7011 (http://www.acq.osd.mil/dpap/dars/dfars/html/current/252235.htm#252.235-7011), each contractor

shall:
(a) Submit two copies of the approved scientific or technical report delivered under the contract to the Defense Technical Information Center, Attn: DTIC-O, 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218;
(b) Include a completed Standard Form 298, Report Documentation Page, with each copy ofthe report; and
(c) For submission of reports in other than paper copy, contact the Defense Technical Information Center or follow the instructions at http://www.dtic.mil.

PROTEST PROCEDURES

Refer to the DoD SBIR Program Announcement for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Monroe Harden, at usarmy.apg.devcom.mbx.sbir-program-managers-helpdesk@army.mil

NOTIFICATION OF SELECTION OR NON-SELECTION: Proposing firms will be notified of selection or non- selection status for a Phase I award within 90 days of the closing date of the BAA. The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from sbir.noreply@amrdec.army.mil with their official notification of proposal selection or non-selection.

ARMY PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DOD requirements specified in the BAA. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$111,500** with up to a six-month duration) AND an optional effort (up to **$56,000** for an up to four-month period to provide interim Phase II funding).

2. The proposal is limited to only **ONE** Army BAA topic.

3. The technical content of the proposal, including the Option, includes the items identified in the DoD Program BAA.

4. The Technical Volume .pdf document has a 20-page limit including, but not limited to: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents [e.g., statements of work and resumes] and all attachments.

   Offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposalsubmission as THESE WILL COUNT AGAINST THE 20-PAGE LIMIT. Any information that details work involved that should be in the technical volume but is inserted into other sections of the proposal will count against the page count. ONLY the electronically generated Cover Sheet and Cost Volume are excluded from the Technical Volume .pdf 20-page limit. Army Phase I proposals submitted with a Technical Volume .pdf document of over 20-

pages will be deemed NON-COMPLIANT and will not be evaluated.

5. The Cost Volume has been completed and submitted for both **the Phase I and Phase I Option** and the costs are shown separately. The Army requires that small businesses complete the Cost Volume form on the DOD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the coversheet.

6. Requirement for Army Accounting for Contract Services, otherwise known as CMRA reporting is included in the Cost Volume (offerors are instructed to include an estimate for the cost ofcomplying with CMRA).

7. If applicable, the Bio Hazard Material level has been identified in the Technical Volume.

8. If applicable, plan for research involving animal or human subjects, or requiring access to government resources of any kind.

9. The Phase I Proposal describes the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfiesone or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

10. If applicable, Foreign Nationals are to be identified in the proposal.

VERSION 3

Army SBIR 22.2 Phase I Topic Index

A22-001	Target on the Move and Dynamic Retargeting for Enhanced Lethality
A22-002	Digital Engineering of Armaments Systems
A22-003	Secure Battlefield Munition Communications and Angular Position Accuracy for Enhanced Lethality
A22-004	Fast Multi-Domain Battle Simulator (FMDS) for AI/ML
A22-005	Physiological Sensing for Improved Human-AI Collaborative Performance
A22-006	Single Photon Counting Ultraviolet Detectors
A22-007	Extremely High Frequency Transmitter for Radar Applications
A22-008	Geometry Perturbations in High Fidelity Millimeter Wave Target Modeling for Scene Generator Systems
A22-009	Positioning and Initialization Enabled by Complementary, Quantum or Photonic Sensors
A22-010	Multi-Purpose DROIC architecture for ranging and 3D active imaging
A22-011	Scene-Based Non-Uniformity Correction (SBNUC) algorithm to lower the polarimetric noise
A22-012	Efficient Parallel IO For In Situ Data Extracts
A22-013	Advancing the Science of Additive Manufacturing for a Rapidly Deployable, Energy Efficient System the Modular Assembly Shelter (MASh) Kit
A22-014	Electronic Textile Impedance Modeling Software and Soldier Worn Networks
A22-015	EXOJUMP - Conformal Exoskeleton to reduce parachute landing force and jump injuries

VERSION 3

A22-001 TITLE: Target on the Move and Dynamic Retargeting for Enhanced Lethality

OUSD (R&E) MODERNIZATION PRIORITY: Autonomy, Hypersonics, Space

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop sensing technologies that enable the receipt and transmission of high-precision, dynamic retargeting data for long-range munitions. Technologies to be developed would provide the means to remove humans as forward observers, especially for long range munitions, with low probably of detection.

DESCRIPTION: This topic addresses enhanced capabilities for three different engagement scenarios. The first scenario involves target information that is to be modified based on reprioritization of targets. The second scenario addresses the delay of target information either because the precise target location is initially unavailable, because the target is moving, or because the munition's destination is to be concealed from enemy forces. The third scenario involves guiding the munition real time to the target through an operator or an autonomous system.
The delivered technology will enable the munition to sense, geolocate, and relay target and munition data from multiple sources to fire control and battle management systems.
The proposed technology should also provide the means to transmit actual position data that can be used by onboard navigational system to determine if the GPS signal is being spoofed and to take appropriate corrective action.

PHASE I: Conduct a systematic feasibility study of the proposed methods using analytical and computer modeling and simulation and well as proof-of-concept prototyping of the basic components of the system and laboratory testing to determine if they have the potential of meeting the all the requirements for use in munitions, UAVs and UGVs that are to be provided to the Phase I awardees. Manufacturability of the proposed concepts and compatibility with mass production technologies used in similar commercial applications to achieve low cost and highly reliable systems must also be addressed. The Phase I effort must also address shelf life and safety issues and provide a detailed plan for the development of concepts, along with their prototyping and testing during the project Phase II period.

PHASE II: Design and fabricate full-scale gun hardened energy system prototypes of the selected concepts for the selected munitions applications and test prototypes in the laboratory and in relevant environments, including in shock loading machines and in air guns. Demonstrate that such prototypes can survive in operational environments while performing the designed transfer of sensory information for moving targets and dynamic retargeting under various conditions. The Phase II period must also include the fabrication and delivery of final prototypes of the selected design for the selected munitions applications.

PHASE III DUAL USE APPLICATIONS: The developed technology has a wide range of military applications for remote sensing and targeting, including in UAVs, UGVs and remotely operated robotic systems. Commercial uses for such technology also include remote sensing and dynamic tracking and delivery of payloads or services using UAVs, UGVs and remotely operated robotic systems, particularly to remote locations and in emergency conditions.

REFERENCES:

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2. Ramesh Garg, "Analytical and Computational Methods in Electromagnetics", Artech House press, ISBN-13:978-1-59693-385-9.
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6. A. G. Yarovoy, R. V. de Jongh, and L. P. Ligthart, "Transmission of electromagnetic fields through an air-ground interface in the presence of statistical roughness," in Proc. IEEE IGARSS'98, Seattle, WA, Jul. 6–10, 1998, vol. 3, pp. 1463–1465.
7. R. Azadegan and K. Sarabandi, "Analytical formulation of the scattering by a slightly rough dielectric boundary covered with a homogeneous dielectric layer, "in Proc. IEEE AP-S Int. Symp., Columbus, OH, , pp. 420–423, 2003.
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9. J. L. Volakis, A. Chatterjee, and L. C. Kempel, Finite Element Method for Electromagnetics: Antennas, Microwave Circuits, and Scattering Applications. New York: IEEE Press, 1998.
10. P. Monk, Finite Element Methods for Maxwell's Equations. Oxford, U.K.: Oxford Univ. Press, 2003.; B. Fornberg, A Practical Guide to Pseudospectral Methods. Cambridge, U.K.: Cambridge Univ. Press, 1998.
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KEYWORDS: Long-range munitions, guided munitions, APNT, fire control

A22-002 TITLE: Digital Engineering of Armaments Systems

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/Machine Learning

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Design, demonstrate and deliver an ontology-based digital engineering solution that enables integration and federated use of models, data, and tools to develop and improve armaments systems.

DESCRIPTION: The integration of engineering tools and models (known as Digital Engineering) presents an opportunity to move at the speed of relevance for the Army Futures Command (AFC) and the Army priorities managed as Cross Functional Teams (CFTs). The data transition across engineering lifecycle phases occurs sequentially with disparate tools and models, resulting in time lost and rework. The integration of such tools was cost prohibitive. However, the proliferation of emerging technologies make this goal more achievable today. Using ontologies and ontological methods and software tools to create and mine data sources provides an opportunity for tool agnostic integration that is flexible and powerful. An ontology-based system opens up the power of triple store and semantic web based technologies to empower our tools and their integration. Such a solution could leverage a domain specific ontology, REST APIs, ETL technology, and visualization technologies, see references [1-5]. Basic research efforts have advanced the utility of ontologies and established frameworks and tools to achieve this end state for DE. For example, Hagedorn et al describe one such framework in [6]. These tools are currently emerging and have not yet been fully matured; as should be expected. There is a need to further develop these tools to a maturity (usability and security being of highest concern) required for use in government and commercial organizations.

With investment, we will link together tools for requirements, architecture, design, analysis, acquisition, manufacturing and fielding, eliminate delays and errors from translating design data between tools and steps. A federated set of data will serve as the single source of truth and change(s) will translate through all levels and tools. The resultant technology supports OSD's Digital Engineering and Data strategies; improving engineering effectiveness and efficiency across all Army Modernization Priorities. Government estimates of improvement show expected reduction in process time from 33-66% varying by process type and program complexity. These solutions have transition potential as an enterprise solution for the DEVCOM/AFC, as an industry solution, and as a manufacturing solution amongst our production. As such, transition partners would include Joint Program Executive Office Armaments & Ammunition (JPEO A&A) including Product Director Joint Services (PD JS), Joint Manufacturing and Technology Center (JMTC), and Watervliet Arsenal (WVA). The DE solution shall demonstrate the following characteristics and requirements:

1) The solution shall enable the conduct of coupled physics based analysis of multiple types with multiple tools
2) The solution shall perform impact analysis conducted in the event of a request for waiver or change with traceability through design, architecture and requirements
3) The solution shall execute a virtual evaluation of a modified system including determination of data needs and conduct of applicable analyses.
4) The solution shall be tool agnostic and integrate with existing tools with minimal user intervention
5) The solution shall share data maintaining and ensuring a federated authoritative data source,
6) The solution shall include validated tools
7) The solution shall comply with or be able to comply with IT and cyber security requirements applicable to the environment, see [7].

With investment, the AFC and our partners will be able to link together tools for requirements, architecture, design, analysis, acquisition, manufacturing and fielding. We will eliminate delays and errors associated with translating a design into an engineering analysis tool, then into a technical data package format, then into a manufacturing file, into a 3D rendering in a tech manual, and then back to the design authority via as-built parametric models to facilitate production, sustainment, and demil support. A single data element will serve as the single source of truth and a change will translate through all levels and associated tools. The resultant technology supports OSD's Digital Engineering and Data strategies; improving engineering effectiveness and efficiency across all Army Modernization Priorities. Government estimates of improvement show expected reduction in process time from 33-66% varying by process type and program complexity. These technology solutions will have powerful transition potential as a local solution for the AC, as an enterprise solution for the DEVCOM/AFC, as an industry solution with our partners, and as a manufacturing solution amongst our production base (first through the Armaments GOCO's). This technology set offers the promise to support seamless transition of products along a Digital Thread that joins partner organizations in a way never achieved before. As such, transition partners would include Joint Program Executive Office Armaments & Ammunition (JPEO A&A) including Product Director Joint Services (PD JS) for their GOCO mission, Joint Manufacturing and Technology Center (JMTC), and Watervliet Arsenal (WVA). At a minimum the DE solution shall demonstrate the following characteristics and requirements:

1) The solution shall enable the conduct of concurrent physics based analysis of multiple types with multiple tools
2) The solution shall perform impact analysis conducted in the event of a request for waiver or engineering change and automated traceability through design, architecture and requirements
3) The solution shall execute a virtual evaluation of a new or modified system including determination of data needs and conduct of applicable analyses.
4) The solution shall be tool agnostic and be able to integrate with existing tools with minimal user intervention
5) The solution shall share data seamlessly maintaining and ensuring a federated and authoritative data source,
6) The solution shall include validated tools and assist in validating new tools
7) The solution shall comply with or be able to comply with IT and cyber security requirements applicable to the environment, see [7].

Ultimately, these tools will enable the realization of modernization at the speed of relevance. Engineering can truly be concurrent, utilizing a single data source to simultaneously design, analyze, plan for manufacturing, and establish logistics products thus reshaping the acquisition process from a serial process of handoffs to a truly rapid, agile and concurrent process. In phase II, the DE solution would be piloted on multiple projects to exercise all uses cases; including an in-house designed item in development, a legacy government designed item in production, and contractor designed item. Specific targets for pilot will be identified before Phase II.

PHASE I: Deliver the design and specification for the system solution that includes an ontology-based framework and integration of relevant tools to include the concurrent conduct of end to end engineering assessments as well as the sharing of data across and between lifecycle engineering processes. Based upon available research, knowledge of the systems engineering process and the Armaments industry, the system requirements shall be included in a specification for the solution. In addition to a specification, the system design should include the structure of the system via system architecture deliverables. The systems specification and architecture shall describe uses cases and associated functions, including but not limited to: (1) conduct of concurrent physics based analysis of multiple types with multiple tools, (2) impact analysis conducted in the event of a request for waiver or engineering change and automated traceability through design, architecture and requirements, (3) virtual evaluation of a new or modified system including determination of data needs and conduct of applicable analyses. The specification for the system shall include the following characteristics: (a) be tool agnostic and be able to integrate with existing tools with minimal user intervention, (b) share data seamlessly maintaining and ensuring a federated and authoritative data source, (c) include validated tools and assist in validating new tools, and (d) comply with or be able to comply with IT and cyber security requirements applicable to the environment, see [7]. Phase 1 will complete with submission of the following deliverables: (i) System specification for the digital engineering solution. (ii) System architecture description (and/or diagrams) for the digital engineering solution. (iii) A system description document describing the solution and its capabilities, (iv) An armaments specific ontology in a format readable and editable by commercially available ontology editors (e.g. TopBraid Composer), and (v) Demonstration or simulation of the solution with models and data from an armaments and/or ammunition item(s) to be specified and provided by the government. The demonstration may be conducted on a network or computing infrastructure as determined by the vendor. The government subject matter experts will evaluate the feasibility and potential of the proposed solution.

PHASE II: Demonstrate a prototype solution, with the system model and data specified in Phase 1 that meets the system specification and description from Phase 1. Phase 2 will complete with submission of the following deliverables: (1) Install of the solution on an appropriate network as defined by the government (e.g. DREN or NIPR) or the delivery of a standalone computer/server environment with the solution installed and running, (2) Representative data and models loaded with the solution for purposes of demonstration, (3) A demonstration of the solution, (4) An introductory training for the customer, so that they may proficiently utilize the prototype solution and explore its capabilities, (5) An update to prior deliverables if applicable.

PHASE III DUAL USE APPLICATIONS: In phase 3 the system solution shall be refined, implemented and demonstrated for dual use. To demonstrate the applicability and scalability of the solution to industry, the system shall be demonstrated within the environment and using functions associated with digital integration of the government R&D environment and industry producer. Specifically, the Ammunition industrial base. The vendor shall recommend to the government the preferred demonstration facility, including but not limited GOCO ammunition producers.

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KEYWORDS: Digital engineering, digital twin, semantic web, digital thread, ontology.

VERSION 3

A22-003 TITLE: Secure Battlefield Munition Communications and Angular Position Accuracy for Enhanced Lethality

OUSD (R&E) MODERNIZATION PRIORITY: Control and Communications

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop methods for secure battlefield communication with munitions to ensure the accuracy of angular orientation, to enhance target intercept capabilities, providing enhanced precision and lethality.

DESCRIPTION: When information is communicated between sensors on the battlefield or when information is transmitted and received between one or more nodes, it is necessary to conceal the information being transmitted. The communication between two or more nodes, requires the transmission of information and recovery of the transmitted information using radio frequency means. As a result, the transmitted sensory information, or the electronic communication between two or more nodes may be detected or jammed by an adversary. The nodes may be a weapon platform and one or more munitions, UAVs, UAGs, fire control stations, and the like.

The initial feasibility studies have shown that information from sensors or information from two nodes or more could be inserted within the noise envelope using novel methods and be completely recovered at every receiving node, even in the presence of interference and noise and significantly better than any conventional methods. When polarization was added to the developed method, the analysis shows a significant increase in resistance to detection, jamming and spoofing.

Such secure and communication capability between weapon platforms and other fire control platforms and munitions is critical for ensuring that the information cannot be detected, jammed, or spoofed and that the munition can be guided to its target with high precision and maximum lethality.
The technology is of particular importance for long range munitions since angular positioning errors can accumulate during their significantly longer flights, requiring correctional information communication from weapon platforms or central control stations and with the adversary having more time to detect and jam or spoof the communication information.

PHASE I: Conduct a systematic feasibility study of the proposed methods using analytical and computer modeling and simulation as well as proof-of-concept prototyping of the basic components of the system and laboratory testing to determine if they have the potential of meeting the all the requirements for use in munitions, UAVs and UGVs that are to be provided to the Phase I awardees. Manufacturability of the required hardware and compatibility with mass production technologies used in similar commercial applications to achieve low cost and highly reliable systems and the development of the required reliable and robust software must also be addressed. The Phase I effort must also provide a detailed plan for the development of concepts, along with their prototyping and testing during the project Phase II period.

PHASE II: Design and fabricate the required hardware prototype and develop the required software of the selected concepts for implementation on selected munition systems. The hardware that is to be integrated into munition must be capable to be hardened to withstand the munition firing environment. The developed hardware and software must be tested in the laboratory and in relevant environments, including in shock loading machines and in air guns. Demonstrate that such prototypes can survive in operational environments while securely communicating the sensory information within the environmental noise level so that it cannot be detected, jammed, or spoofed. The Phase II period must also include the fabrication and delivery of final prototypes and software of the selected munitions applications.

PHASE III DUAL USE APPLICATIONS: The developed technology has a wide range of military applications for secure communication for remote sensing and targeting, including in UAVs, UGVs and remotely operated robotic systems. Commercial uses for such technology also include secure communication in highly noisy environment with low power for payloads or services using UAVs, UGVs and remotely operated robotic systems.

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KEYWORDS: APNT, guidance, secure communications, fire control, noisy environments

VERSION 3

A22-004 TITLE: Fast Multi-Domain Battle Simulator (FMDS) for AI/ML

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/Machine Learning, Network Command

TECHNOLOGY AREA(S): Sensors

OBJECTIVE: Military operation simulator with high speed Multi-Domain capabilities and AI/ML, XR interfaces in which AI-enabled Command and Control (C2) agents shall learn by executing simulated Multi Domain Operations (MDO).

DESCRIPTION: Recent assessments by US Army's Future Study Program have shown that there are no capable simulation systems that meet the requirements of AI for C2 in MDO. Although there are government-owned and commercial C2 simulation systems available, none of them offer the necessary combination of very high speed execution, multi-domain richness, and specialized interfaces for AI/ML applications. The speed and complexity of MDO against a peer adversary are likely to exceed the cognitive abilities of a human command staff in conventional, largely manual C2 processes. At the same time, emerging applications of Artificial Intelligence (AI) techniques such as Deep Reinforcement Learning (DRL) [1] [2] begin to suggest the potential to support C2 of MDO. Recently there has been a growing interest in the DOD community, including military departments, unified combatant commands and defense agencies like DARPA to research and develop C2 AI techniques, specifically DRL based techniques that can learn to seek, create, and jointly exploit Windows of Superiority (WoS), a key element of the MDO paradigm. To converge multi-domain friendly assets on a WoS, the C2 agents will learn to perform complex (re)planning on shortened timelines, quickly offer suggestions, and test alternative Course of Actions (COAs). Developing these agents will require a simulator engine(s) of appropriate fidelity since DRL-derived policies are fundamentally limited to the experiences that is available. This topic looks at developing a simulation environment that can generate scenarios which cover all relevant domains/ capabilities that an AI-enabled C2 system is expected to manage, rapidly produce large amounts of training data for ML algorithms, run much faster than real-time and support massive parallelization in order to make the learning process tractable within operational timelines. From an operational perspective for future MDO, it is envisioned that a comprehensive AI-based C2 system will create high-fidelity simulations of combat scenarios within a short duration of time. AI agents will be trained in the simulator and deployed on the field to generate predictions, decisions, and commands at multiple levels of abstraction. These AI-enabled solutions will also work collaboratively with humans within command posts to ensure that data collection, processing, exploitation, and dissemination is efficient and timely to enable rapid and accurate decision-making. Currently, the C2 simulation environments such as OpSim [3], DXTRS [4], OneSAF [5] mostly provide war gaming, Course of Action (CoA) implementation in the traditional physical domains and are not tailored towards developing AI applications. They do not have the provision to communicate/interface with AI algorithms, adjust resources, scale the computation to generate experiences and incorporate humans into the AI-C2 loop. In summary, the goal of the SBIR is to research and develop an integrated simulated battle space that address current limitations in training and testing AI systems for C2 with and without human-in-the-loop.

PHASE I: The Phase I research effort shall focus on conceptualizing a brigade level model-based C2 simulation environment prototype with Land, Air, and Sea domains that runs 1,000 times faster than real-time/actual mission time. This simulation environment will consist of both a stochastic simulator based on a provided CoA and an OpenAI gym compatible iterative interface for training DRL algorithms that allows every entity in a simulation to be controlled as a separate agent. The vendor shall allow the user to modify observations, actions, rewards, metrics and interactions produced by the simulator. The software shall be designed to execute multiple independent instances on each node of a multi-node system and collect experience through parallel data collection. A typical unit of measurement for evaluating C2 environment performance is the amount of time required to perform a C2 function or known as a Boyd's Observe-Orient-Decide-Act (OODA) loop, is the OODA time. An OODA military task using training data suggest that various C2 environments will execute a task between 5 to 30 seconds depending on the complexity of the task and the C2 environment [6][7]. The performer shall develop proof of concept that AI agents trained in the simulator shall produce similar or improved OODA time. Further, the performers shall produce experimental/analytical results to emonstrate the ability of AI agents trained in the simulator to produce improved values for intermediate goals such as casualties, fuel and ammunition consumption, movement when compared to the CoA designed by expert CoA designers. In addition, the deliverable for Phase I shall include detail documentation on problem description, current limitations, conceptual design, architectural overview, methodology, modules, analytical/experimental critical function and a detailed prototype development plan for Phase II (TRL 2).

PHASE II: The initial part of Phase II shall involve building a prototype based on the concept/methodology conceived in Phase I and meeting the performance criteria described in Phase 1. Further, the simulator will be extended to cyber, electronic warfare (EW) and space domains with the ability to depict communication and information flows at very high resolution. The overall fidelity and realism in simulation will be increased by incorporating weather, sensors, terrain interactions, and environmental attributions. Phase II shall also involve development of a next-generation XR user interface that can alter the battlespace by receiving input from the human user for handling human-in/on-the-loop interactions. The user latency of the interface will be less than 7 ms. The Phase II deliverable shall be an end-to-end software prototype of a multi-domain high-fidelity simulation environment, AI interface, and low latency XR user interface. At the end of phase II, DRL based agents shall be implemented in the simulation and at least 70% of AI re-planning recommendations on scenarios jointly developed by concept writers and stakeholders shall be assessed as reasonable by expert human jurors (TRL 5).

PHASE III DUAL USE APPLICATIONS: The software shall be extended to improve the run time to 10,000 times faster than real-time. The integrated system shall have the capability to simulate MDO at multiple echelons including squad, platoon, brigade, division and corp. The simulation system shall be implemented on DOD's advanced supercomputing capability and evaluated using DRL algorithms and human participants on scenarios jointly developed by concept writers and stakeholders. In terms of the Army's modernization priorities, this software infrastructure will contribute to the three core tenets of multi-domain operations – calibrated force posture, multidomain formations, and convergence and is critical for multiple Cross Functional Teams (CFTs) including Network Command, Control, Communication, and Intelligence (C3I), Next Generation Combat Vehicle (NGCV) and Air and Missile Defense (AMD). Other commercial application include R & D and operational simulation infrastructure for planning and decision making during humanitarian assistance, disaster response and emergency management. The C2 simulation environments could also be used for improving training for pilots, air traffic controllers and other complex data intensive professions involving civilian safety and lives.

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KEYWORDS: Command and Control, Simulator, Artificial Intelligence, Machine Learning, Human-in-the-Loop

A22-005 TITLE: Physiological Sensing for Improved Human-AI Collaborative Performance

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/Machine Learning

TECHNOLOGY AREA(S): Human Systems, Information Systems

OBJECTIVE: Create software-hardware systems to sense and process a user's physiological states, providing just-in-time triggering of adaptive automation to improve computer-supported task performance.

DESCRIPTION: Artificial Intelligence (AI) enabled systems are used by human users to reduce mental workload and ensure greater accuracy and speed at performing task or set of tasks through a robust division of responsibility between AI and human user.

Technological capabilities to sense and process a user's cognitive state and intervene with adaptive automation aids when needed (and not when the user performs well) would improve human-AI collaborative performance. This SBIR topic is intended to introduce new technology to improve aid triggering that is not presently known to exist. Proposals will posit physio measures that can be sensed, processed, and used as triggers to aid user only when the user needs help. The research question is: "How can physiological indicators from a user be used to improve AI-user collaborative performance?" The contractor will need to provide a proposal outlining a plan for how technological innovations can be used to: (1) sense pertinent physiological data from the user; (2) transform these data into meaningful digital signatures; (3) detect and set cutoffs to determine whether the physiological states indicate a need for cognitive intervention to aid goal completion in the form of adaptive automation; and (4) provide solutions to how AI can aid a militarily relevant task (e.g., convoy route-planning, threat assessment from military intelligence, command and control, etc.) when the user is struggling as indicated by poor performance or physiological indicators.

Physiological measures are often associated with different cognitive processes and therefore may act as triggers for adaptive automation meant to aid the user. Physiological measures are objective (i.e., not involving subjective opinions of the user), and therefore plausible options for AI triggers. The goal of this SBIR initiative is to develop a system that can: (1) sense output from the user for two of five identified physiological variables; (2) assess two of five distinct cognitive variable states; (3) set quantitative thresholds for each of the variables (via physiological assessment) at which the system engages or disengages adaptive automation, (4) implement at least one adaptive automation application using any two of the five physiological variables, and (5) demonstrate task performance increases through empirical testing.

PHASE I: The end of Phase I should produce several outcomes in the range of TRL2-3. (1) Identification of five target physiological measures that relate to specific cognitive variables with at least two citations corroborating these conclusions. (2) Proposed ranges for the two most promising physiological variables that would indicate a need for triggering adaptive automation based on literature search or pilot testing and consultation with ARL researchers. (3) One citation and description of technology that senses and records two of the five chosen physiological measures. (4) An explanation and justification for a plan to leverage each of the existing technologies to process measures in real time. (5) A plan to form new technology which can record and process in real-time minimally two of the five physiological variables that have not previously been recorded simultaneously in the same device. The integration of physiological variables is a particular challenge as physiological variables often differ on the time scale in which they may be collected and analyzed from tens of milliseconds to seconds. These five points need to be incorporated into a report at the end of Phase I that also: (1) Discusses the project's problem space and current limitations to demonstrate full understanding of what needs to be solved; (2) Explains a methodology to overcome challenges and limitations; (3) Provides a conceptual design of the problem solution with anticipated performance at the end of Phase II, and (4) Outlines what will be done in Phase II. A successful report will demonstrate a path forward for using physiological variables from the user to give technology critical inputs to understanding when and how the user can be helped when challenged. Therefore, a successful Phase I will make a strong argument that the two chosen physiological variables are measurable and are predictive of the associated cognitive states.

PHASE II: The end of Phase II should produce several outcomes in the range of TRL 4-5. (1) Methods of measuring and processing two of the five physiological variables that relate to each cognitive state isolated in Phase 1. (2) One working demonstration for each measure with a display representing a near-real-time assessment of the measure. (3) One working demonstration of at least three of the physiological measures in an Army-oriented task and scenario in which the user's physiological state triggers adaptive automation. The task must involve decision-making regarding uncertainty as this a major focus area for Artificial Intelligence in general and particularly in Multi-Domain Operations. (4) A demonstrated ability to transfer adaptive automation trigger data to a third-party software. (5) Recommendations and paths forward for implementing adaptive automation based on the remaining physiological measures. The contractors should work toward the following benchmarks to enhance the odds of Phase III investment: (1) Flexibility of approach to account for numerous tasks (e.g., air traffic control, Army training programs, surveillance and sentry duties, security screening); (2) Resiliency of equipment to continue working in rugged conditions; (3) Ability to detach and stay powered when in environments without ready power sources; (4) Capability to interface with a range of secondary systems; (5) Capability to transition technology for commercialization to industry and possible Army applications; (6) Robust statistical procedures to account for large variability in physiological recordings; and (7) Plan for data sharing and use of experimental data, particularly for use by government personnel. A successful conclusion to Phase II will demonstrate technology that can predict through two physiological-variable inputs when a user needs help and experimental results showing the efficacy of the equipment with at least a 0.6 Area Under Curve (AUC) improvement in performance.

PHASE III DUAL USE APPLICATIONS: At the conclusion of the SBIR, the contractor will be well positioned to offer numerous technological applications for end users in both the commercial and military domains. In particular, the contractor may design adaptive automation for mental workload intensive jobs such as Intensive Care Unit monitoring and coordination, air traffic control, sports psychology, tutoring system development, pandemic responses, and military intelligence analysis. When physiological measures indicate difficulties with cognitive processing in any of these domains, adaptive automation may be triggered to ease the cognitive burden associated with performance of duty and thus improve outcomes. In the end, the contractor should be positioned to produce one or more potential commercial technologies that could be inserted into defense systems. The market contains many examples of work processes that involve users engaging with smart technology and computers. Following a successful Phase II, award winner can use the knowledge gained and technology created to optimize any number of these processes with adaptive automation using physiological sensors attached to the end user and deliver improved AI-user collaborators performance across a host of tasks and jobs.

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KEYWORDS: Artificial intelligence; Cybernetics; Information Science; Behavior; Intelligence; Physiological psychology; Military psychology

A22-006 TITLE: Single Photon Counting Ultraviolet Detectors

OUSD (R&E) MODERNIZATION PRIORITY: Microelectronics

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: To advance photon counting UV detectors and surpass the performance of UV photomultiplier tubes by making a reduced SWaP, more robust/ruggedized solid state solution for applications to sensing and communications.

DESCRIPTION: Sensing in the ultraviolet (UV) spectrum (200-375 nm) has many important Army applications, including detection and identification of chemical and biological agents; precision position, navigation and timing using compact atom-based quantum sensors; optical communications for 2 radio-frequency denied environments; and environmental sensing. Many of these are impactful for Army Modernization priorities, including networks as well as soldier lethality. However, high cost, bulkiness, and power requirement limitations in commercially available UV single photon detectors (UV-SPD), such as photomultiplier tubes and intensified charge coupled device cameras, hinder system development.

This topic is interested in novel research and development towards demonstrating compact, UV single-photon-counting detectors (UV-SPD) sensitive in spectral range between 200 – 375 nm. The devices should have high single photon detection efficiency (SPDE) in the UV spectrum from 200-375 nm and low dark count rate density (DCRD), while also being visible-blind, compact and operable at room-temperature or using a compact thermo-electric cooler. Of particular interest are semiconductor based solutions based upon device architectures that include avalanche photodiodes (APDs), charge-coupled devices or phototransistors. For example, silicon (Si)-based SPDs have been demonstrated with low dark count rates (~ 25 Hz) but their response both drops off at wavelengths shorter than 400 nm and exhibits strong out-of-band signal [1] . Improvement requires addressing surface recombination effects and exploring novel device designs to increase carrier collection while suppressing long wavelength response [2]. While there are extensive reports on high multiplication gain measured in wide-bandgap APDs based on SiC or GaN operating in linear mode, there are fewer results on single-photon-counting operation; these studies report dark count probability at least 1-2 orders of magnitude greater than that of Si devices [3-4]. Improvements could be achievable through approaches that build on nascent research advances in the infrared that can be implemented with wide-bandgap heterostructures. Of interest would be internal amplification mechanisms (such as carrier avalanche processes) that produce very low noise suitable for single-photon counting. In particular, advances such as those made using digital alloys [5], staircase based APDs [6], or other novel amplification schemes needed to surpass photomultiplier performance (signal to noise) would be considered (although not required). Other interests include advances in circuitry to operate the detector and count in Geiger mode.

PHASE I: Demonstrate through design, modelling, and/or experimental measurements the ability to produce a UV-SPD that can have a SPDE greater than 15% over a 50 nm region within the spectral range between 200-375 nm, > 3 orders of magnitude UV-visible rejection, and with a DCRD less than 1 MHz/mm^2 and a maximum count rate > 1 MHz. Designs should operate at room temperature or employ a compact thermo-electric cooler and ultimately fit in a package no larger than 90 mm x 90 mm x 40 mm (not including power supply). Initial device functionality should be demonstrated showing a path to meet all requirements within Phase 2. Circuit design considerations for photon counting should be made. Concepts at the end of this phase should achieve a maturity of TRL 2-3.

PHASE II: Using designs developed in Phase 1, demonstrate UV-SPDs meeting all the requirement defined in Phase 1. In this phase, performers will design, fabricate, and test their device concept and provide a report on the results as well as deliver the UV-SPD to the US Government for evaluation. Devices developed in this phase should achieve a maturity of TRL 4 – device with basic optical package and with a functional photon counting circuitry demonstration that can fit within specified size constraints.

PHASE III DUAL USE APPLICATIONS: A complete detector module suitable for sensor integration should be demonstrated based upon devices developed in phase 2. The size of the housing should be smaller than 90 mm x 90 mm x 40 mm and contain all necessary focusing optics and filters for operation. The module should provide standard output to enable integration into a sensor such as the transistor-transistor-logic standard or another equivalent industrial standard. Potential sensors for integration include Raman spectrometers, scintillation detectors, water-quality monitors, combustion control systems, arc-flash detectors, atom based quantum systems, chemical-biological detectors or other environmental sensors.

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KEYWORDS: Ultraviolet detection, single photon counting, avalanche photodiode, phototransistor, charge coupled device

A22-007 TITLE: Extremely High Frequency Transmitter for Radar Applications

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Weapons, Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Design, build, demonstrate, and deliver a high power amplifier (transmitter) operating at an atmospheric transmission window towards realizing short-range Radar applications above 100 GHz.

DESCRIPTION: Robust short and medium-range air surveillance is an essential capability for the security of critical assets and areas as unmanned aerial vehicles commonly known as drones are gaining increased attention in various fields due to their vast application potential. Several air surveillance capabilities in the form of traditional Radar systems operating at X-band and below as well as active and passive infrared and optical systems are tasked to solve the issue of providing a robust air picture, with limited success in a stressing and congested environment.

The upper region of the extremely high frequency millimeter wave band is loosely defined for frequencies between 100 and 300 GHz. This band has shown promising potential for imaging and high-resolution Radar applications. However, those have been limited to very short ranges of centimeters to meters due to the lack of a transmitter that can amplify a waveform in this band to meaningful levels for Radar applications.

Other major parts of a high frequency millimeter wave Radar systems exist to include continuous wave and pulsed signal generators, frequency mixers, antennas, and super heterodyne receivers. What remains is the high power amplifier to complete the hardware requirements for a Radar system.
It is the goal of this project to push the technology of high frequency millimeter wave Radar to instrumented ranges that are useful for cued air surveillance applications and to produce another frequency band for meeting the challenge of short-range air surveillance. In particular, a high power amplifier operating in a propagation window bounded between 100 and 300 GHz (W-band is purposefully excluded to foster technology development at extremely high frequencies above 100 GHz) is needed for ranging applications reaching 20 km for a 1 square meter target. Initial models suggest that an amplifier with peak output powers of tens of Watts (50 W objective, 15 W threshold) is required assuming high gain antennas (60 dBi) are used. In order to promote multiple approaches, such transmitter may operate in continuous wave mode and/or pulsed mode with a minimum duty cycle of 5%. Associated waveform parameters (pulse width, instantaneous bandwidth, frequency tunability, pulse repetition frequency, harmonics, spurs, etc.) are to be defined by the proposer but should meet the requirements for Radar applications (e.g. an instantaneous bandwidth of 10% is desirable).

PHASE I: Design a high power amplifier operating in an atmospheric transmission window between 100 – 300 GHz (e.g. 140 GHz, 220 GHz). The amplifier solution needs to be compact to allow for transport and use outside a laboratory environment. The delivery is a detailed and technically sound solution for building proposed transmitter within the schedule and budgetary constraints of a Phase 2 award. The transmitter shall accept and amplify a signal provided by an external signal generator with output power of 0 dBm. The transmitter shall output the signal in the form of a rectangular waveguide.

PHASE II: Construct, demonstrate, and deliver the high power amplifier described above. The transmitter shall allow for operation with general AC power supply equipment (e.g. 120V single phase, 208V 3 phase shore power or generator power), meaning the DC power supply has to be included with the transmitter build. Forced air and liquid cooling are both acceptable.

PHASE III DUAL USE APPLICATIONS: High power transmitters operating above 100 GHz will open a commercial sector in this frequency region for ranging and high bandwidth communications. With the proliferation of drone usages in urban areas and the ever-increasing need for high bandwidth wireless communications to connect commercial and residential areas and push the availability of high-speed internet to rural areas, high power extremely high frequency millimeter wave signal generation is needed now.

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KEYWORDS: millimeter wave, radar, terahertz, sub-millimeter wave, transmitter, high power amplifier

A22-008 TITLE: Geometry Perturbations in High Fidelity Millimeter Wave Target Modeling for Scene Generator Systems

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/Machine Learning, Hypersonics

TECHNOLOGY AREA(S): Battlespace, Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Identify and develop techniques to analytically correlate and efficiently represent geometric perturbations with millimeter wave target scattering for use in existing scene generation application

DESCRIPTION: The U.S. Army employs a wide array of radar simulations to include all-digital, signal injection, and hardware-in-the-loop environments to conduct high fidelity, cost effective, millimeter wave (MMW) weapon system development and evaluation. These simulation environments are used in sensor and seeker performance assessments, flight test analysis, and algorithm developments and are driven by high-fidelity target and threat radar scattering models which are validated against available referent signatures. MMW target signatures may be derived from a variety of physics based, signature prediction tools that utilize computer aided design (CAD) geometry models as inputs.

CAD inputs are routinely modeled as pristine geometry sources as a philosophical choice to avoid exact fingerprinting of a single target instance in addition to real-world limitations such as a lack of input information, memory limits, or polygon budgets. That said, real-world target structures may exhibit a wide range of non-pristine geometric surfaces and unit-to-unit variability due to operational use, battle and test damage, manufacturing processes, and fabrication tolerances. For millimeter wave applications, geometry perturbations can produce significant deviations in radar scattering parameters to include dominant scattering amplitude, physical location of scattering, as well as the angular extent of scattering phenomenology as experienced for ground and air targets. While existing radar target models provide high fidelity inputs to scene generator applications, radar inputs to scene generation are generally not correlated to or functionally representative of underlying perturbations in target geometry and are handled on a discrete basis. In addition, a significant development resources are expended in MMW radar signature model creation and validation to discern and account for effects of non-pristine geometry elements that may be modeled by polygonal, spline, or parametric solid entities.

Previous research has approached target variability through statistical variation of observed target signatures. While statistical variability methodologies present valuable approaches for modeling signature variation over a target class, the current desire is to research and address the correlation of geometric perturbations and radar signature modeling at the source CAD and scattering physics level. Techniques are required to analytically correlate and functionally represent target geometric perturbations in millimeter wave radar models for use in existing scene generation applications and simulation environments to include the Army's Common Scene Generator (CSG), CCDC AvMC hardware-in-the-loop (HWIL) facilities, and CCDC AvMC Virtual Target Center (VTC) predictive models. This would allow modeling flexibility and ensure simulation environments are driven by millimeter wave models that capture and quantify the effect of geometry perturbations encountered with a target structure while reducing development duration and validation complexity. The modeling approach for this effort should be adaptable for integration to radar signal generation chains within existing simulations with emphasis on Ka-band scattering for both ground and air assets. Considered solutions should be capable of application to any desired physics-based radar predictive signature application with further extension to empirically derived, measurement-based target modeling. In addition, techniques and methodologies should support VTC validation processes with comparison to empirical data sets.

PHASE I: Identify an approach and demonstrate a methodology to support the analytical correlation of target CAD geometry and associated geometric perturbations to Ka-band scattering from air and ground targets. Quantify implementation and interface requirements for existing CAD modeling, predictive signature, and scene generator applications based on proof-of-concept approaches. Research and recommend methods for metric assessment of model enhancements accounting for perturbation effects as applied to the virtual target validation process.

PHASE II: Develop corresponding algorithms, processes, and frameworks to support assessment, test, execution, and demonstration of correlated CAD geometry and radar scattering model perturbation approaches. Finalize a software toolkit for target model creation and development with demonstrated support of the Virtual Targets Center validation process for a sample high fidelity ground target geometry. Address implementation requirements with CAD, predictive radar, and scene generation applications.

PHASE III DUAL USE APPLICATIONS: Integrate correlated perturbation techniques and software application into validation processes used by the Army Virtual Targets Center for support of target model generation for all-digital and HWIL simulation environments. Conduct an end-to-end creation, correlation, and perturbation refinement an air and ground target system at Ka-band. Conduct formal validation of final target model results through the virtual target validation process.

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KEYWORDS: computer aided design, CAD, radar cross section, Ka-band target modeling, geometric correlation, radar scattering, signature prediction

VERSION 3

A22-009 TITLE: Positioning and Initialization Enabled by Complementary, Quantum or Photonic Sensors

OUSD (R&E) MODERNIZATION PRIORITY: Control and Communications, Network Command, Microelectronics, Quantum Sciences

TECHNOLOGY AREA(S): Sensors, Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and demonstrate positioning, navigation and timing (PNT) sensors and technologies, such as database reliant (i.e. star maps, terrain, and the technology developments, etc.), complementary navigation (i.e. earth-based phenomena such as magnetic fields, gravity, etc.), quantum and/or photonic to provide earth-based position updates without external Radio Frequency (RF) sources and signals. Solutions should utilize techniques and algorithms to enable initialization and positioning of PNT systems without the reliance on the Global Positioning System (GPS) or Multiple Global Navigation Satellite Systems (Multi-GNSS). The solutions should be suitable for mounted applications and comply with the Army PNT Modular Open Systems Approach (MOSA)

DESCRIPTION: Recent advancements in PNT sensors and technologies, specifically database related, complementary, quantum and photonics have made sensors more applicable to provide alternative sources of PNT data and enable Assured PNT. These capabilities enable GPS independent initialization, positioning and operations of PNT systems and solutions. In addition, developments in quantum and photonic sensors and technologies have made it possible to sense physical phenomena effects presented by atoms, electrons, and photons. Sensors that are Quantum and Photonic based have the potential to perform with greater precision, be constructed within much smaller sized packages, and offered at more affordable cost over traditional systems, making many PNT systems realizable.

Complementary technologies and sensors of interest for this topic include database related (i.e. star maps, terrain, and the technology developments, etc.), earth-based phenomena (i.e. magnetic fields, gravity, etc.), and any other non-RF sensors. Quantum and photonics sensors (i.e. inertial measurement units, magnetometers, gravimeters, or clocks, etc.).

The sensors and technologies for this topic shall be compliant with the pntOS (PNT Operating System) application programming interface (API), the Army PNT Reference Architecture (PNT RA), the DoD All Source Position and Navigation (ASPN) Interface Control Document (ICD) version 3.0, the C5ISR/Electronic Warfare (EW) Modular Open Suite of Standards (CMOSS), and Vehicular Integration for C4ISR Interoperability (VICTORY), which will enable rapid integration of the sensors within multiple Army PNT suites.

Metrics that will be assessed include position and time accuracy, Size, Weight and Power (SWaP), compliance with pntOS and the other defined standards, and the complexity associated with system initialization and overall set up time.

PHASE I: The vendor will conduct trade-studies, analyses and/or modeling and simulations to determine the technical feasibility of their proposed solutions to meet the objective. The vendor will present to the government the sensor design to include system error budgets that support expected performance metrics and environmental analyses. The vendor will present a plan for compliance with the pntOS API, the Army PNT RA, ASPN version 3.0, CMOSS and VICTORY. The vendor will provide a system specification needed for phase II development.

PHASE II: Develop and demonstrate sensor and/or technology prototypes based on the specifications, hardware and software identification from phase I. Ensure that developed prototypes and software comply with the pntOS API, the Army PNT RA, ASPN version 3.0, CMOSS and VICTORY. Provide documented reports of compliance to these standards. Conduct demonstration of the prototypes at Technology Readiness Level (TRL) 5. Evaluate and provide the test results of the prototypes to the government POC. Deliver two units of the developed prototypes to the government for evaluation, including all hardware and software necessary to operate and collect data from the delivered units. Deliver digital engineer artifacts, such as Models Based System Engineering (MBSE) products of the product and software.

PHASE III DUAL USE APPLICATIONS: Modify the sensor prototype design based upon test and evaluation results from Phase 2 to achieve a better small size, weight, and power (SWaP) system applicable to a selected host A-PNT systems and comply with CMOSS or other standards identified in Phase II. Transition the technology to the U.S. Army and integrate this technology into future A-PNT Programs of Record (PoRs) or Science and Technology (S&T) Projects.

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KEYWORDS: Positioning, Navigation and Timing (PNT), Assured Positioning, Navigation and Timing (APNT), PNT Assessment Exercise (PNTAX), C5ISR/Electronic Warfare Modular Open Suite of Standards (CMOSS), pntOS (PNT Operating System), All Source Position and Navigation

VERSION 3

A22-010 TITLE: Multi-Purpose DROIC architecture for ranging and 3D active imaging

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR), Microelectronics

TECHNOLOGY AREA(S): Sensors, Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Design and develop a digital read-out integrated circuit (DROIC) capable of passive imaging and active LIDAR-like 3D ranging for use with small pitch, cooled, infrared detectors.

DESCRIPTION: Active imaging systems all require the detection of reflected light, usually from an active source such as a laser, but depending on the intended application, different readouts are required. One significant difference in active imaging capability is the required gate times, where laser range finders require high-precision short gate times and the use of a voltage ramp or other timing device, while asynchronous laser pulse detection (ALPD) requires longer gates and need to be able to detect multiple pulses in a single gate. Additionally, current range finding technologies have the limitation of ensuring that the object of interest is being ranged, and does not allow for verification of the object being ranged. This topic seeks to develop a digital read-out integrated circuit (DROIC) architecture that achieves laser range finding alongside the ability to do passive imaging to verify the object, while adding one other capability such as ALPD or multi-pulse detection. The ideal ROIC would support all forms of active imaging while enabling passive imaging in a single design.

The developed DROIC architecture should function with active imaging sensors with small pixel pitches and be scalable to HD arrays. The DROIC architecture should be able to be hybridized with a linear mode avalanche photodiode (APD) detector and have an overall low power consumption. The architecture must be able to eventually be integrated into an integrated dewar cooler assembly (IDCA). Designs where all capabilities are achieved in a simultaneous, snap-shot format will be considered but are not expected over designs that require switching modes between frames or sequential readout. The design must support triggering from an external source. Stacked (3-D) or tiled ROIC architectures will be considered but are not required.

PHASE I: Investigate, research, and design a DROIC architecture to meet the above specifications. A PDR level design is acceptable; but a design leading into a CDR and tapeout is preferred. Demonstrate design feasibility and capability of the DROIC through modeling, simulations and analysis.

PHASE II: Using the results of Phase I or demonstrated results in the proposal, complete the design for the DROIC through tape-out. A test chip with test data to verify key circuit design concepts is highly desirable. Establish a working relationship with a detector vendor to acquire infrared detectors for a possible Phase III effort and ensure that design will integrate with a working detector array.

PHASE III DUAL USE APPLICATIONS: Transition the DROIC technology to use with an infrared detector. Produce a fully working focal plane array (FPA) module. The commercialization applications of this technology may include autonomous driving and advanced object recognition.

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KEYWORDS: DROIC, 3D LIDAR, active imaging, passive imaging, ALPD

VERSION 3

A22-011 TITLE: Scene-Based Non-Uniformity Correction (SBNUC) algorithm to lower the polarimetric noise

OUSD (R&E) MODERNIZATION PRIORITY: Microelectronics

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a long wave infrared (LWIR), scene-based, non-uniformity correction (NUC) algorithm to lower the noise in polarimetric micro-grid sensors suitable for use on small unmanned aerial vehicles (UAV).

DESCRIPTION: Fixed pattern noise in infrared focal plane arrays affects the ability to detect, recognize and identify targets. Two-point correction is often used make offset and gain corrections to the image to lower the fixed pattern noise. However, factory correction is inadequate due to the drift of pixel response over time. Correction in the field is often cumbersome, impractical, and inadequate to accommodate changing scene conditions. The problem becomes worse when dealing with polarization because of the image processing involved in generating the polarization images. For example, microgrid sensors typically have four polarization filters, horizontal(H), vertical(V), and two filters at 45 degrees and 135 degrees. Calculating the Stokes vector involves adding, subtracting, and dividing. Calculating the Degree of Linear Polarization (DoLP) involves squaring square rooting, and dividing. Each of these operations increases the noise. The Army requires a correction for pixel drift and changing scenes using microgrid, microbolometer sensors operating from a moving platform such as a small UAV. The algorithm(s) should operate in near-real time at an imager’s frame rate.

PHASE I: Phase I consists of the development or adaptation of an SBNUC process using image sequence or video data that has characteristics of imagery collected from a small UAS using a minimum number of images or scene changes. It is required that a quantitative improvement in performance of the SBNUC process over that of a conventional two-point NUC be established. Analysis shall include a comparison of mean and standard deviation of degree of linear polarization (DoLP) noise characteristics in addition to other image comparison algorithms or metrics. Shortcomings of the developed process should be described. The path to make the approach more robust under a greater variety of scene and platform motion conditions to be implemented in Phase II should be described. It is necessary to eliminate to the greatest extent possible any dependence on additional hardware or specific motions of the platform or a gimbal to achieve scene-based corrections. Trade- offs that may be necessary to achieve the SBNUC improvement shall be identified.

PHASE II: Phase II consists of the implementation, testing, and optimization of the polarimetric SBNUC process on real data collected from a small UAS platform. Further, data shall be collected and the SBNUC shall be demonstrated under a variety of environmental, background, and time of day conditions. The improvement shall be demonstrated using the analysis developed in the Phase I. Any potential sensor or other hardware improvements for optimization shall be identified.

PHASE III DUAL USE APPLICATIONS: The commercialization of this process is expected to provide low cost, high performance uncooled cameras that operate over a wide range of conditions. Potential uses are in a variety of military applications including sensors for manned and unmanned aerial and ground platforms for clutter suppression, target detection and tracking, and in commercial applications including environmental monitoring, security/law enforcement, border patrol, and homeland security.

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KEYWORDS: Scene-Based Non-Uniformity Correction; Polarization; Infrared Focal Plane Arrays

VERSION 3

A22-012 TITLE: Efficient Parallel IO For In Situ Data Extracts

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: Develop parallel file readers and writers that work efficiently on HPC systems for in situ data extracts.

DESCRIPTION: The goal of this topic is to develop efficient, parallel IO tools for in situ data extracts that work with ParaView Catalyst and VisIt LibSim. The tool should support all VTK (https://www.vtk.org) data types that are supported in ParaView Catalyst and VisIt LibSim. The tool must be open source with an appropriate license to work with both of these libraries (e.g., BSD, Apache) and the data format must be open as well. The data extract output should minimize the number of files generated per output time step and, possibly, aggregate over multiple output time steps. Additionally, the tools would automate the efficiency of the parallel IO, considering significant and varying load imbalance, with as little as possible user parameters.

PHASE I: Demonstrate prototype software that combines parallel partitioned VTK data that would normally be written to separate files into a consolidated dataset that minimizes the number of files produced. Characterize the performance improvements of new IO algorithms that can deal with time varying, poorly load-balanced in situ data, through increased IO speed, and reduced number of files produced.

PHASE II: Complete in situ workflows that minimize the number of files produced for in situ data extracts per time step for all appropriate VTK data types used in ParaView Catalyst and/or VisIt LibSim. Tools must be in open-source software with open-data formats. Complete effective strategies for efficient parallel IO of in situ data extracts. These strategies should be able to be automatically tuned to specific HPC machine architectures in order to minimize user specified parameters to get the tool to work efficiently.

PHASE III DUAL USE APPLICATIONS: In situ use through both ParaView Catalyst and VisIt LibSim are already well established in the CREATE-AVTM program through Helios and Kestrel, respectively. Additionally, in situ use has spread to non-DOD specific simulation codes. See for example, OpenFOAM (https://www.openfoam.com/news/main-news/openfoam-v1806/post-processing). It is expected that this technology will simplify parallel file IO for data extracts for many ParaView Catalyst and VisIt LibSim users.

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KEYWORDS: HPC, in situ analysis & visualization, parallel IO

VERSION 3

A22-013 TITLE: Advancing the Science of Additive Manufacturing for a Rapidly Deployable, Energy Efficient System the Modular Assembly Shelter (MASh) Kit

OUSD (R&E) MODERNIZATION PRIORITY: Autonomy, General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials, Human Systems

OBJECTIVE: The Modular Assembly Shelter (MASh) Kit (Patent # 10,612,233), developed by the Construction Engineering Research Laboratory (ERDC-CERL), is an innovative system designed to use lightweight materials for expeditionary shelters and capitalize on the advantages of large-scale 3D printing, or Additive Manufacturing (AM). The MASh Kit concept uses pre-engineered construction techniques to produce a kit-of-parts for rapid assembly of a rigid shelter that is modular, simple, portable, durable, and reusable, which are all desirable shelter characteristics defined by the Capability Development Document for Army Standard Family (ASF) of Rigid Wall Shelters (RWS) (U.S. Army 2016). When fully developed, the AM process can be performed near the point-of-need producing an assembly-ready system that does not need cure time for full structural strength.

The AM transformation strives to create a world with less waste, less inventory, and lower emissions. While 3D printing has been in existence for decades, the industry is still relatively young with applications of this scale. This project will develop the MASh Kit design for production, evaluation, and fielding for use in austere environments, to include Arctic regions, through a partnership with the Private Sector and the Academic Community. The project aims to advance the AM technologies, as well as, exploring the suitability of the utilization of emerging sustainable materials as feedstock in the AM processes. Additionally, the viability of a MASh Kit comprised of a combination of both AM and traditionally manufactured components, resulting in more cost-effective production or more rapid emplacement, will be explored. The offeror will utilize domain experts who understand the technology, know its capabilities and limitations, recognize its maintenance requirements, and are keen to innovate and explore business improvement opportunities.

DESCRIPTION: One of ERDC-CERL's missions is to support military requirements and bring innovative technologies to bear in fielded equipment, resulting in reduced logistics burden, design complexity, and contracting time; all of which enables military or humanitarian responders to rapidly deploy and quickly adapt as needed.

The payoff associated with this research is providing the military with the capability to produce expeditionary shelters using AM methods that are durable, reliable, reusable, modular, and scalable, reduce the logistics burden, enhance Soldier protection, and support rapid deployment. The use of AM methods to produce expeditionary shelters will result in reduced logistics that potentially saves lives, money, and time, as well as an enhanced ability to produce mission essential infrastructure closer to the point-of-need. Successful development of the MASh Kit will provide a RWS solution that is adaptable, modular, and configurable to withstand the spectrum of potential operating environments (arctic, desert, jungle, mountain, etc.). Successful identification of composite materials that meet all of the requirements for expeditionary shelters as described above will benefit the larger AM community by advancing material research into feedstock recipes for use in any AM application.

The capabilities developed through this effort are expected to significantly contribute to the field of additive manufacturing as unit deployment speed through the ability to manufacture locally on-site if necessary. This capability would enable units to support and complete the mission when the procurement system is not responsive, delayed, or compromised, thereby increasing readiness. Since AM uses digital files instead of physical tooling like patterns and molds, it is a highly flexible technology. Manufacturing costs can be determined by three metrics – material, operating, and labor expenses. Unlike wasteful reductive manufacturing techniques, AM is a process that uses just enough material to produce an object. As a single unattended process, operating and labor expenses are eliminated by freeing personnel for other tasks. Since AM does not require object-specific tooling, the end result is additional savings whenever implementing product changes or improvements.

The MASh Kit has not yet been manufactured or tested at full scale, which is required to facilitate research and testing of optimal material feedstock, component connection designs, structural integrity, and printing setup. This testing is needed to ensure that the MASh Kit meets or exceeds Army requirements for expeditionary structures. The MASh Kit also requires comparative analysis against existing military shelter systems in terms of ease of use, production timelines, logistics, and end user point-of-need adaptability.

The offeror will propose an AM system that would serve as a component of the Developmental and Operational Testing of the MASh Kit shelter and will be required to substantiate performance to determine if the system, as a whole, meets the Army's requirements and is capable of fielding a first unit within 24 months.

PHASE I: The offeror will examine the feasibility and capability of the Science of AM to advance the design of the MASh Kit from a low TRL concept to a fieldable product, and to print parts and components for evaluation and further development to a fieldable product that is both producible and commercially viable to the military, humanitarian, and commercial markets. Additionally, the offeror will perform structural testing of the printed parts for comparison to traditionally manufactured components, perform development of near-continuous 3D printed linear parts using market-available materials, and evaluate emerging sustainable and recycled materials for use in the printed components. For improved sustainability, the offeror will explore design of traditional production hardware components and accessories that can be 3D printed and identify improvements where feasible, while meeting relevant military requirements. In addition to printing of hardware, the offeror will explore the use of traditional commercially available hardware for comparison of cost, sustainability, and availability. The wall panels to be deployed as part of the MASh Kit will be developed, and the potential of 3D printing walls or printing high R-value wall sections that will accept traditional commercially available insulation will be developed and evaluated. Driving a high R-value for MASh Kit will allow deployment in Arctic or extreme environments. Also, consideration will be given to development of insulating material that can be 3D printed and designed into the MASh Kit wall panel.

Finally, the offeror will use the Phase I effort to identify potential additional uses and capability gaps that can improve or leverage Science of AM to advance the MASh Kit design in both garrison and deployed environments.

PHASE II: If the MASh Kit is adopted into the ASF-RWS program, ERDC-CERL will partner with U.S. Army Product Manager Force Sustainment Systems (PdM FSS), the program office responsible for managing ASF-RWS, and the offeror to resource any remaining evaluation required of the MASh Kit and development of the required Integrated Logistics Support (ILS) elements to support the product as it enters and proceeds through its Production & Deployment phase. ASF-RWS shelters are centrally procured and customer-funded by the requiring program office or military unit. So, in order to facilitate that procurement approach for MASh Kit, PdM FSS will coordinate the necessary contracting vehicle(s) and item management and logistics support for the product.

PHASE III DUAL USE APPLICATIONS: ERDC-CERL also strives to leverage the feasibility determination accomplished in Phase I with the Objectives of Phase II being:
A) The offeror will complete design and manufacture up to twelve (12) full scale MASh Kits for demonstration/testing of shelter that is equivalent in size and function to a B-Hut (530 sq ft), capable of

being transported and reassembled for field testing.
B) The offeror will demonstrate the Science of AM capability to produce the MASh Kit system and any components required for its maintenance and repair.
C) The offeror will demonstrate the ability for the MASh Kit to be manufactured in high volume using a combination of AM and traditional non-AM methods.
D) The offeror will demonstrate the ability for AM-produced MASh Kit components to duplicate non-AM MASh Kit components as similar in physical characteristics such as strength, ruggedness, and application.
E) The offeror will evaluate the feasibility of AM-produced MASh Kits components to include ballistic protection inherent in the AM process.
F) The offeror will complete a Technology Readiness Assessment and provide a document detailing the artifacts and justification to satisfy TRL determination.
G) The offeror will provide a model for configuring and packaging the above concepts into a deployable containerized system requiring only electric power and the raw materials for 3D printing of the MASh Kit. The AM capability studied will need to meet necessary size and weight criteria to enable packaging within the current footprint of standard international shipping containers.
H) Additionally, the offeror will identify advantages and benefits of utilizing the MASh Kit, including but not limited to cost, technical, training, readiness, logistics, technology limitations, and weight.

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KEYWORDS: expeditionary, additive manufacturing, shelter

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A22-014 TITLE: Electronic Textile Impedance Modeling Software and Soldier Worn Networks

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

OBJECTIVE: Develop, demonstrate, and validate models, design tools, software and networks that will be used to support the efficient development and eventual mass production of high-speed data networks for electronic textile (etextile) wearable applications.

DESCRIPTION: Ongoing Army modernization efforts will provide Soldiers with enhanced capabilities that increase their ability to quickly understand and react to emerging battlefield situations. Digital transformation will improve data access and machine learning to understand, visualize, and decide and direct faster. Information will flow rapidly between the enterprise and soldiers on the ground.
Soldier worn power and data networks are necessary to bring these concepts to fruition. To date, success has been achieved in the development, test and evaluation of a variety of functional textile-based data networks for the dismounted Soldier. Examples of network protocols that have been successfully prototyped include USB 2.0, Gigabit Ethernet, serial, SMBus, and I2C. These demonstrations have shown that while etextiles can be used to form effective data networks, they behave differently than traditional theoretical models or empirical guidelines would indicate due to their unique composition and structure. Standard models used for designing strip lines and cables do not accurately predict the impedance characteristics of etextile materials. The connectors used for these networks, and the methods used to connect them to the etextile also have unique impedance characteristics. Line impedance is one of the main components of cable design and it's a driving factor when designing for high speed data. The higher the data rates, the tighter the tolerances become for all design parameters.

Currently the process of designing etextile data networks relies on laboratory experimentation to achieve the desired performance which is time consuming and expensive. The development of new models and design tools are desired that accurately predict the impedance and other performance characteristics necessary to quickly build these networks. The development process will include the investigation of the composition and structure of etextile networks and related state-of-the-art materials to characterize and understand the impact of these components on impedance. In addition, the influence of dielectric and shielding materials, connectors, and connector interface media will also be evaluated and characterized. The resulting modeling and design tools are necessary to support early prototyping, testing, and touch points with Soldiers from the operational force to help ensure that solutions generated are the right ones. Ultimately these models will feed into advanced manufacturing methods and processes and will be incorporated into system design, development, production and sustainment.

PHASE I: The Phase I awardee shall determine the technical feasibility to develop new design tools and guidelines, including but not limited to, a signal line impedance model to be based on a combination of first principles and empirical data. Using this new conceptual capability, proof-of-concept bench-scale data networks will be designed, fabricated and evaluated. At the conclusion of this Phase I effort, the awardee will deliver a tangible proof-of-concept network demonstration article, conceptual impedance model and design tools, and survey of shielding options.

PHASE II: Improvements will be made to the conceptual model and design tools using data collected and lessons-learned. Using these tools, methods for improving the impedance characteristics of etextile networks will be developed and evaluated in an iterative process and ultimately validated. The electronic textiles shall handle various communication protocols (USB, SMBUS, etc.) without signal degradation or loss of data that is comparable to current cable technology.

Weight: Same or lighter (for similar length)

Amperage: Same or better
Efficiency (η): Same or better
MIL-STD-810: Same or better
MIL-STD 461: Same or better

Working with Soldier Center and PM-Integrated Visual Augmentation System (IVAS) subject matter experts, the contractor shall identify a suitable system that can be used to demonstrate the capabilities of these component networks in a relevant setting. The finalized and validated impedance model, design tools and related software will be delivered. Etextile networks sufficient for three prototype systems shall be fabricated and evaluated through a combination of bench-top and EMI chamber testing prior to delivery to the Government. Following delivery of the fully functional and shielded etextile networks, the contractor will support testing and evaluation activities in a relevant setting.

PHASE III DUAL USE APPLICATIONS: The successful completion of the Phase II effort will provide a detailed understanding of how the complex architectures embodied in etextiles affect network impedance and how these unique properties can be used to extend the state-of-the-art in wearable network design. This knowledge will facilitate the rapid and efficient development of future etextile networks that reduce system weight and bulk, eliminate snag hazards, allow electronic capabilities to be hidden in plain sight, and cost less than current cable technology. Commercial applications include physiological status monitoring for first responders and athletes, general wearable electronics, electric vehicles, telemedicine, and gaming for the entertainment industry. Military examples include the use of the electronic textile impedance modeling software to develop new and improved etextile cables and networks for Nett Warrior and IVAS applications that are lighter weight, have reduced number of components, can be easily integrated within the Soldier System, and are less expensive to manufacture

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KEYWORDS: Impedance, models, wearables, etextiles, smart textiles, personal area network

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A22-015 TITLE: EXOJUMP - Conformal Exoskeleton to reduce parachute landing force and jump injuries

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/Machine Learning

TECHNOLOGY AREA(S): Human Systems

OBJECTIVE: Develop an exoskeleton system that mitigates Parachute Landing Forces (PLF) experienced by Warfighters with the goal of reducing injuries. The system can be active or passive, reusable or disposable.

EXOJUMP would form a system of body-worn sensors that collects real-time data on the biomechanics of para-jumping. The information from the sensor system (or exoskeleton system with embedded sensors) would be used in two ways: build either a passive or active exoskeleton that mitigates PLF forces; provide unit training insight and feedback to Warfighters and Military Units to inform proper or dangerous landing techniques. This will garner new training metrics to indicate landing risk level and highlight other problem areas of concern.

A secondary objective of the system is to provide load carriage and mobility support to the Warfighter pre-jump by assisting them move with a full load to the aircraft and post-jump to rapidly exit the landing zone.

DESCRIPTION: Combat parachute jumping is a high-risk endeavor with a significant potential for injuries or death in rare cases. The risk is exacerbated by the heavy and voluminous weights Warfighters carry while jumping and environmental conditions such as night-ops, wind, and terrain. Injuries require time and resources to resolve which slow the unit down and increases their risk of being attacked.
The current T-11 parachute jumps at 400 lbs all-up-weight (AUW) and has a vertical velocity of 18 feet per second (ft/s) and a horizontal velocity (due to side winds) up to 13 knots which increases the parachute landing force (PLF). Increasing a T-11 AUW to 450 lbs increases the PLF to over ~21 ft/s. This is akin to jumping off a 9 to 12-foot truck while moving at 15 miles per hour.

The EXOJUMP will mitigate the PLF and significantly increase the likelihood of a safe landing.

System Features:
- Mitigates PLF (resulting in lower risk of injuries and/or death)
- Passive or active
- Disposable or re-useable
- Does not hinder the jump mission in any way
- Jump-safe with no snag-hazards (note that Warfighters tape over the eyelets of their boots so that they will not become snag hazards)
- Donned in minutes, doffed in seconds
- Air worthy: if active, appropriate levels of EMI
- Other Desired Features
- Active sensors that record, process, and inform the user about the unique forces on individual Warfighters as they participate in the jump
- Artificial intelligence or machine learning that can actively sense and respond to optimize the system in real time so that a safe landing is assured
- Assists Warfighters as they move with their jumping load on and about the aircraft
- Assists Warfighters as they get off the landing zone

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PHASE I: EXOJUMP should deliver up to three factors, the ability to improve paratrooper aircraft exits, understand and reduce the parachute landing force, and an increase in the Unit and Warfighters' ability to move upon ground arrival. The EXOJUMP would compose a conformal system that reduces snag hazards and weight critical to a jumping system and an artificial intelligence that recognizes, responds, and reduces the PLF to an acceptable level on all types of terrain by applying biomechanical knowledge to a critical issue. Identify technology and capability gaps to show how the technology can be developed into a TRL 5/6 prototype at the end of Phase II. Demonstrate or describe in engineering terms how the technology would be used in the field and any required safety issues or concerns to support user operational use in Phase II. EXOJUMP is a new novel application of exoskeleton system and should increase training knowledge and potential to reduce PLF injuries by 25%. The metric is tied to the ability to capture the real time jump forces, then apply the knowledge to reduce the PLF and help train the Warfighter.

Phase I deliverables include:

- Monthly reports
- 1 System mockup and digital model
- A final technical report describing
    - Development and testing of the technology
    - Technology risks, gaps and recommendations
    - Estimated cost in production
- Demonstration of the state of the art of the technology

PHASE II: The EXOJUMP effort will use 2 Warfighter touchpoints, actual unit data with 82nd Airborne and USAF assets to quantify the efficacy of the system and reduce system development risk. A capstone event would require jump certification of the base system that will transition to MATDEV at a TRL 6 (real world experimentation). Show how technology could potentially be available for scaled production in 3 years (FY25). Eight (8) EXOJUMP systems will be evaluated (location TBD - Yuma Proving Ground or Nellis AFB, NV)

Phase II deliverables include:

- Monthly reports
- Training information, safety assessment, health hazards, and human use
- Demonstration of the state of the art of the technology
- A final technical report describing
    - Development and testing of the technology and training material
    - Technology gaps and recommendations for future work
    - Estimated cost in production

PHASE III DUAL USE APPLICATIONS: Technology could potentially be used for scaled production in 3 years (FY25). The system would increase Training, Mission Effectiveness and Readiness. Output data from the system would form a method to gain a deeper understanding of the biological systems and their response to para-jumping activities, create a system of body-worn sensors that collects real-time data on the biomechanics of para jumping. EXOJUMP effort would collect the baseline data similar to a motion-capture studio but in the real world of actual and simulated jumps. Sensors would include anatomic joint angles, accelerations, forces, and/or EMG for muscle contraction. This will increase the stresses on the user, allow us to address, and increase the speeds or loads users need to survive.

Further refine prototype to enhance reliability, reduce weight, and ruggedize to manufacture and commercialize the product at a price point that is competitive and sensible for the intended market.

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KEYWORDS: Exoskeleton, Augmentation, Musculoskeletal Disorders, Knee Joint, PLF, Parachute

VERSION 6

DEPARTMENT OF THE NAVY (DON)
22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to SBIR topics only:**
  - **N222-087 through N222-089, and N222-111 through N222-128**
- **The information provided in the DON Proposal Submission Instructions document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **DON Phase I Technical Volume (Volume 2) page limit is not to exceed 10 pages.**
- **Proposers that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposers are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.**
- Phase I Technical Volume (Volume 2) and Supporting Documents (Volume 5) templates, specific to DON topics, are available at https://www.navysbir.com/links_forms.htm.
- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON's mission can be found on the DON website at www.navy.mil.

Digital Engineering. DON desires the ability to design, integrate, and test naval products by using authoritative sources of system data, which enables the creation of virtual or digital models for learning and experimentation, to fully integrate and test actual systems or components of systems across disciplines to support lifecycle activities from concept through disposal. To achieve this, digital engineering innovations will be sought in topics with titles leading with DIGITAL ENGINEERING.

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information

Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

TABLE 2: DON SYSTEMS COMMANDS (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N222-087 to N222-089	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	sbir.admin@usmc.mil
N222-111 to N222-120	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil
N222-121 to N222-128	Mr. Michael Pyryt	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

PHASE I SUBMISSION INSTRUCTIONS

The following section details requirements for submitting a compliant Phase I Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposers are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposers are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposers submitting through DSIP for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Please refer to the DoD SBIR/STTR Program BAA for further information.

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Proposal Volumes. The following six volumes are required.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA.

- **Technical Proposal (Volume 2)**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 10 pages, regardless of page content
    - Single column format, single-spaced typed lines
    - Standard 8 ½" x 11" paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point
    - Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified. Phase I Options are exercised upon selection for Phase II.
    - Work proposed for the Phase I Base must be exactly six (6) months.
    - Work proposed for the Phase I Option must be exactly six (6) months.

  - Additional information:
    - It is highly recommended that proposers use the Phase I proposal template, specific to DON topics, at https://navysbir.com/links_forms.htm to meet Phase I Technical Volume (Volume 2) requirements.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposers are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).**
  - Cost Volume (Volume 3) must meet the following requirements or the proposal will be REJECTED:
    - The Phase I Base amount must not exceed $140,000.
    - Phase I Option amount must not exceed $100,000.
    - Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.
    - For Phase I a minimum of two-thirds of the work is performed by the proposing firm. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing firm the sum of all direct and indirect costs attributable to the proposing firm represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor (Total Subcontractor Costs (TSC)) as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator.
      - Firm Costs (included in numerator for firm calculation):
        - Total Direct Labor (TDL)
        - Total Direct Material Costs (TDM)
        - Total Direct Supplies Costs (TDS)
        - Total Direct Equipment Costs (TDE)
        - Total Direct Travel Costs (TDT)

    - Total Other Direct Costs (TODC)
    - General & Administrative Cost (G&A)

    NOTE: G&A, if proposed, will only be attributed to the proposing firm.
  - Subcontractor Costs (numerator for subcontractor calculation):
    - Total Subcontractor Costs (TSC)
  - Total Cost (denominator for either calculation)

- Additional information:
  - Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.
  - Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
  - The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award. All proposers must review and submit the following items, as applicable:
  - **Telecommunications Equipment Certification.** Required for all proposers. The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As such, all proposers must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.
  - **Disclosure of Offeror's Ownership or Control by a Foreign Government.** All proposers must review to determine applicability. In accordance with DFARS provision 252.209-7002, a proposer is required to disclose any interest a foreign government has in the proposer when that interest constitutes control by foreign government. All proposers must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized firm representative must complete the Disclosure of Offeror's Ownership or Control by a Foreign Government (found in Attachment 2 of the DoD SBIR/STTR Program BAA) and upload as a separate PDF file

in Volume 5. Please refer to instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.

- **Majority Ownership in Part.** Proposers which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

- Additional information:
  - Proposers may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposer may want to include in Volume 5:
    - Additional Cost Information to support the Cost Volume (Volume 3)
    - SBIR/STTR Funding Agreement Certification
    - Data Rights Assertion
    - Allocation of Rights between Prime and Subcontractor
    - Disclosure of Information (DFARS 252.204-7000)
    - Prior, Current, or Pending Support of Similar Proposals or Awards
    - Foreign Citizens
  - Do not include documents or information to substantiate the Technical Volume (Volume 2) (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
  - A font size smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

PHASE I EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposer has met eligibility requirements and followed the instructions for the Proposal Cover Sheet as specified in DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposer has met the following requirements or the proposal will be REJECTED:

- Not to exceed 10 pages, regardless of page content
- Single column format, single-spaced typed lines
- Standard 8 ½” x 11” paper
- Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
- No font size smaller than 10-point, except as permitted in the instructions above.
- Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified.
- Work proposed for the Phase I Base must be exactly six (6) months.
- Work proposed for the Phase I Option must be exactly six (6) months.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will only undergo a compliance review to verify the proposer has met the following requirements or the proposal will be REJECTED:
  - Must not exceed values for the Base ($140,000) and Option ($100,000).
  - Must meet minimum percentage of work; a minimum of two-thirds of the work is performed by the proposing firm.

- **Company Commercialization Report (CCR) (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy’s award decision. However, all proposers must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposer has included items in accordance with the PHASE I SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposers to consider during proposal preparation and submission process.

Discretionary Technical and Business Assistance (TABA). The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Firms may request, in their Phase I Cost Volume (Volume 3) and Phase II Cost Volume, to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase I TABA amount is up to $6,500 and is in addition to the award amount. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,800,000 or lower limit specified by the SYSCOM). As with

Phase I, the amount proposed for TABA cannot include any profit/fee by the proposer and must be inclusive of all applicable indirect costs. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project. A firm receiving TABA will be required to submit a report detailing the results and benefits of the service received. This TABA report will be due at the time of submission of the final report.

Request for TABA funding will be reviewed by the DON SBIR/STTR Program Office.

If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR proposer
- Propose a TABA provider that is the SBIR proposer
- Propose a TABA provider that is an affiliate of the SBIR proposer
- Propose a TABA provider that is an investor of the SBIR proposer
- Propose a TABA provider that is a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:

- Phase I:
  - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
  - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.
- Phase II:
  - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
  - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must NOT exceed:

- Phase I: A total of $6,500
- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

If a proposer requests and is awarded TABA in a Phase II contract, the proposer will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual DON STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A firm whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposers that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, **are eligible** to submit proposals in response to DON topics advertised within this BAA.

For proposers that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal, firms must register with the SBA Company Registry Database.
b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents (Volume 5).
c. Should a proposer become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposer must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

System for Award Management (SAM). It is strongly encouraged that proposers register in SAM, https://sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposers should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a firm is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.htm.

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposer must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: https://www.onr.navy.mil/work-with-us/how-to-apply/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed, and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the technical merit of the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests. Protests of Phase I and II selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 2. If the protest is to be filed with the GAO, please refer to instructions provided in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA.

Protests to this BAA and proposal submission must be directed to the DoD SBIR/STTR Program BAA Contracting Officer, or filed with the GAO. Contact information for the DoD SBIR/STTR Program BAA Contracting Officer can be found in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct compliance review of Volume 3 to confirm eligibility of proposer, and to take other relevant steps necessary prior to making an award.

Contract Types. The DON typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, for Phase II awards the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Funding Limitations. In accordance with the SBIR and STTR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per firm per topic. Additionally, to adjust for inflation DON has raised Phase I and Phase II award amounts. The maximum Phase I proposal/award amount including all options (less TABA) is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $1,800,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,800,000 based on available funding. The structure of the Phase II proposal/award, including maximum amounts as well as breakdown between Base and Option amounts will be provided to all Phase I awardees either in their Phase I award or a minimum of 30 days prior to the due date for submission of their Initial Phase II proposal.

Contract Deliverables. Contract deliverables for Phase I are typically a kick-off brief, progress reports, and a final report. Required contract deliverables (as stated in the contract) must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

Payments. The DON makes three payments from the start of the Phase I Base period, and from the start of the Phase I Option period, if exercised. Payment amounts represent a set percentage of the Base or Option value as follows:

Days From Start of Base Award or Option	Payment Amount
15 Days	50% of Total Base or Option
90 Days	35% of Total Base or Option
180 Days	15% of Total Base or Option

Transfer Between SBIR and STTR Programs. Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa.

PHASE II GUIDELINES

Evaluation and Selection. All Phase I awardees may submit an **Initial** Phase II proposal for evaluation and selection. The evaluation criteria for Phase II is the same as Phase I. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable) will be used to evaluate the proposer's potential to progress to a workable prototype in Phase II and transition technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

NOTE: All SBIR/STTR Phase II awards made on topics from BAAs prior to FY13 will be conducted in accordance with the procedures specified in those BAAs (for all DON topics, this means by invitation only).

Awards. The DON typically awards a Cost Plus Fixed Fee contract for Phase II; but, may consider other types of agreement vehicles. Phase II awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the firms (e.g., the DON STP).

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

VERSION 6

Navy SBIR 22.2 Phase I Topic Index

VERSION 6

N222-128 Development of Hypersonic Glide Body Deployable Antennas

N222-087 TITLE: Performance and Safety Improvement of the Li-ion 6T Battery

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR); Microelectronics

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop a safer and more sustainable Li-ion 6T battery.

DESCRIPTION: The current state of Li-ion 6T batteries is not capable of meeting Marine Corps needs. Transportability and operational safety are limited by current technology. Distributed Maritime Operations (DMO) will present operational challenges that current technology does not meet. Current batteries have not been certified for transportation; have limited (short duration) long-term storage; and has limited capability in austere environments. Weight and cost of the battery need to be reduced. This SBIR topic is intended to mitigate these shortcomings and provide the Marine Corps with a Li-ion 6T battery that can meet operational demands. The system requirements include:
• Full charge capacity (min at 1 hr. rate): 90 Ah (at 22 °C) (T); 100 Ah (at 22 °C) (O) at 18 – 30 VDC.
• Minimum shelf life of 10 years at 27°C (T); 72 °C (O). "Shelf life" is determined as the ability to provide 80% of its rated capacity after being fully charged, after storage.
• Shall not degrade to less than 80% of rated capacity in less than 4000 cycles (T=O) to a 90% depth of discharge at the C/2 rate of the battery.
• Remain at 30% of rated capacity for six months at 21 - 32 °C not to exceed 10% loss.
• The design shall address meeting the requirements of NAVSEA INSTRUCTION 9310.1C, Naval Lithium Battery Safety Program.
• Total Weight: 56 lbs (T); 44 lbs (O).
• Survivability: Must survive ballistic testing (i.e., impact of .557 caliber). Must meet SAE J2464 hazard level 6.
• Rapid Recharge – Must be able to go from 0 – 80% rated charge in 120 min (T); 30 min (O).
• Cost: $2,000/KWh (T); $1,500/KWh (O).
• Deliver 5- 10 prototypes for test, evaluation, and experimentation. TRL of 6 (T), 7 (O).

PHASE I: Develop concepts for an improved 6T battery that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones, and that addresses technical risk reduction.

PHASE II: Develop a full-scale prototype evaluation. Deliver 5 – 10 prototypes (TRL of 6 (T), 7 (O)) for test, evaluation, and experimentation, to include evaluation to determine their capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the Improved 6T Battery. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements. Provide a detailed plan for meeting NAVSEA Instruction 9310.1C. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop an Improved 6T Battery for evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

There is no dual-use application for this form factor (6T) battery beyond the DoD. However, the cell technology inside the form factor may be transferable to commercial battery applications and designs, e.g., shelf life, degraded capacity.

REFERENCES:

1. “Advanced Battery Manufacturing Technologies.” Sciligent. BAA Topic Number DLA142-001, 2014, Defense Logistics Agency. https://www.dodsbirsttr.mil/submissions/baa-schedule/broad-agency-announcements
2. MIL-PRF-32565, Compliant Battery Maintenance & Charging System MIL-PRF-32565 BATTERY RECHARGEABLE SEALED 6T (everyspec.com)
3. MIL-STD 1275E, Compliant Vehicle Charging System. MIL-STD-1275 E INTERFACE CHARACTERISTICS 28 VOLT DC (everyspec.com)
4. MIL-PRF-32143B, BATTERIES, STORAGE: AUTOMOTIVE, VALVE REGULATED LEAD ACID (VRLA). http://www.everyspec.com/MIL-PRF/MIL-PRF-030000-79999/download.php?spec=MIL-PRF-32143B.037624.PDF
5. SAE J2464_200911, Hazard Severity Level (R) Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing. f SAE International, November 6, 2009. https://www.sae.org/standards/content/j2464_200911/
6. NAVSEA INSTRUCTION 9310.1C, Naval Lithium Battery Safety Program. https://nps.edu/documents/111291366/111353854/NAVSEAINST+9310+1C+08.12.15.pdf/0f5b8c13-b5d1-4f28-b9aa-cf607a6ac1f6?t=1450394616000
7. SG270-BV-SAF-010, High-Energy Storage System Safety Manual. http://everyspec.com/USN/NAVSEA/SG270-BV-SAF-010_27APR2011_50446/

KEYWORDS: Battery; 6T; Lithium; Zero-volt; Rapid Charging; Vehicle; Safety

N222-088 TITLE: Integrated High Power Generation for the Joint Light Tactical Vehicle

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Ground / Sea Vehicles

OBJECTIVE: Develop an integrated, compact, prime engine-driven high power generation system for the Joint Light Tactical Vehicle (JLTV) that will support both onboard and export electrical power capabilities while fitting within the confines of the chassis to meet expected power demands and allow for future mission growth.

DESCRIPTION: The JLTV is currently capable of generating between 12.8-14.6 kW of electrical power and while this capability allows for future vehicle system growth, it is insufficient to support future systems. Currently the system is limited by the onboard power capability of the JLTV, forcing us to either accept a reduced capability or carry an additional standalone generator. These approaches unnecessarily restrict capability and/or complicate the mission by reducing mobility, fuel efficiency, reliability, and cargo capacity. Vehicle integrated power generation systems will be needed to power future Missile and Air Defense systems, Counter Unmanned Arial Systems (C-UAS), and Command and Control (C2) systems without burdening the mission with standalone generators.

The system requirements are:

- Integrated electrical power generation system kit driven by the existing JLTV General Motors Duramax 6.6L Turbodiesel V-8 engine
- Power output of 50 kW Threshold (T); 70 kW Objective (O), at 28 volts direct current (VDC) while stationary and on the move
- Stationary power output shall not require the engine to exceed tactical idle (1800 RPM)
- Compatible with 28-VDC tactical electrical systems and 14-VDC vehicle electrical systems
- Physical size of generator no larger than 11”H x 11”W x 16”D
- Physical weight of export power system less than 225 lbs.
- Operate in hot and cold mission environments between -40°C to 52°C
- Operate in a JLTV environment to include: Primary Roads, Secondary Roads, Trails and Off-Road / Cross-Country.
- Electrical component and connections shall comply with MIL-STD-810H where appropriate and have an ingress protection rating of IP67 or higher in accordance with American National Standards Institute (ANSI) International Electrotechnical Commission (IEC) 60529-2004
- Initial quantities for these systems is approximately 66, but could be higher if other Marine Corps platforms and other services decide to use this capability.
- Quantities will also depend on the cost of the conversion kit estimated to be between $50K and $75K.

PHASE I: Develop concept(s) for a generator technology and its supporting control equipment that can meet the system requirements in the Description. Demonstrate the feasibility of the concept(s) in meeting Marine Corps needs. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and/or analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones, and that addresses technical risk reduction.

PHASE II: Develop a full-scale prototype for evaluation. Evaluate the prototype through bench or lab testing to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirement for the integrated power generation system. System performance shall be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluate the results of the demonstration and refine the design as necessary. Conduct on-vehicle testing in a relevant environment. Evaluate and compare the results to Marine Corps requirements. Prepare a Phase III development plan to transition the technology for Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Provide support to the Marine Corps in transitioning the technology for Marine Corps use. Refine a power generation system for further evaluation and determine its effectiveness in an operationally relevant environment. Support the Marine Corps test and evaluation program to qualify the system for Marine Corps use.

Commercial applications include law enforcement vehicles, search and rescue vehicles, tractor trailers, and general automotive platforms to provide integrated power capability and reduction of both weight and space claim, supporting a more demanding future mobile power environment.

REFERENCES:
1. “MIL-STD-1275E Characteristics of 28 Volt DC Input Power to Utilization Equipment in Military Vehicles.” U.S. Army Tank automotive and Armaments Command, March 22, 2013. https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=36186
2. “MIL-STD-1332B Tactical, Prime. Precise, and Utility Terminologies For Classification of the DoD Mobile Electric Power Engine Generator Set Family”. Naval Facilities Engineering Command, Naval Construction Battalion Center, March 13, 1973. https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=36687
3. “MIL-STD-705D Mobile Electric Power Systems”. Communications Electronics Research Development Engineering Center (CERDEC) Product Realization Directorate (PRD), November 22, 2016. https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=35902
4. “ANSI/IEC 60529-2004 Degrees of Protection Provided by Enclosures (IP Code)”. https://www.nema.org/Standards/ComplimentaryDocuments/ANSI-IEC-60529.pdf

KEYWORDS: Tactical Vehicle; Power Generation; Integration; Joint Light Tactical Vehicle; JLTV; Exportable Power; Onboard Power

N222-089 TITLE: Celestial Navigation System for Long Range Unmanned Surface Vessels

OUSD (R&E) MODERNIZATION PRIORITY: Autonomy; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Battlespace Environments;Electronics; Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an optical celestial system (CNS) to provide position and timing updates to an inertial navigation system on a Long Range Unmanned Surface Vessel (LRUSV) during day and night.

DESCRIPTION: The LRUSV is a 40-foot autonomous boat designed to operate at ranges up to 1,000 nautical miles and launch loitering munitions to engage enemy targets afloat and ashore. The LRUSV must maintain accurate knowledge of position and time for navigation. During hostilities, reliance on GPS is ill advised as GPS can be degraded, denied, or spoofed. The size of the LRUSV will not permit the use of a purely Inertial Navigation System (INS) and therefore the INS will require periodic updates. Use of active sensors can disclose the vessel’s location.

Celestial Navigation (CELNAV) is a technique which has been around for hundreds of years. Traditional CELNAV does not provide the accuracy required for LRUSV’s mission. Recently, the U.S. Navy demonstrated that optically tracking satellites, combined with CELNAV, provides a high accuracy system which functions both day and night. However, that system’s size is far too great for LRUSVs.
A CNS will provide position updates to the LRUSV’s INS as available. It will function in Wilbur Marks Sea State 3 conditions, and function day and night. It will provide an accurate estimate of position errors and operate without any user input. It is desired that the CNS also provide time updates to the INS. The CNS does not have a firm size requirement; however the CNS must be smaller than the Navy’s ACNS which is 1 cubic meter topside plus a 5U computer rack.

The CNS is not required to optically track satellites in addition to celestial objects; candidate CNSs without this ability will be considered. Optically tracking satellites to provide improved accuracy when combined with celestial measurements is permitted. The CNS will be purely passive. The use of satellite RF signals to determine position is not permitted for this system.
While the CNS is not expected to provide position and time updates in all weather conditions; the use of infrared imagers, expanding the field of view, and other methods can increase system availability.

PHASE I: Develop concepts for the CNS, which includes models permitting system trades to be evaluated by the program office. The system trades include accuracy and availability (due to cloud cover) as well as size, weight, power, and cost. Position accuracy of less than 100 meters is desired.

Demonstrate the feasibility of the concepts in meeting Marine Corps needs. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones, and that addresses technical risk reduction.

PHASE II: Develop a scaled prototype. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for the CNS. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters, including numerous deployment cycles. Refine the prototype, based on evaluation results, into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop the CNS for evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

The potential for commercial and dual-use is significant. Improved CELNAV provides a backup to GPS and other Global Navigation Satellite Systems. CELNAV, which is small enough for a 40-foot vessel, is applicable to many other manned or unmanned vehicles, such as larger sea vessels, aircraft, and ground vehicles. The CNS can be utilized by law enforcement to maintain UAV surveillance if GPS is jammed.

REFERENCES:

1. United States Government Accountability Report to the Committee on Armed Services, U.S. Senate, May 2021 “Technology Assessment – Defense Navigation Capabilities.” https://www.gao.gov/assets/gao-21-320sp.pdf
2. Kaplan, G. H.: "Angles-Only Navigation: Position and Velocity Solution from Absolute Triangulation", Navigation, Vol. 58, No. 3,2011, pp. 187-201. https://gkaplan.us/content/nav_by_angles_ION_v5.pdf
3. Wilbur Marks Wind & Wave Scale - https://navysbir.com/n22_2/N222-089_REF_3_Wilbur_Marks_Wind_and_Wave_Scale.pdf

KEYWORDS: Celestial Navigation; Satellite Tracking; Inertial Navigation; Autonomy; Long Range Unmanned Surface Vehicle; LRUSV

VERSION 6

[Navy topics numbered N222-090 through N222-110 removed from the 22.2 SBIR BAA ahead of the Pre-release date of April 20, 2022.]

VERSION 6

N222-111 TITLE: Advanced Manufacturing of Piezoelectric Textured Ceramic Materials

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes;Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a low cost and high yield manufacturing method to fabricate textured piezo-ceramics for low frequency and high power underwater projector applications.

DESCRIPTION: Recent development of lead based piezoelectric textured ceramics, which have electromechanical properties between those of conventional PZT and relaxor crystals, has shown promise of improving acoustic transducer performance, relative to Navy Type III PZT. These materials have a high texture fraction (> 98%), a high d33 (> 600), and a loss factor of less than 10-2. The unique properties of textured ceramics have made it a material candidate for several Navy compact sonar systems, such as A-size sonobuoys. Given that sonobuoys are expendable sensors that require low per unit cost and high rates of production, it is in the Navy's best interest that the cost of manufacturing textured ceramics is comparable (< 2X) to that of traditional PZT. This SBIR topic aims to support the emerging innovations in ceramics manufacturing with the potential to result in a high rate and high yield textured piezoelectric ceramics production line with a per unit cost comparable to traditional ceramics manufacturing.

PHASE I: Demonstrate with models, simulations, analyses or laboratory test results the viability of developing, through innovations in manufacturing processes, a 2X improvement in expected material yield for PZT ceramic material. The selected materials must be suitable for use in systems that use Navy Type III lead zirconate titanate. The improvement in expected yield should be measured relative to the vendor's current expected yields in production quantities. Develop a Phase II plan for implementing and demonstrating the proposed innovations into a prototype production system.

PHASE II: Develop the proposed prototype and demonstrate its viability for laboratory scale small batch production. Develop a plan for implementing the method at pilot scale production and demonstrating scalability from laboratory/benchtop results.

PHASE III DUAL USE APPLICATIONS: Successful development of this innovation is expected to increase incorporation of textured ceramic materials into Navy and commercial applications, such as sonar systems and medical devices, requiring high output or broadband piezoelectric devices.

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KEYWORDS: piezoelectric; textured ceramic; transduction; affordable; PZT; acoustic projector; SONAR

N222-112 TITLE: Low-profile High-Frequency Maritime Antenna

OUSD (R&E) MODERNIZATION PRIORITY: Networked C3

TECHNOLOGY AREA(S): Electronics; Sensors

OBJECTIVE: Design, construct, and test a high-gain 1.5-35 MHz transmit/receive antenna to be utilized on small, low free-board maritime craft.

DESCRIPTION: Traditional High Frequency (HF) antennas are physically large and generally instantaneously single-banded for low Voltage Standing Wave Ratios (VSWR) in order to match requisite operating frequencies. For small maritime crafts such as an unmanned surface vehicle operating at or slightly below the waterline, a large tall antenna is unfeasible due to the craft's small available footprint and a traditional monopole antenna's high center of mass would affect the craft's stability. Vertical incidence ionospheric measurements are obtained with horizontal dipole antennas. These antennas are horizontally polarized and must be instantaneously wideband supporting VSWR below 1.5:1 from 5-20MHz and better than 2:1 from 3-35MHz. Active loop antennas can provide sufficient receive signal gain but inherently become limited in their ability to transmit energy at high power due to the tuning circuitry.

PHASE I: Design and develop a concept for a lightweight low center of mass maritime antenna that achieves the technical goals in the Description. Prepare a Phase II plan.

PHASE II: Construct a HF antenna prototype. Test the prototype for a multi-week long duration in a maritime environment across the HF spectrum to assess performance of the system.

PHASE III DUAL USE APPLICATIONS: Transition the system via a maritime platform integration of the antenna for HF communications. The commercial sector uses HF communications as a back-up for SATCOM so this antenna could support those applications in shipboard environments.

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KEYWORDS: antenna; high frequency; maritime

N222-113 TITLE: Interoperable Toolbox of Run Time Reconfigurable Digital Signal Processing Modules

OUSD (R&E) MODERNIZATION PRIORITY: 5G; Microelectronics;Networked C3

TECHNOLOGY AREA(S): Electronics; Information Systems; Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Situational Awareness (SA) system that combines all classes of commercial off-the-shelf (COTS) digital processors and record capability.

DESCRIPTION: SA systems strongly need the ability to quickly sense and adapt their priorities to changes in the battle space environment which are expected to evolve much more quickly in the future than in the past. Both the mix of signals present and the details of the waveforms utilized are expected to change. Both because understanding new signals is more processor intense than standard signals and cost pressures favor minimal processing power, it is critical to optimize processor utility if the user is not to be surprised by unrecognized threats. This SBIR topic focuses on the design of the processing control system. It assumes that all 3 types of COTS Digital Signal Processing (DSP) modules will be present and that the GOTS processing modules will have different computational efficiencies and latencies on each kind of hardware. Independent of the system’s size scale and hardware (HW) blend, a facile way of altering the allocation of processing resources among the different signals of interest (SOI) as the situation evolves is needed. In particular, the Navy seeks development of a cost function for use in AI-based system control algorithms which reflects both the effectiveness of a particular processor in addressing a specific class of SOI and the current importance of that SOI to the outcome of the battle. The latency and energy costs of changing the HW class used needs to be included and minimized wherever possible. Moreover, within every processing module for each class of SOI, the ability to respond to an interrupt signal and reconfigure its processing for a new SOI is essential. A way to quantify each module’s degree of completion of a given processing task and alternatives to simple dropping all partially completed results are desirable to invent.

Proposals should include tasks to Architect and demonstrate a Situational Awareness system which combines all classes of COTS digital processors and record capability. Include branching routing and fan-out that is conditional and based on the content of signal data, interrupt driven partial reconfiguration (alteration of the algorithmic instructions as well as data), and during operation updates to signal processing parameters. Develop one or more cost functions for the optimization of the realized processor loading that incorporates the operational priority of each class of signal being worked, the degree of completion of processing likely achieved by a given allocation of processor resources, and a measure of the operational cost of all the signals and tasks ignored for lack of sufficient system processing capacity. The planned system should in all cases be compatible with scaling to handle 1,000 simultaneous signals received by a multi-bit 20 GHz Nyquist band receiver front end.

• At the threshold level of performance and in actually planned demonstrations, focus on a system limited in total power to 5 KW and constrained to a processor volume of 18x18x26 inches. If active cooling fits within the energy budget, it may be considered.
• At the objective level of performance, design a 100 KW system and define all alterations necessary to complete the processing if 50% of the information comes from the partially digested results delivered from off-board systems (versus response to new real time information).

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: During the base period, elaborate the proposed architectural structure into a notional 3 class of processor system design at the threshold level of complexity and develop the requested adaptive performance-based cost function for it. Determine a strategy for handling reassignment of a SOI between the HW classes. Determine technical risks. If the Phase I option is exercised, perform validation studies of the modules designed for scaling system capacity on the proposed example set of signals. Prepare and provide a Phase II plan.

PHASE II: Develop and demonstrate a prototype product threshold scale adaptive processing system during the base award. Develop a plan for an objective scale system. Retire one or more technical risk items. If the Phase II option is exercised, demonstrate the scale system the cost-share sponsor wants to realize and experimentally test.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Perform field validation of the delivered hardware. Test its performance advantages. The cost function could be used to design optimal processors for specific signal systems.

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VERSION 6

KEYWORDS: Field Programmable Gate Arrays; Graphical Processing Units; central processing units; rates for data loading; energy efficiency of processing; processing latency; cost functions in Artificial Intelligence/Machine Learning; router architectures

N222-114 TITLE: Modern Integration/Application Techniques for Resilient Riblets

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platforms; Materials / Processes; Weapons

OBJECTIVE: Develop methods to produce accurate riblet profiles in outer mold line (OML) surfaces that yield significant drag savings (> 5%), require little or no maintenance or cleaning, are inexpensive to apply or to include in production or normal maintenance, and achieve long useful life (> 5 years), yielding fuel cost savings and extended range for USN aircraft.

DESCRIPTION: Riblets are inverted V-shaped grooves that have been proven to reduce viscous (friction) drag approximately 5 to 8%. The inverted groove patterns have heights on the order of 50 microns with the width typically equal to or less than the height, and can be adjacent to one another or spaced laterally to maximize performance. Drag reduction is optimal when they are flow aligned, but performance is tolerant of misalignment up to 10 to 15 degrees. Moreover, riblet profiles may be constant or three-dimensional, with variable peak heights and/or groove direction.

Prior efforts to implement riblets on commercial aircraft focused mainly on plastic films and suffered from high initial cost and short lifetimes, thus negating economic benefits. This SBIR topic seeks development of a system for accurately producing a variety of riblet-like shapes into the OML of USN aircraft. It must be cost-effective so that the fuel saved due to drag reduction is not significantly offset by production cost. Likewise, the resulting OML should be maintainable and have long life (> 5 years). The prototype system can be a film but must be compatible with Navy requirements and durable in the maritime environment. A prototype may be developed that produces the final shape in the paint/topcoat. This can be done with photo-curable paint or rapid curing of shaped paint; alternate means of production are encouraged. Compatibility with Navy topcoat requirements must be considered.

Drag-reduction performance is sensitive to geometric features of the riblets. Height and spacing within 10% of the desired design are sufficient, but height and spacing should not vary rapidly in the streamwise direction from design specifications. The peak of the profile must be sharp. Radius values should not exceed 5% of the riblet height. The system should allow production of the riblet shapes in the local flow direction when the aircraft is flying at best range, cruise conditions. This could be accomplished through smooth changes in the riblet direction to match known or predicted local flow direction or step changes, so long as the profile alignment can be maintained with the nominal flow direction within 10 degrees.

PHASE I: Define and develop a concept for a system to produce riblet shapes in the OML of USN aircraft that can meet the performance requirements listed in the Description. Perform high level modeling that demonstrates the feasibility of the manufacturing concept and clearly defines a path to meeting the requirements outlined in the Description. Based on the modeling results or initial prototype testing, develop plans for a Phase II prototype that is expected to meet the requirements.

PHASE II: Produce prototype hardware based on experiments or modeling results and initial plans created in Phase I. Demonstrate production of riblets with the prototype system. Depending on technology maturity, perform riblet production demonstrations that could focus on both conventional and/or more complex three-dimensional geometries for improved performance. Production demonstration can be done on flat coupons as small as 12”x12”, though scale-up issues should be considered. Validate that the riblet geometry produced by the prototype system meets the requirements in the Description. This could be done with laser profilometer or scanning electron microscope measurements. Conduct low-speed wind tunnel testing or other low-cost drag testing. Measure the aerodynamic drag reduction achieved with the completed coupon or multiple coupons. Complete larger panel testing and subsequent wind tunnel testing at flight conditions that match those of Navy aircraft flight profiles, focused on cruise conditions. Develop plans for integration of the prototype into a system for creating large areas of riblets on surfaces with complex curvature. Integration issues should include consideration of aircraft surface normals that may have any direction relative to gravity (e.g., upper surfaces, lower surfaces, and vertical surfaces).

PHASE III DUAL USE APPLICATIONS: Integrate the prototype from into a system for application to large surface areas with complex curvature. Maximum aircraft surface area coverage is a goal, but 100% coverage is not expected or required. The prototype system should be designed to cover sufficient area of a Navy aircraft to produce measurable drag reduction. Deliver a prototype to the Navy for production of riblets to use on a flight test aircraft.

Reynolds number and Mach number at cruise conditions for Navy aircraft and commercial airliners are very similar. As an example, the P-8 Poseidon operated by the USN is a derivative of the Boeing 737 commercial airliner, which is one of the workhorses of the current commercial aviation fleets worldwide. Benefits to the commercial sector would be similar, if not greater, to the benefits to the Navy. Commercial and military ships may also benefit as riblets can be applied to reduce the friction drag produced by a ship moving through the water, though maintenance issues are expected to be more difficult and OML requirements will be significantly different.

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KEYWORDS: riblets; drag reduction; photo-curable paint; photo-curable film; increased range; tactical aircraft

VERSION 6

N222-115 TITLE: Quiet Auxiliary Propulsion Unit for Combatant Craft

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Ground / Sea Vehicles

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a rugged, quiet, transom-mounted, retractable electric propulsion system for high-speed planing craft - Special Operations Craft – Riverine (SOCR).

DESCRIPTION: Recent design studies provide operational and technical justification for the performance parameters listed in this Description for the quiet APU. Proposers will be expected to minimize the vibro-acoustic source level of all components of the propulsion system; however, specific (classified) performance parameters will not be provided. ONR will support acoustic testing of an outfitted SOCR under a separate R&D program. The test platform SOCR will be provided by the Government.

• The APU system shall provide a minimum thrust at varying speeds as indicated below:
Speed (kts) 3.5 4.0 4.5 5.0 5.5
Thrust (lb) 113 338 553 725 890
• The propeller/impeller shall be designed to minimize underwater acoustic noise and eliminate cavitation.
• The thruster system must be able to provide reverse thrust (or rotate) sufficiently to provide 2 kts reverse speed.
• Thruster, transom mounted with a quiet, automated deployment/retraction mechanism
• Steering controls will be provided by the proposer (e.g. via joystick)
• Drive motor and controller with drive frequency and primary harmonics greater than 50 kHz.
• A portable electrical storage system (ESS) will be provided by the proposer for temporary installation on the target platform for the purpose of all performance trials and should have the capacity to propel the platform at 5.5 kts for approximately 4 hours on a single charge.
• The system shall be acceptable for use in various harsh marine environments, and be capable of continuous operation in 0-45°C seawater.
• The system (retracted) will be capable of handling dynamic shock loads frequently experienced by small craft during operation (6.0-7.0 G's depending on vessel operation parameters).
• The system shall be constructed from materials acceptable and proven for use in marine/offshore applications using galvanically compatible materials to minimize corrosion to ABS standards.
• The APU system must be designed to minimize weight and space because deck and transom space as well as weight margins on target platforms are extremely limited.
• All seals and bearings will be capable of operating without deleterious effects in bodies of water with high levels of turbidity, silt, and sand.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Demonstrate the capability to design, build, and assess an advanced propulsion system through a parametric study on propulsion efficiency, cavitation performance, materials/weight, and vibration for every component in the drive train from controller to prop. Employ state-of-the-art design and performance analysis tools such as Computational Fluid Dynamics (CFD) tools, FEM, etc. but may also rely on historical performance databases in conjunction with the computational efforts for all components under consideration by the performers. Demonstrate capability through validation of their computational/empirical design and analyses by comparing with well-documented experimental data.

The cost estimate for travel (as detailed in the Navy Instruction for this BAA in under the Cost Volume heading) will be for the Norfolk, VA area. It is estimated that travel to Norfolk, VA will take place at the start of the Phase I award.

Prepare a Phase II plan.

PHASE II: Revise and refine the system designs. Fabricate a proof-of-concept demonstrator (vendor-designed power and drive train) to be installed and tested on a SOCR (Note: U.S. Navy personnel will participate in these tests so that multiple Phase II systems can be evaluated.) Test for thrust, speed, endurance vs payload, and acoustic trials in protected (SS0) conditions on a test platform provided by ONR during the demonstration period. Acoustic trial data will be classified as they will be performed on Navy platforms.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

Commercial Impact: It is highly probable that a rugged deployable electric propulsion system would find a strong market in the commercial and sport fishing sectors where current “trolling motors” are cumbersome to attach and deploy, and are easily damaged in harsh physical environments. In addition, for pleasure craft, the additional sea keeping control achievable with auxiliary electric drive would make harbor navigation and docking much safer, and quieter. Many boat makers are already experimenting with related technologies.

PHASE III DUAL USE APPLICATIONS: Further refine, re-fabricate, and demonstrate the system under conditions exceeding those in Phase II. Phase III testing will include higher sea-state performance, vibro/acoustic measurements, and impact/debris testing. If successful, the technology vendor could add their product to the GSA Federal Supply Schedule as Militarized-Off-The-Shelf (MOTS) technology.

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KEYWORDS: Electric propulsion; cavitation; vibration; efficiency; motor; controller; acoustic; Rigid Hull Inflatable Boat; 11m RHIB; Special Operations Craft – Riverine; SOC-R

VERSION 6

N222-116 TITLE: Tunable, Repeatable, Calcium Lanthanum Sulfide Ceramic Powder Development

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR);Hypersonics

TECHNOLOGY AREA(S): Materials / Processes;Sensors; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a process to manufacture Calcium Lanthanum Sulfide (CLS) powder suitable to provide a starting material for producing optical ceramics.

DESCRIPTION: Since the 1970's sulfides of the general formula AB2S4 have been considered as possible optical materials. Work in the 1980's done in the United States and Great Britain specifically considered applications for CaLa2S4 as an infrared transparent aperture material [Ref 1]. At that time, the difficulty that has inhibited the development of CLS as an optical ceramic material was stated as: "Reproducibility of the product remains a problem, which is thought to be a result of variability of the powder. However, measurable properties of the powder which can be used to predict if a particular batch of powder will give a good ceramic piece have been impossible to identify." [Ref 2]

Current interest in CLS is motivated by the desire to (a) revisit basic research investigations into its high temperature optical and mechanical properties [Ref 3], and (b) to perform applied research into its application as a material for multi-band optical components with complementary chromatic dispersions [Ref 4]. The literature has a number of reported synthetic processes, but typically these are at a TRL2/MRL2 laboratory proof of concept level. It is the goal of this SBIR topic to mature a CLS optical ceramic powder-manufacturing process to TRL4/MRL4. This level of maturity should encompass providing both highly consistent CLS powder for an Acquisition Program of Record and providing the capability for tuning the CLS powder for basic research [Refs 5, 6].

The CLS powder-manufacturing process must lead to consistent powder properties across multiple lots of powder delivered, with well-understood powder characterization metrics linked to optical and mechanical performance of fully dense coupons and optical component prototypes. The CLS powder-manufacturing process must also be tunable allowing for the controlled variation of powder stoichiometry and physical characteristics to permit the refinement of the optical and mechanical properties of fully dense coupons and component prototypes. The fabrication of fully dense coupons and component prototypes is outside the scope of this SBIR topic, but powder manufacturers shall work with third party fabricators to exchange technical information that will lead to an evaluation of the repeatability and tunability of delivered powder lots.

PHASE I: Develop and/or demonstrate method(s) for synthesizing high purity CLS powder that is suitable for densification to maximize optical performance. Develop powder characterization metrics and measurement procedures for attributes such as stoichiometric composition, particle size and morphology, rheological properties, etc. Demonstrate the relation between intended Ca:La stoichiometry and measured stoichiometry and any replacement of sulfur by oxygen. Demonstrate the repeatability of obtaining an intended stoichiometry. Collaborate with a third party participant who will produce fully dense optical coupons/parts from the synthesized powders. Deliver to the Government (1) an initial minimum 50g sample powder, at a date within the Phase I period of performance (PoP) as projected by the proposer and (2) a single lot of 500g powder at the end of the Phase I PoP. These powder deliveries will be used by the Government to support third party coupon fabrication and subsequent material characterization and testing. Participate in a kick-off meeting at the Central Florida Tech Grove in Orlando, Florida [Ref 7] and in regular monthly telecons, which could bring together one or more third parties in addition to the Government and could include other optical industry fabrication and finishing houses, optical system design and manufacturing companies, as well as university and Government lab participants. Schedule a meeting at the end of Phase I, to include a tour of the powder manufacturing facility. Deliver a rough order of magnitude cost estimate for a notional, but viable, scale-up plan of the process to (a) 5 kg/month and (b) 50 kg/month capacity, noting any capital equipment costs, monthly labor costs, and a quality control plan for key powder metrics that document the repeatability of powder properties. Prepare a Phase II plan.

PHASE II: Participate in a Phase II kick-off meeting at the Central Florida Tech Grove in Orlando, Florida [Ref 7] and participate in regular monthly telecons, which could bring together one or more third parties in addition to the Government. These meetings and telecons could include other optical industry fabrication and finishing houses, optical system design and manufacturing companies, as well as university and Government lab participants. Modify CLS powder attribute metrics to meet needs of third party coupon/part fabricator based on meeting/teleconference outcomes, including quantification of Ca:La stoichiometry and efforts to quantify oxygen content within the sulfide. Deliver to the Government two 500 g lots (with modified metrics if required) to demonstrate tunability of the process. Subsequently to demonstrate repeatability of process control, deliver to the Government four 500 g lots with consistent, agreed upon, powder attribute metrics, based on the prior two 500 g lots.

PHASE III DUAL USE APPLICATIONS: Potential dual use applications may include optical windows on infrared sensing equipment, supporting optical components for various infrared lasers on medical equipment. Could also lead to further miniaturization of forward-looking infrared cameras for manufacturing advancements. Material may also be considered as a durable replacement material for zinc sulfide.

In partnership with a commercial or Government program, tune the powder metric attributes and scale-up repeatable CLS optical ceramic powder production to support the manufacture of prototype and commercial optical components.

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KEYWORDS: optical material; ceramic; powder; Long Wavelength Infrared; LWIR; Calcium Lanthanum Sulfide; CLS; high temperature material

VERSION 6

N222-117 TITLE: AI/ML for Additive Manufacturing Defect Detection

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence (AI)/Machine Learning (ML)

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop Artificial Intelligence/Machine Learning (AI/ML) based software tools to help identify additive manufacturing (AM) defects from in-situ sensor-based data. Capture sufficient process control and monitoring data in real-time to later on, through AI/ML analysis, help improve the reliability, speed, and cost of post processing inspections by knowing where and what to look for ahead of time.

DESCRIPTION: There is continued advancement in the use of in-situ sensing in metal AM processes. This includes the use of in-situ sensor data to help develop stable AM process windows and more recently the use of sensors to help control the AM process through feed forward control or other real-time adaptive control methodologies. Advanced sensing capabilities for metal AM includes cameras and sensor arrays with increased temporal and spatial resolution, and cameras with adaptable fields of view and broader thermal sensing range. Advances are taking place not just in the specification of the sensor arrays used, but also on the types of sensing modalities incorporated into the AM process chamber. Aside from the more traditional infrared (IR) and visual infrared (VIS) cameras mentioned previously, other sensor types include optical emission spectrometers, acoustic and vibration spectral sensors, laser profilometers, and others. Additionally, sensors within the AM system may include power monitoring, galvo locations, oxygen monitoring, etc.

Despite all the progress achieved in process monitoring and control to improve the quality of metal AM parts, very little progress has been accomplished in intelligently fusing all the data collected during the AM process to help reduce the cost and increase the reliability of post-fabrication nondestructive evaluation (NDE) techniques. In particular, X-Ray Tomography remains the gold standard for AM part inspections, though it can be costly and ill-suited for large components. This SBIR topic explores the use of AI/ML tools to help identify the location and type of potential defects (with statistical margins of error and confidence intervals). Even though the objective of the topic is to use existing process monitoring and control data to develop AI/ML algorithms, the Navy is open to new and creative hardware enhancements that can improve the reliability of AI/ML predictions. Enhancements such as replacing a sensor by an array of sensors, adding a new sensing modality or advanced data processing hardware card.

PHASE I: Define, design, and develop the AI/ML methodology for defect type identification and localization (with statistical bounds). Identify the metal powder bed fusion system that the proposer plans to upgrade with AI/ML tools. Provide a list of all the sensors and control parameters (including ones already available in the system and additional ones) to fuse via the AI/ML framework. This will include the rationale for the selections \. Indicate if there will be modification(s) or addition(s) of new sensing modalities/other hardware for added defect identification reliability. As part of the Phase I AI/ML algorithm development effort, simple sample coupons with embedded defects (e.g., porosity, hot cracking, keyholing, etc.) should be fabricated. Define the ground truth methodology to be used (i.e., coupon sectioning, x-ray tomography) for AI/ML training purposes. Provide a Phase II plan.

PHASE II: Focus on increased validation of AI/ML tools with aggregated large data sets from multiple sensors. This may also include aspects of transfer learning. Validation and comparison to NDE/I techniques will also be emphasized for Phase II. Phase II will also focus on key performance property impacts based on defect population.

PHASE III DUAL USE APPLICATIONS: Validate AI/ML tools for a different metal alloy to test AI/ML tools. Engagement with an OEM is highly encouraged. Commercial applications of additive manufacturing can be found in a wide range of commercial sectors such as: aerospace, shipping, transportation, rail, automotive, medical, etc. This technology would be applicable to identifying defects in critical metallic applications across all the sectors.

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KEYWORDS: additive manufacturing; AM; artificial intelligence/machine learning; AI/ML; nondestructive evaluation; defects; discontinuities

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N222-118 TITLE: Artificial Intelligence-Driven Multi-Intelligence Multi-Attribute Metadata Enabling All-Domain Preemptive Measures

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence (AI)/Machine Learning (ML); Cybersecurity; Networked C3

TECHNOLOGY AREA(S): Battlespace Environments;Information Systems; Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a system of Artificial Intelligence (AI)-driven multi-attribute metadata analytic tool sets that can be fully integrated with proper associative databases to monitor and track developing activities/signals in all operational domains. The system will utilize available multi-INT indicators and observables to isolate persistent threats including those engaged in undesired reconnaissance activities. The multi-INT information sphere encompasses all physical domains (undersea, surface, air, space, land) as well as cyber. Associative databases serve as the living ground truth repository of wide-ranging information. This AI framework serves as a unifying platform among disparate surveillance sources. It is a persistent AI-driven evidentiary metadata rendition of activities, context, and content. Not just a snapshot of events but the active process of mining, fusing, and expressive tagging of multimodal – multidomain sensory contents (acoustics, thermal, full motion video, wide area motion imagery, etc.), including social media contents as evidence into a collaborative multi-level knowledge database. The multi-level metadata control measures and access points ensure content quality, validity, reliability, and accuracy, including: origination source (temporal, geospatial, operator, modalities); sensor types; signal characteristics (including format, encoding, files size, duration); scene narration; content validity and attributes (raw or time-stamped modification by end user…); security and privacy restriction policy; and chain of custody. These control measures ensure trusted collaborative knowledge medium that can be searched, processed, annotated, linked to relevant disparate data sources, and shared amongst military and Intelligence Community (IC) analysts, federal and local law enforcement, and other Government personnel in real-time.

DESCRIPTION: Analysts supporting naval missions develop actionable intelligence from an extensive array of data sources. National Intelligence, Surveillance, and Reconnaissance (ISR) assets such as Global Hawk and Predator have proven invaluable in multiple theaters of interest. These systems provide high resolution sensory content that has been used to detect adversarial activities, such as movement of fighters and weapons, implanting decoys and IEDs, or gathering of key leaders. Unfortunately, multimodal streaming contents are time consuming to analyze, cumbersome to annotate, and distribute for further review, analysis, or approval. For example, the large size of the video files encourages segmenting of the video data into small pieces containing highly valuable and sensitive information. When this is done, metadata links are broken, causing the loss of temporal- and geo-tracking – both of which are important for further refinement of intelligence and value evidentiary information in support of ongoing operations. Threat assessment efforts require a multi-disciplinary approach that can automatically ingest and process structured and unstructured data from an expanding array of sensors and information sources. Automated content tagging and multimodal sensor fusion are critical components of proactive threat assessment and course of action determination. This SBIR topic seeks development of novel AI metadata methods to automatically create, explicitly document, manage, control, and preserve time-critical sensory content for the development of actionable intelligence. Synchronization of different data types and formats will be an important component. Metadata promotes assessment of the captured behavioral indicators and observables of potentially threating activities. The multi-attribute metadata provides an aggregated array of chronicled indicators that brings into focus the likelihood of a specific entity or group being engaged in the identified hostile activity, as basis for concern. Analysts can then assess the gathered observables to justify additional ISR operations, precautionary defensive measures, or preemptive actions. This technology will be an essential building block for a seamless all-domain interactive offensive and defensive kill chain.

Weaknesses of current approaches: Metadata schemes vary based on mission objectives and operational domain. Lack of alignment and compatibility between the metadata schemes complicates the ability to share information and make systems interoperable for cross agency collaboration to mitigate future threats. For instance, metadata included in the video transport wrapper can vary from typical information about the video source and playback parameters to extensive information as detailed by the Motion Imagery Standards Board. Descriptive metadata consisting of geo-, time-, and other references may be directly overlaid onto the video image. While this is compact and avoids the challenge of synchronizing metadata to the video stream, it offers limited metadata content and occludes significant portions of the video image. Descriptive metadata, such as analyst annotations included in the transport wrapper, often trace events by noting the number of frames from the initial I-frame of the video file; however, this type of reference schema is easily broken when video is cut into smaller clips to be sent to other analysts. The goal is to improve efficiency and accuracy through automation.

Note 1: Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances in order to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

Note 2: Phase I will be UNCLASSIFIED and classified data is not required. For test and evaluation, a contractor needs to define the ground truth for a scenario and develop a storyboard to serve as an overarching scenario to guide the test and evaluation of this SBIR technology in a realistic context. Supporting datasets must have acceptable real-world data quality and complexity for the case studies to be considered rich in content. For example, image/video dataset of at least 4000 collected images and frames for a case study is considered content-rich.

Note 3: Contractors must provide appropriate dataset release authorization for use in their case studies, tests, and demonstrations, and certify that there are no legal or privacy issues, limitations, or restrictions with using the proposed data for this SBIR project.

PHASE I: Determine technical feasibility, design, and prototype an AI-enabled multi-attribute metadata generation system, as detailed:
• Develop metadata attribute representation methods to express: operational coverage; organic domain features; anomalous entities, events, observations, and relations; and perceived intent relevant to aforementioned naval sensory domains.
• Motivate the design by three compelling scenarios for emerging situations supported by relevant datasets.

• Develop ontology framework for representing and annotating multimodal events and entity relationships.
• Develop machine learning, recognition, and reasoning schemes for metadata annotation to infer content, context, association, and activity by interpreting the body of variety behaviors attached to collected text, video, audio, image, document, diagram, etc. As a minimum, the following metadata information types are required: (a) organic content metadata representing various salient features and signatures captured from a scene when those features are combined as a feature vector can be used as input to machine learning system to form final metadata annotation; (b) content independent (tagged) metadata representing the originator, geospatial, temporal details, etc.; and (c) semantically descriptive metadata that describes the significance of the scene by applying machine learning along with ontology based techniques, for example, video frames and audio data can describe intention, depict the escalation of an event, reveal depth of emotions, or implication of the scene.
• Develop metadata synchronization methods for multi-sensory content types while maintaining temporal synchronization.
• Performance metrics (considering outcomes are dependent on the quality of datasets):
1. Analytic Completeness: – not just identifying and stopping hostile act but how it occurred by synthesizing the entire chain of events what would have happened had it not been stopped < 90%
2. Uniqueness: Signature attributes definable and retrievable (who, what, why, where, when) < 90%
3. Validity: Supporting evidence < 95%
4. Consistency: Updated metadata attribute from various sources that reinforce linkages < 90%
5. Accuracy: Overcoming noisy data < 90%
• Deliverables: Analytics, signal processing tools, models, T&E and demonstration results, final Phase I report, prepare a Phase II plan.

PHASE II: Conduct proof-of-concept and prototype development incorporating the recommended candidate technology from Phase I. Demonstrate the operational effectiveness based on the following criteria: (a) prioritized sensor alerts, (b) prioritized threat escalation, (c) measured severity of events, and (d) measure of analytic completeness – not just identifying and stopping a hostile act but identifying how it occurred by synthesizing the entire chain of events i.e., what would have happened had it not been stopped. Apply the prototype to the synchronization of dissimilar multimodal data streams in real time, with at least one of the sources to include high-definition video. Ensure that the prototype is compatible with a cloud-type architecture and presents a scalable solution. Test and demonstrate the improved capability based on the performance metrics detailed for Phase I with the following requirements: Analytic Completeness < 95%, Uniqueness < 95%, Validity < 98%, Consistency < 98%, and Accuracy < 98%. Develop a final report to include a detailed design of the system, and a plan for transition to the program of record in Phase-III. Deliverables: analytics, signal processing tools, models, prototypes, T&E and demonstration results, interface requirements, and final report.

Note 4: It is highly likely that the work, prototyping, test, simulation, and validation may become classified in Phase II (see Note 1 in the Description section for details). However, the proposal for Phase II will be UNCLASSIFIED.

Note 5: If the selected Phase II contractor does not have the required certification for classified work, ONR or the related DON Program Office will work with the contractor to facilitate certification of related personnel and facility.

PHASE III DUAL USE APPLICATIONS: Further develop the AI-driven multi-attribute metadata analytic tools to TRL-8 for integration with representative multi-INT naval data sources to demonstrate potential naval all-domain tactical preemptive measures expected in Indo-Pacific regions either into Minerva INP, the Maritime Tactical Command and Control, or MAGTF Command, Control, and

Communications. Once validated, demonstrate dual use applications of this technology in civilian law enforcement and commercial security services.

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KEYWORDS: Artificial Intelligence; Metadata; Machine Learning; Kill Chain; Intent; Geospatial; Temporal

VERSION 6

N222-119 TITLE: Next Generation Infantry Heads-up Displays for Close-Air Support

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Human Systems; Information Systems

OBJECTIVE: Develop next-generation daytime heads-up displays (HUDs) to provide training aids, operational tools, and situation awareness (SA) visualizations to improve the speed and quality of decision making by Marine Corps Ground Forces, specifically for close-air support (CAS) and call-for-fire (CFF).

DESCRIPTION: Ground forces must make rapid decisions in complex situations, such as requesting CAS, deconflicting airspace, and providing target information. In these situations, keeping heads-up and aware of the changing dynamics is critical. HUDs take advantage of augmented reality (AR) technologies to overlay information onto the battlefield and enhance SA. While HUD and AR systems have made progress in the past several years [Refs 1, 2], further innovation is required to develop systems for ground forces conducting CAS during daytime training and operations [Refs 3, 4]. Proposed solutions are sought to refine hardware and software requirements for Marine Corps use cases and deliver functional HUDs or HUD prototypes for next-generation AR HUD systems that can serve both as training aids and operational tools in CAS scenarios.

These systems must have maximum utility to Marines while maintaining survivability in a variety of complex environments. The display must be unobtrusive and mountable on existing Marine Corps helmet Night Vision Goggle (NVG) rails. The general device requirements are: (1) a low-cost (< $10,000) optical or video-see through HUD that is rugged (e.g., for outdoor use); (2) has a small form-factor; (3) is very low weight; (4) has ultra-low electronic power requirements; and (5) is capable of high-resolution operation. Specific device optical requirements include: (1) field-of-view (FOV) approaching 120 degrees width and 80 degrees height; (2) a blended, high-resolution 60 pixel/degree Field of View (FOV) across the foveated display area; and (3) a head-mounted display (HMD) with a refresh frame rate above 90 Hz. For requirements of form-factor size and weight, power requirements, and high-resolution operation (general device requirements 2-5), we are not identifying specific targets in this topic call. The solicitors expect performers to make trade-offs between the listed requirements and justify their decisions during Phase I. Priority should be given to higher resolution, lower latency, and smaller size and weight (in that order).

Proposals must detail how hardware and software systems will address physical ergonomics [Ref 5] and cognitive performance (i.e., situation awareness, decision making [Ref 6]) concerns for use in training and operations by Marine Corps Infantry. Proposals do not need to detail development of a complete AR system, but they must describe how they will investigate and evaluate their proposed hardware and software innovation. Development should be done with technologies that have little-to-no licensing fees for development or execution (e.g., Unity), and focus primarily on HUD systems, not AR-related technologies (e.g., tracking, object insertion, etc.). The training and operational use case of interest is daytime Marine Corps CFF and CAS missions.

PHASE I: Develop a concept for a low-cost (< $10,000), high-performance HUD to superimpose computer-generated information on an individual's view of the real world. Demonstrate the feasibility of the selected concept (hardware/software HUD-centric system) to meet Marine Corps infantry needs through a set of specific Phase I deliverables.

Standard deliverables that are a part of every SBIR Phase I contract include: (1) kick-off brief; (2) progress reports; and (3) a final report. Additional deliverables include: (1) an initial prototype; (2) a computer aided design (CAD) mechanical design package showing the top-level device and all major sub-assemblies anticipated; and (3) trade-off design decisions and associated justification for system design and human factors considerations.

PHASE II: Develop at least two working proof-of-concept HUDs for the Marine Corps. Conduct critical design reviews. Demonstrate that initial capabilities are sufficient for existing AR training applications. Facilitate evaluation of the prototypes to determine their capability to meet Marine Corps needs and requirements for an augmented reality HUD.

Deliverables include: (1) a final bill-of-materials (BOM); (2) all CAD drawings, hardware schematics, software source code; and (3) at least two proof of concept devices for evaluation.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the HUD system. Support the Marine Corps with integrating the HUD into existing AR training devices. Assist with certifying and qualifying the HUD system for Marine Corps use. Assist in writing Marine Corps device user manual(s) and system specifications/materials. As appropriate, focus on scaling up manufacturing capabilities and commercialization plans. Specific examples of commercial markets that could use this technology include manufacturing, law enforcement, and other hands-on tasks in time-critical domains.

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KEYWORDS: Augmented Reality; AR; Virtual Reality; VR; Heads-up-display; HUD; Training; Infantry; Close-Air Support; CAS; call-for-fire; CFF

N222-120 TITLE: Next-generation Underwater Life-support System (Rebreather)

OUSD (R&E) MODERNIZATION PRIORITY: Biotechnology

TECHNOLOGY AREA(S): Biomedical; Human Systems; Materials / Processes

OBJECTIVE: Develop a next-generation underwater life-support system (rebreather) with improved oxygen supply and/or carbon dioxide removal.

DESCRIPTION: Open circuit self-contained underwater breathing apparatus (SCUBA) wastes much of the usable oxygen (O2) in divers' bottled gas and produces bubbles that limit its use in covert operations. The closed circuit underwater breathing apparatus (CCR) extends dive times and supports covert operations by eliminating telltale bubbles. Carbon dioxide (CO2) scrubbers contribute much to the overall size and weight of rebreather rigs. Rebreather fatalities may result when divers exceed capacities of either scrubbers or oxygen bottles. Therefore, the Navy seeks new technologies that will improve rebreather safety and mission endurance by reducing the limitations and risks associated with present CO2 scrubbing materials and compressed oxygen gas. Due to size and power constraints, new chemical processes will be needed. Ideal features for the final product form factor would be modular, no larger than current rebreather components, low power requirements; and include appropriate sensors and control systems. System needs to produce oxygen and/or scrub CO2 at a rate to match metabolic rates of an active diver in missions lasting up to 10 hours. Note that a functional system must scrub CO2 effectively for the full duration of the mission, but oxygen production may be supplemented by bottled oxygen to meet full mission duration. Optimal designs eliminate CO2 (not as a gas form into the water) through chemical conversion instead of storing scrubbed CO2 within the rebreather unit.

PHASE I: Develop a concept for a life-support breathing apparatus that improves oxygen supply and/or CO2 removal improved underwater life-support system (rebreather). Demonstrate feasibility through analysis and limited laboratory demonstrations. Provide energy estimates matched to human metabolic demands, energy source, cost of system, cost per dive, and reliability estimates, including lifetime expectancy and lifetime cost estimate. The required Phase I deliverables will include: 1) a research plan for the engineering the design of the life support system; 2) a preliminary prototype, either physical or virtual, capable of demonstrating capability of the design; and 3) test and evaluation plan including data collection guidelines and identification of proper controls. Important considerations should include ability to resist corrosion and fouling. Phase I will provide key information about the uses and limitations of the system and could include rapid prototyping and/or modeling and simulation.

PHASE II: Develop, demonstrate, and validate the life support system prototype based on the Phase I design concept. The system should be tested under expected operational environmental conditions (e.g. temperatures, pressures; potential contaminants. Ideal features for the final product form factor would be modular, no larger than current rebreather components, low power requirements (not to exceed 2 kg Li-ion battery); and include appropriate sensors and control systems.

PHASE III DUAL USE APPLICATIONS: Develop prototype into a functional system as agreed to by an appropriate sponsor. Operationally relevant conditions (e.g., greater depths and prolonged dives) may necessitate additional development. System would have value for commercial/recreational diving as well as potentially life support systems for underwater manned vehicles or facilities.

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2. Selective production of oxygen from seawater by oxidic metallate catalysts. T. P. Keane and D. G. Nocera, ACS Omega 2019, 4, 12860–12864

KEYWORDS: Oxygen generation, electrochemistry, carbon dioxide scrubbing

N222-121 TITLE: Compact Sensor for Non-Destructive Propellant Mechanical Property Evaluation

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes; Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a compact sensor capable of operating safely in an energetic environment that collects data that can be used to determine the mechanical state of solid rocket propellant in a non-destructive manner. The sensor will take data that can be used to infer the mechanical state of solid rocket motor propellant and be used in the analysis of propellant grain integrity.

DESCRIPTION: Solid rocket motors employed by the Navy use propellants that must withstand all of the structural loads the motors are exposed to during transport, storage, stowage, and operation. The motors are designed to meet/exceed these load requirements. However, age and environmental exposure can alter the response of the propellant to these structural loads. The Navy has a need for a compact sensor or a suite of sensors that can collect data that can be used to infer the mechanical state of solid rocket motor propellant in a non-destructive manner. Such a sensor would be used to inspect the propellant of solid rocket motor assemblies in a rapid fashion. Understanding the mechanical state of the solid rocket motor propellant allows for a better evaluation of the health of the propellant and provide greater fidelity in aging trend evaluations. In addition to the sensor(s), an insertion system that can place the sensor at different locations on the propellant surface of a solid rocket motor system will need to be designed. The needed R&D is the miniaturization of the sensor head (on the order of inches) and the development of an insertion system compatible with solid rocket motor assemblies currently deployed by the Navy.
A sensor or a sensor suite that can perform the required measurements will address the difficulty of non-destructively evaluating the mechanical state of the propellant grain while having limited access to the interior of the solid rocket motor assembly. This technology will avoid the current need to disassemble the solid rocket motors and avoid all associated costs with disassembly and reassembly. The technology will minimize or eliminate (preferred) the need to attach the inspection equipment to the solid rocket motor. All of these features will allow measurements to be taken on substantially more available solid rocket motor assets as opposed to the current limited number of assets assigned to the monitoring program.

This SBIR topic is focused on the development of a compact, highly mobile sensor that can collect the data needed to determine fundamental (gross or bulk) material properties, such as the modulus for elastic and elastic-plastic deformation. The propellant is a highly filled elastomer that contains organic and inorganic solids, plasticizers, and stabilizers, held together by a polymeric binder. The proposed approach may employ a miniature version of an indentation testing technique or leverage a completely different method. Proposed methods should minimize the need for attachment to the solid rocket motor. The proposed sensor would move to the correct measurement position. The sensor then measures the resisting force being applied by the material on the contact head. In this mode, the contact head is moved to fixed required depth. In another mode, the contact head is moved at a constant rate while measuring the resisting force. The sensor should meet low power, low voltage, and the Navy's HERO (Hazards of Electromagnetic Radiation to Ordnance) requirements for on-shore use [Ref 6]. The sensor should be capable of being maneuvered through the confined area of a nozzle and be used in the interior of a solid rocket motor. The sensor system must be capable of being calibrated prior to use. The insertion system must be capable of placing the sensor at multiple locations, up to several meters into the solid rocket motor or preferably a mobile system capable of moving to the correct location for measurement. The insertion system should be simple to install and minimize the number of personnel and amount of support equipment needed for measurements. The sensor and insertion assembly must be capable of intermittent usage for a period of ten years.

PHASE I: Develop a technical concept for a propellant mechanical property sensor. Proposed design concepts should be completed during Phase I. Laboratory-scale demonstrations to verify the proposed sensor concept(s) should be completed. Modeling should be completed to verify proposed concept(s) can meet size/volume constraints while providing the correct data. The laboratory testing and modeling must be satisfactorily completed to transition from Phase I to Phase II. Identify risks to the technical approach and develop/evaluate plans to mitigate those risks for Phase II. Laboratory-scale demonstrations to verify the proposed insertion system should be completed. The Phase I Option, if exercised, will include the initial design specification and capabilities description to build a prototype solution in Phase II. Coordinate with Navy SBIR liaisons on key technical requirements data to be measured, size of the sensor, size of the insertion system, application method, power, and data storage/transmission needs.

PHASE II: Design and develop a prototype of the mechanical property sensor based on the concept(s) from Phase I. Ensure the design has the ability to collect data that can be used to measure, at a minimum, the data needed to calculate the initial modulus and the relaxation modulus. Ensure the design is sized such that it can pass through the throat of a solid rocket motor nozzle and fit within the bore of the motor. Ensure the design is capable of performing the measurements at multiple locations in a repeatable manner. Ensure the insertion system is capable of moving the sensor to the desired location. Complete testing of the sensor prototype to validate operation and feasibility. Design the testing to emulate the installation, sensing, data collecting/storage, and removal. Test material compatibility to ensure survivability and compatibility with solid rocket propellant during the inspection process.

PHASE III DUAL USE APPLICATIONS: Update the sensor based on Phase II efforts. Support the development of an instruction manual for use. Manufacture an updated prototype and demonstrate use on an identified asset that is considered representative. Provide the necessary support for certification and qualification of the system for deployment and use at fleet facilities and/or facilities where fleet assets are located.

This technology has the potential to be used commercially in any industry that has a need for mechanical property monitoring of elastic / elastic-plastic materials in areas of high hazards.

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KEYWORDS: Relaxometry; 1.1 Propellants; Non-Destructive Measurement; Mobile Sensor; High Elongation Propellants; Propellant Mechanical Properties

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N222-122 TITLE: High Temperature Cable and Connector Development for Radio Frequency (RF) Applications in Harsh Environments

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR); Hypersonics

TECHNOLOGY AREA(S): Battlespace Environments; Materials / Processes; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop High Temperature Radio Frequency (RF) cables and connectors that can perform in harsh environments and are reliable, cost effective, and manufacturable. Solutions are to be utilized in various applications in a high-speed missile system.

DESCRIPTION: A major technical challenge for high-speed weapon systems includes managing the extreme heating environments experienced at increased speeds. Temperature requirements for components can vary depending on the location/placement on the platform. Air friction can cause extreme heating of the leading edge. Most materials, including RF cables and connectors, cannot sustain these high temperatures.

The developed RF cables and connectors should have a minimum temperature rating of 1200° C and an objective of 1500° C. The RF cables will be used in different applications so a wide variety of impedance, frequency specifications, phase stability, attenuation specifications, power specifications, and physical dimensions should be considered. Some possible applications are:
• Aerospace industry for accurate communication equipment
• Military and space application
• Satellite communications

Commercial High Temperature cables are typically rated at 1000° C and High Temperature connectors are 600° C.

This technology will enable critical RF capabilities to be achievable, reliable, and cost effective.
Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Propose a solution for developing a RF cable and connector prototype. The recommended solution shall demonstrate the ability to withstand an operational harsh aerospace military environment.

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Demonstrate a proof of concept for the subsystem design and analysis, addressing material and environmental requirements for the cable and connector. Specific requirements for material, performance characteristic, and measurement implementation for the prototype design must be understood. The proposed solution must demonstrate a concept that can improve the temperature rating of a RF cable and connecter system. Trade studies shall be completed if optimal materials are predicted to affect performance.

Cable diameter, flexibility, and weight should be considered when designing for increased temperature capabilities.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype that meets the government's design requirements based on the results of Phase I and the Phase II Statement of Work (SOW). The developed units must be suitable for proof of concept demonstration and ensure the cable and connector prototype meet the Government's requirements, which will be provided upon contract award. During this phase, access to classified design data is required to gain the actual system requirements for the technical specifications of the sensor, as well as the exact mechanical and electrical constraints that the prototype must adhere. The effort should also focus on procuring materials for test and evaluation. High fidelity analysis will be conducted. Testing will take place in contractor selected facilities to validate design.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Qualify the prototype to system testing. Support the Navy in transitioning the technology to Navy use. This may include modifications to meet all testing requirements. Develop and document assembly instructions and drawings provided to the government for manufacturing purposes. This technology can be transitioned to other Navy, DOD, and Government weapon systems for integration of next generation flight systems. In the commercial sector, space shuttles and any high-speed systems could utilize the developed cables and connectors.

REFERENCES:

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KEYWORDS: High Temperature materials; Aerospace cables; RF harsh environment components; Military Communication; cables and connectors; material integration

N222-123 TITLE: Software Simulation of a Thermal Protection System for Hardware-in-the-Loop

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR); Hypersonics; Space

TECHNOLOGY AREA(S): Battlespace Environments; Materials / Processes; Weapons

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OBJECTIVE: Develop a software simulation of a Thermal Protection System (TPS) for a Hypersonic Weapon with intent to integrate the software into a system-level test architecture.

DESCRIPTION: A Thermal Protection System (TPS) on a vehicle protects vehicle components from heating effects brought on by the advanced aerodynamic environments of hypersonic flight. The Navy desires a high-fidelity software model of a TPS to show the effects of these advanced hypersonic aerodynamic environments on the TPS. The novel nature of this SBIR topic stems from two requirements on this high-fidelity software model; the software model is expected to be seeded with experimental data of a real TPS from provided material coupon and the software model is expected to interface with a Navy system-level test asset that runs on a real-time computational platform. The Navy is currently expanding its ability to do real-time system level test and evaluation of hypersonic weapons, and so requires continuous improvement to the subcomponent models that make up system-level test architecture.
Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Outline the following three concepts:
1. A framework for a software simulation of a TPS in a Hypersonic environment. Key inputs to this simulation should be derived from vehicle kinematics and TPS material properties, utilize publically available data for hypersonic boost-glide systems to define inputs. Key outputs to this simulation should indicate TPS performance and vehicle heat exchange information. The software simulation will be required to run in a real-time computational environment.
2. A test plan for advanced TPS materials outlining the process of experimentally determining relevant data parameters for the software simulation model.
3. A software architecture for integrating the software simulation model into the Navy’s system level test architecture.
Relevant information for setting up the framework will be provided upon contract award.

PHASE II: Develop prototype software development is expected to happen in two sections based on the three concepts outlined in Phase I:
1. Software development of the TPS software simulation will begin, with the expectation that initial development will be complete by the end of Phase II with preparation to integrate into the Navy's system-level test equipment during Phase III. Interface with Navy engineers familiar with the system-level test equipment and be provided with specific details of the software interface definition. Navy engineers will also work with the awardee to provide details of the system-level test software for software integration to ensure smooth transition in Phase III. Certain details of the Navy's system-level test equipment will be Classified.
2. Execution of the test plan for the advanced TPS material will occur. The awardee will receive advanced TPS material coupons for experimental test in order to seed the TPS software simulation with TPS material data. TPS material coupons will be classified.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: The delivered product to the Navy is expected to be a software package to reside on system-level test hardware and interface with system-level test software. Provide installation guidance and support for the software. Provide a level of support for validation and debugging as the Navy team performs checkout activities on the software. These checkout activities will take the form of data packages created using the Navy's system-level test with the incorporated software package, to be compared to data packages of the system-level test without the software and also compared to data packages of experimental data. Experimental data will include the awardee's experimental data from Phase II. Experimental data may also include Navy generated data, which will not be distributed to the customer – in this case, the expectation is the Navy will generate internal reports that include this data and distill out of these reports a version sharable with the customer as it relates to the performance of the customer supplied software product. Transition activities will end when the company awardee and the Navy have agreed to successful integration of the software package into Navy system-level test equipment.

While specific data within the software package related to the TPS will remain classified, the software architecture and advanced TPS modeling tools developed by the awardee are expected to be usable by the awardee for non-military applications in the commercial hypersonic industry.

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KEYWORDS: Hardware-in-the-loop; Thermal Protection System; Software; Modeling and Simulation; Hypersonics; System Level Test Architecture

N222-124 TITLE: Secure Data Module for Leave-Behind Applications

OUSD (R&E) MODERNIZATION PRIORITY: Cybersecurity

TECHNOLOGY AREA(S): Electronics; Information Systems

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OBJECTIVE: To generate a unique capability with appropriate National Security Agency (NSA) approvals at Technology Readiness Level Eight (TRL-8), leveraging existing component technologies at TRLs 3-9. The proposed device would provide a small form factor computer with integrated classified data storage and transmission, meant for integration into small unmanned platforms, and would be interoperable with other standard NSA Type 1 encryption technologies.

DESCRIPTION: Existing encryption solutions for Data at Rest (D@R) are bulky and require significant power availability to operate, making deployment on smaller platforms or in power-limited systems challenging. Much smaller Data in Transit (DiT) solutions are available but are designed for use over solid networking connections, making deployment in situations with limited bandwidth or intermittent connectivity difficult or impossible. The proposed device incorporates existing chips available from multiple vendors for implementation of cryptographic algorithms into a single box meant to optimize size, weight, and power (SWaP) for field implementations. SWaP objectives are a maximum of the following: 0.5 cubic feet volume, 20 lb, and 100 W. The device should be ruggedized, designed for leave behind operations with automated tamper detection and zeroization, and designed to meet NSA standards required for handling of TS/SCI.

As Navy systems are increasingly small, unmanned devices in remote locations, securing of data collected and generated by these systems becomes more complex. Current devices require each system to devise custom implementations for handling of DiT over low bandwidth or inconsistent communications links. The only alternative to the existing devices is to develop a fully custom implementation, which requires NSA approvals of each specific use case.

Enabling technologies are available, including OEM devices intended to host the level of encryption required, and small form factor data diodes which could be incorporated. Most chip-level encryption devices require NSA approval of the specific implementation, making implementation of these in each situation requiring encryption extremely cost prohibitive.

Innovative approaches will be required to optimize SWaP, and to implement appropriate tamper-safety mechanisms for leave behind operation. The ideal solution is easily powered from a battery bank, can operate without need for ventilation, and is smaller and lighter when compared with existing D@R solutions.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: In Phase I, a project plan and schedule will be developed. In these, the awardee should demonstrate a thorough understanding of the required processes and potential challenges of building an approved cryptography device and pursuing NSA approvals. Key enabling technologies should be identified and understood, including any necessary government support for procurement of approved crypto items. Basic data flow diagrams should be developed, showing interconnections and locations of all key components.

PHASE II: In Phase II, specific key components will be identified, purchased, and integrated into two benchtop prototype solutions. Ruggedness of the designed unit should be confirmed through mechanical modeling. Data handling, zeroization, and network management should be tested using the benchtop prototypes. Successful keying of devices, development and sustainment of the necessary security associations across intermittent communications paths, as well as appropriate fail-secure mechanisms should be demonstrated.

It is probable that the work under this effort with be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III, the device should be manufacturable at scale, with target uses in unmanned systems in a variety of environments. Validation testing should be performed by the awardee. Additional testing will be required for NSA authorization of the device; the awardee must accommodate testing and documentation requirements for NSA approvals.
This concept is for an enabling technology for a variety of systems serving a wide range of purposes. Certification to the NSA standard provides authorization for use to the Navy and other government organizations.

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1. Trinidad, J. M. Programmable encryption for wireless and network applications. MILCOM 2002 Proceedings, 2002, pp. 1374-1377 vol. 2.
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KEYWORDS: Encryption; Cryptography; Unmanned Systems; Leave Behind; Data at Rest; D@R; Data in Transit; DiT; Disadvantaged Communications

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N222-125 [TOPIC REMOVED]

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N222-126 TITLE: Compact Boost Motor Propellant Stabilizer Sensor

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes; Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a compact sensor(s) that will collect the data which is used to infer the stabilizer content as well as other energetic, low molecular weight, organic compounds from the propellant in a solid rocket motor assembly.

DESCRIPTION: Solid rocket motors used by the Navy have propellant formulations that contain highly energetic materials. The formulations contain inorganic and organic solids, plasticizers and an elastomeric polymer. Stabilizers are employed to protect the polymeric structure used in the propellant formulations. The stabilizer content changes with age and environmental exposure. The Navy has a need for a compact sensor or suite of sensors that can collect data that can be used to infer the stabilizer content of solid rocket motor propellant in a non-destructive manner. The sensor would be used to inspect a suitably prepared propellant surface or subsurface in a rapid fashion. Knowledge of the stabilizer content and some of the other energetic components allows for a better evaluation of the health of the propellant. In addition to the sensor(s), an insertion system that is capable of positioning the sensor at a variety of difficult to reach locations within the solid rocket motor assembly will need to be designed. The needed R&D effort is the miniaturization of the sensor head (on the order of inches) and the development of an insertion system capable of moving the sensor into hard to reach areas within the rocket motor.

A sensor or a sensor suite that can perform the required measurements will address the difficulty of non-destructively evaluating the stabilizer content of the propellant grain in areas that are difficult to access. This technology will avoid the need to extract samples, potentially rendering the asset unusable, or dissecting an asset which forces the need for a replacement. The technology will avoid the need to disassemble and reassemble the solid rocket motor and minimize or eliminate the need to attach the equipment to the solid rocket motor. The capability the technology provides will allow measurements to be taken on substantially more assets.

This SBIR topic is focused on a sensor or multiple sensors that have the ability to collect the data needed to determine the stabilizer content, concentration, of the two stabilizers present, as well as the concentration of the energetic, low molecular weight plasticizer. Current non-destructive approaches employ an Ultra-Violet – Visible (UV-Vis) light technique to determine stabilizer content. Laboratory methods typically employ high performance liquid chromatography techniques to determine stabilizer content. Future approaches may employ a miniature version of these techniques or leverage a completely different method. In the current approach, the operator manually places the sensor head into position. Fiber optics are used to expose the sample area to UV-Vis light. Some of the light is absorbed by the sample and the remainder is reflected off of the surface. The intensity of the reflected light is measured as a function of wavelength. Through calibration and data-processing, the stabilizer and plasticizer concentration is determined. The propellant surface is typically slightly oxidized or has a surface finish and may need to be prepared before surface measurements can be made. The sensor should meet low power, low voltage and HERO (Hazards of Electromagnetic Radiation to Ordnance) requirements for on-shore use [Ref 4]. The sensor should be capable of being able to pass through the confined area of the nozzle and be used at locations in the interior of a solid rocket motor. The sensor must be capable of being calibrated prior to use. The insertion system must be capable of placing the sensor at multiple locations, up to several meters from the exterior of the solid rocket motor assembly or preferably a mobile system capable of moving to the correct location for measurement. The sensor and insertion assembly must be capable of intermittent usage for a period of ten years.

PHASE I: Develop a technical concept for a propellant stabilizer sensor. Proposed design concepts should be completed during Phase I. Laboratory-scale demonstrations to verify the proposed sensor concept(s) can meet size constraints while provide the correct data. The laboratory testing must be satisfactorily completed to transition from Phase I to Phase II. Identify risks to the technical approach and develop/evaluate plans to mitigate those risks for Phase II. Laboratory-scale demonstrations to verify the proposed insertion system should be completed. The Phase I Option, if exercised, will include the initial design specification and capabilities description to build a prototype solution in Phase II.

Coordinate with Navy SBIR liaisons on key technical requirements data to be measured, size of the sensor, size of the insertion system, application method, power, and data storage/transmission needs.

PHASE II: Design and develop a prototype of the propellant stabilizer sensor based on the concept(s) from Phase I. Ensure the design has the ability to collect the data that can be used to measure the concentration of the two stabilizers and the energetic plasticizer. Ensure the design is sized such that it can pass through the throat of a Third Stage solid rocket motor nozzle and fit within the confined spaces of the propellant grain geometry. Ensure the design is capable of performing the measurements at multiple locations. Ensure the insertion system is capable of moving the sensor to the desired location. Complete testing of the sensor prototype to validate operation and feasibility. Design the testing to emulate the installation, sensing, data collecting/storage, and removal. Test material compatibility to ensure survivability and compatibility with solid rocket propellant during the inspection process.

PHASE III DUAL USE APPLICATIONS: Update the sensor from Phase II efforts. Support the development of an instruction manual for use. Manufacture an updated prototype and demonstrate use on an identified asset that is considered representative. Provide the necessary support for certification and qualification of the system for deployment and use at fleet facilities and/or facilities where fleet assets are located. This technology has the potential to be used commercially in any industry that has a need for stabilizer monitoring of materials in areas of high hazards.

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2. Moniruzzaman, M. and Bellerby, J.M. “Use of UV-Visible Spectroscopy to Monitor Nitrocellulose Degradation in Thin Films.” Polymer Degradation and Stability 93(6), 1067-1072 June 2008. https://www.journals.elsevier.com/polymer-degradation-and-stability
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KEYWORDS: Stabilizer Measurement; 1.1 Propellants; Compact Ultra-Violet/Visible Light Spectrometer; UV-Vis; Low Molecular Weight Aromatic Compounds; Compact Multi-Spectral Spectrometer; Non-Destructive Measurement

N222-127 TITLE: Innovative Manufacturing/Materials in Hypersonic Thermal Protection Systems

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR); Hypersonics; Space

TECHNOLOGY AREA(S): Battlespace Environments;Materials / Processes; Weapons

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OBJECTIVE: Develop a weather-resistant, conductive Thermal Protection System (TPS) material, which can survive hypersonic flight environments and is manufactured by methods/processes with high uniformity/reproducibility.

DESCRIPTION: Current generation hypersonic vehicle Thermal Protection System (TPS) materials provide adequate thermal resistance but have limited structural capability in all-weather environments and a low level of manufacturing sophistication. This leads to high levels of variability and introduces program and performance risk. Hypersonic vehicles experience temperatures in excess of 3000°F and encounter elevated levels of shock and vibration. These vehicles must also be able to fly through all types of weather and withstand precipitation at high speeds. Developing and integrating conductive TPS materials capable of withstanding the harsh environments and weather experienced through flight is a priority for enhancing performance in hypersonic vehicles. Proposers should utilize publicly available data on hypersonic flight conditions when identifying material solutions, specific requirements will be provided in the Phase II. Material solutions that could yield agile configurations with tailored conductivity throughout the TPS would provide more versatile hypersonic vehicles. While proposed materials must meet thermal, dielectric, mechanical and conductive specifications, solutions must also maintain uniformity when manufactured in bulk and ensure ease of assembly.

Solutions proposed to this SBIR topic should apply some of the advanced aerospace composite materials and manufacturing technology developed over recent years; including but not limited to: fiber reinforcement, fiber orientation, ultra-high temperature ceramics, high-temperature dielectrics, and additive manufacturing to develop reliable, uniform, thermally conductive/high strength materials and near-net shape components in form-factors applicable to Navy hypersonic flight vehicles. Specific form factors and requirements are held at higher distribution levels and shall be provided upon contract award as applicable.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Demonstrate a proof of concept for conductivity and structural capability of materials/manufacturing solutions at the desk top/lab scale level. Figures of merit for consideration and to be defined are dielectric properties, physical density, mechanical and compressive strength, and in-plane/through thickness thermal conductivity up to 3000°F. Address manufacturing approaches, uniform producibility concerns, and scale-up potential for production of aerospace grade hardware.
The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce prototype hardware to the requirements, materials, form factors and manufacturing approaches defined from Phase I. Further material, thermal and mechanical characterization data shall also be provided in order to assess replacement risk against current incumbent materials. At the end of Phase II, prototype hardware will be provided for government evaluation in a relative hypersonic environment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. The final product shall be a prototype and design package outlining the material and manufacturing/assembly methods. A suitable material solution and assembly method is required for the future system to ensure reliability and performance throughout flight. This technology can be transitioned to Navy and Air Force hypersonic and ballistic re-entry weapon systems. Solution materials would have applicability in commercial access-to-space environment as well as commercial aerospace, and gas turbine engine applications.

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KEYWORDS: Weather-Resistant Materials; Thermal Protection System; Manufacturability; High Thermal Materials; Thermal Resistance; Reentry Vehicles; Hypersonic Vehicle Heat Loads; Conductive Materials.

N222-128 TITLE: Development of Hypersonic Glide Body Deployable Antennas

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR); Hypersonics; Space

TECHNOLOGY AREA(S): Air Platforms; Battlespace Environments; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop aft-deployable antenna systems from the aft plate of hypersonic glide vehicles, with release or retraction mechanisms.

DESCRIPTION: Hypersonic vehicles have limited antenna mounting real-estate. The limited space on the available antenna real-estate limits the number of antennas and other mounted capabilities that can be employed. Fortunately, many systems do not require the use of their antenna all the time. Some only need a small period of time during the flight, some only need periodic access, and some only after glide body separation. Hence, deployable, retractable, and releasable antennas present an additional approach for managing the antennas. There is also interest in applications for relatively high gain antennas with patterns directed perpendicular to the vehicle axis. Deployable antennas are a potential solution for enabling perpendicular oriented antennas. CubeSats are analogous to hypersonic vehicles in that they are both volume constrained for antennas. Examples of CubeSat deployable antennas include helical antennas, parabolic reflectors, mesh reflectors, conical horns, and conical log spiral (CLS) [Ref 1].

This SBIR research is intended to explore innovative technical solutions that would enable the design of deployable, retractable, and releasable antennas for hypersonic vehicles. The proposed approaches must be demonstrated in analysis, simulation, or prototype. Size, Weight and Power (SWaP) requirements of the resultant system are critically important given volume limitations in the glide body. The research should be conducted with the goal of designing and demonstrating a prototype deployable antenna system. When framing the proposal, firms should utilize publicly available data on hypersonic boost-glide systems. Specific SWaP requirements will be provided upon contract award.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Provide a concept that will lead to the development of a deployable antenna system. Demonstrate the feasibility of that concept. All critical materials, components, and technologies must be identified and demonstrated in the lab or through clearly relevant references. Demonstrate the feasibility of the approach to provide required antenna functionality, and the usefulness to hypersonic applications. Provide modeling, simulation, and preliminary prototype results to demonstrate feasibility for anticipated applications. Size and weight trades should also be addressed.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype with enough detail for development and demonstration of a deployable antenna system, as addressed in Phase I, for a to-be-identified exemplar experiment on a sounding rocket launch. The Phase II Statement of Work (SOW) should identify a work plan that provides proof of concept that the technology has the potential to meet the performance goals highlighted in Phase I. The Phase II effort will produce at least one prototype for laboratory characterization and demonstration, and two flight ready prototypes for the sounding rocket experiment.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: If the demonstration in Phase II is deemed to be of high interest to the government, support transition of the deployable antenna technology for government use.

The transitioned products are expected to be able to support current and future hypersonic glide body systems. Commercial hypersonic applications should be considered for transition as well. The primary objective of this project is for transition to defense contractors. To meet these needs, maturation and packaging of the technology to meet practical size, weight, and power constraints will be required.

REFERENCES:

1. Sakovsky, Maria, Pellegrino, Sergio, Constantine, Joseph. “Rapid Deployable Antenna Concept Selection for CubeSats.” Air Force Office for Scientific Research. October 2016. http://www.its.caltech.edu/~sslab/PUBLICATIONS/Rapid%20Deployable%20Antenna%20Concept%20Selection%20For%20CubeSats%20ESTEC.pdf.
2. Constantine, Joseph; Tawk, Y; Ernest, A; Christodoulou, C.G. “Deployable antennas for CubeSat and space communications.” 2012 6th European Conference on Antennas and Propagation (EUCAP). 01 June 2012. https://ieeexplore.ieee.org/document/6206124
3. Chahat, Nacer; Hodges, Richard E, Sauder, Jonathan; Thomson, Mark; Peral, Eva; Rahmat-Samii, Yahya. “CubeSat deployable Ka-band mesh reflector antenna development for earth science missions.” IEEE Transactions on Antennas and Propagation. 24 March 2016. Accessed September 2021. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=B-A8zvAAAAAJ&citation_for_view=B-A8zvAAAAAJ:BqipwSGYUEgC

KEYWORDS: Hypersonics; Deployable Antennas; RF communications; alternative navigation; Retractable Antennas; Enabling Technologies

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions

AMENDMENT 3

13 May 2022

This Amendment accomplishes the following changes:

1. Chart 1 is replaced in its entirety.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions
AMENDMENT 2
5 May 2022

This Amendment accomplishes the following changes:

1. The TPOC information associated with Topic AF222-002, Automated Data Forensics for Collaborative Weapon Behavior is changed to

2. The topic numbering scheme reverts to the original topic numbering scheme in place prior to Amendment 1.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions
AMENDMENT 1
28 April 2022

This Amendment accomplishes the following changes:

3. The TPOC information associated with Topic AF222-002, Automated Data Forensics for Collaborative Weapon Behavior is changed to

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Phase I
Proposal Submission Instructions

AF Phase I proposal submission instructions are intended to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Firms must ensure proposals meet all requirements of the 22.2 SBIR BAA posted on the DoD SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

Complete proposals **must** be prepared and submitted via https://www.dodsbirsttr.mil/submissions/ (DSIP) on or before the date published in the DoD 22.2 SBIR BAA. Offerors are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The AF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the AF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "22.2 Address Change".

Points of Contact:

- General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD 22.2 SBIR BAA.
- Air Force SBIR/STTR Contracting Officers (CO):
  - Mr. Daniel Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Businesswebsite, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

Chart 1: Air Force 22.2 SBIR Phase I Topic Information at a Glance

Topic Number	**Performance Period**	**Max SBIR Funding**	**Technical Volume Contents**
All Topics	9 Months	$150,000.00	White Paper NTE 20 Pages

PHASE I PROPOSAL SUBMISSION: DoD 22.2 SBIR Broad Agency Announcement, https://www.dodsbirsttr.mil/submissions/login, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements. For the AF, the Phase I contract periods of performance and dollar values are found in the table above.

Limitations on Length of Proposal: The Phase I Technical Volume page/slide limits as identified in Chart 1 (above) do not include the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-h). The Technical Volume must be no smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins. Only the Technical Volume and any enclosures or attachments count toward the page limit. In the interest of equity, pages/slides in excess of the stated limits will not be reviewed. The documents required for upload into Volume 5, "Other", do not count toward the specified limits.

Phase I Proposal Format

Proposal Cover Sheet: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in these sections.

Technical Volume: The Technical Volume should include all graphics and attachments but should not include the Cover Sheet, which is completed separately. Phase I technical volume (uploaded in Volume 2) shall contain the required elements found in Chart 1. Make sure all graphics are distinguishable in black and white.

Key Personnel: Identify in the Technical Volume all key personnel who will be involved in this project; include information on directly related education, experience, and citizenship.

- A technical resume of the principal investigator, including a list of publications, if any, must be included
- Concise technical resumes for subcontractors and consultants, if any, are also useful.
- Identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors, or consultants.
- Identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For all non-U.S. citizens, in addition to technical resumes, please provide countries of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project, as appropriate. Additional information may be requested during negotiations in order to verify the foreign citizen's eligibility to participate on a contract issued as a result of this announcement.

Phase I Work Plan Outline

NOTE: The AF uses the work plan outline as the initial draft of the Phase I Statement of Work (SOW). Therefore, **do not include proprietary information in the work plan outline**. To do so will necessitate a request for revision, if selected, and may delay contract award.

Include a work plan outline in the following format:
Scope: List the effort's major requirements and specifications.
Task Outline: Provide a brief outline of the work to be accomplished during the Phase I effort.
Milestone Schedule
Deliverables
Progress reports
Final report with SF 298

<u>Cost Volume</u>: Cost information should be provided by completing the Cost Volume in DSIP and including the Cost Volume Itemized Listing specified below. The Cost Volume detail must be adequate to enable Air Force personnel to determine the purpose, necessity and reasonability of each cost element. Provide sufficient information (a-i below) regarding funds use if an award is received. The DSIP Cost Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing may be submitted in Volume 5 under the "Other" dropdown option.

a. **Special Tooling/Test Equipment and Material**: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness to the work proposed. Special tooling and test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort and should not be equipment or materials of the type that an offeror would otherwise possess in the normal course of business. It may include such items as innovative instrumentation and/or automatic test equipment.

b. **Direct Cost Materials**: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, prices and where appropriate, purpose.

c. **Other Direct Costs**: This category includes, but is not limited to, specialized services such as machining, milling, special testing or analysis, and costs incurred in temporarily using specialized equipment. Proposals including leased hardware must include an adequate lease vs. purchase justification.

d. **Direct Labor**: Identify key personnel by name, if possible, or by labor category if not. Direct labor hours, labor overhead and/or fringe benefits, and actual hourly rates for each individual are also necessary.

e. **Travel**: Travel costs must relate to project needs. Break out travel costs by trip, number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each, should be reflected. Recommend budgeting at least one trip to the Air Force location managing the contract

f. **Subcontracts**: Involvement of university or other consultants in the project's planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. The proposed total of consultant fees, facility lease/usage fees, and other subcontract or purchase agreements may not exceed **one-third of the total contract price** or cost (<u>do not include profit in the calculation</u>), unless otherwise approved in writing by the CO. The SBIR funded work percentage calculation considers both direct and indirect costs after removal of the SBC's proposed profit. Support subcontract costs with copies of executed agreements. The documents must adequately describe the work to be performed. At a minimum, include a Statement of Work (SOW) with a corresponding detailed Cost Volume for each planned subcontract.

g. **Consultants**: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without exchanges. Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the

Phase I CO identified on the cover page. The Government reserves the right to reopen negotiations later if the CO determines doing so to be necessary.

h. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms or Export Administration Regulations (ITAR/EAR), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website,
http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/JCP/DD2345Instructions.aspx. DD Form 2345 approval will be required if proposal if selected for award.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors TEC Solutions, Inc., APEX, Oasis Systems, Riverside Research, Peerless Technologies, HPC-COM, Mile Two, Wright Brothers Institute, and MacB (an Alion Company). In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space and Missiles Centers may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. Contact the AF SBIR/STTR COs with concerns.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals in response to Air Force topics shall not include TABA.

PHASE I PROPOSAL SUBMISSION CHECKLIST

Firms shall register in the System for Award Management (SAM), https://www.sam.gov/, to be eligible for proposal acceptance. Follow instructions therein to obtain a Commercial and Government Entity (CAGE) code and Dunn and Bradstreet (DUNS) number. Firms shall also verify “Purpose of Registration” is set to “I want to be able to bid on federal contracts or other procurement opportunities. I also want to be able to apply for grants, loans, and other financial assistance programs”, NOT “I only want to apply for federal assistance opportunities like grants, loans, and other financial assistance programs.” Firms registered to compete for federal assistance opportunities only at the time of proposal submission will not be considered for award. Addresses must be consistent between the proposal and SAM at award. Previously registered firms are advised to access SAM to ensure all company data is current before proposal submission and, if selected, award.

Please note the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete. The AF recommends completing submission early, as site traffic is heavy prior to solicitation close, causing system lag. **Do not wait until the last minute.** The AF will not be responsible for proposals not completely submitted prior to the deadline due to system inaccessibility unless advised by DoD. The AF will not accept alternative means of submission outside of DSIP.

AIR FORCE PROPOSAL EVALUATIONS

The AF will utilize the Phase I proposal evaluation criteria in the 22.2 SBIR DoD announcement in descending order of importance with technical merit being most important, followed by principal investigator's (and team's) qualification, followed by the potential for commercialization as detailed in the Commercialization Plan.

The AF will utilize the Phase II proposal evaluation criteria in the 22.2 SBIR DoD announcement in descending order of importance with technical merit being most important, followed by the potential for commercialization as detailed in the Commercialization Plan, followed by the qualifications of the principal investigator (and team).

Proposal Status and Feedback

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. Small businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal Number and Topic Number referenced.

Feedback will not be provided for Phase I proposals determined Not Selectable.

IMPORTANT: Proposals submitted to the AF are received and evaluated by different organizations, handled topic by topic. Each organization operates within its own schedule for proposal evaluation and selection. Updates and notification timeframes will vary. If contacted regarding a proposal submission, it is not necessary to request information regarding additional submissions. Separate notifications are provided for each proposal.

It is anticipated all the proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Air Force SBIR/STTR Contracting Officer Daniel Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding AF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

PHASE II PROPOSAL SUBMISSIONS

AF organizations may request Phase II proposals while technical performance is on-going. This decision will be based on the contractor's technical progress, as determined by an AF Technical Point of Contact review using the DoD 22.2 SBIR BAA Phase II review criteria. All Phase I awardees will be provided an opportunity to submit a Phase II proposal unless the Phase I purchase order has been terminated for default or due to non-performance by the Phase I company.

NOTE: Air Force primarily awards Phase I and II contracts as Firm Fixed Price. However, awardees are strongly urged to work toward a Defense Contract Audit Agency (DCAA) approved accounting system. If the company intends to continue work with the DoD, an approved accounting system will allow for competition in a broader array of acquisition opportunities. Please address questions to the Phase II CO, if selected for award.

All proposals must be submitted electronically via DSIP by the date indicated in the Phase II proposal instructions. Note: Only ONE Phase II proposal may be submitted for each Phase I award.

AIR FORCE SBIR PROGRAM MANAGEMENT IMPROVEMENTS
The AF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees will be notified. The AF also reserves the right to change any administrative procedures at any time that will improve management of the AF SBIR Program.

AIR FORCE 22.2 SBIR Phase I Topic Index

SF222-0023 Hardware to Enhance Resilience of Satellites to Directed Energy Threats

AF222-0024 Novel method of estimating moving target spatial dynamics for radar imaging

AF NUMBER: AF222-0001

TITLE: Hyperspectral, Wide Field of View Spatially Variant Photonic Crystals

TECH FOCUS AREAS: Microelectronics; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Materials

OBJECTIVE: Design, simulate, and fabricate durable, practical photonic devices to function as components in guidance systems operating in the Near Infrared (NIR) and Mid Infrared (MIR) with a wide field-of-view.

DESCRIPTION: Novel, robust, durable, and practical photonic devices are sought to function as components in guidance for alternate navigation systems to augment GPS degradation or availability. The devices must produce a tunable, highly directional radiation pattern. They must be broadband and operate through the NIR/MIR wavelengths. They must support a wide field-of-view between 150° – 170°. Devices will ideally be composed of single units rather than an array of components to minimize footprint. Designs must support a variety of novel geometries in addition to standard, traditional structures. Material requirements must be practical and not include high refractive index, negative refractive index, or other media that is difficult and costly to procure. Electromagnetic simulations should be performed with open-source tools on the candidate devices to provide proof-of-concept performance. The proposed designs will leverage modern additive manufacturing methods to enable the design of practical, durable, low-cost, low-volume devices. State-of-the-art approaches to achieving practical, directional, lightweight systems include devices based on material composition including frequency dependent, anisotropic, and metamaterials, electromagnetic band gap waveguides, array feeds, and transformation optics. Devices emphasizing material composition can be highly directional, but they tend to be narrow band and require large footprints. Arrays of feeds rather than a single feed have also been used to broaden system performance, but this leads to an increase in size and mechanical complexity – an important consideration due to mechanical scan systems often being a key point of failure. Devices based on transformation optics can be highly tailorable, but these often require exotic materials. All these methods also tend to require complex fabrication.

PHASE I: Explore proof-of-concept device designs capable of supporting a field-of-view between 150°-170°, operating across the NIR/MIR wavelengths, with low refractive index materials. Perform simulations using open-source tools such as Julia and Python. Compare the simulated performance of traditional structures with novel designs, including size, weight, power, and durability.

PHASE II: Fabricate the most promising designs identified during Phase I. The fabricated devices will undergo inspection and electromagnetic characterization to validate a wide field-of-view, broad bandwidth, and other target performance metrics mentioned above. Identify applications where these devices would offer improvements in size, weight, power, and durability.

PHASE III DUAL USE APPLICATIONS: GNC system components are used in many commercial and defense applications including aerospace, automotive, land, and remote sensing applications. Devices made to be durable, tunable, and broadband would provide a considerable improvement to existing solutions and would find widespread applications in these areas.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES:

1. Shirk, J. S., Sandrock, M., Scribner, D., Fleet, E., Stroman, R., Baer, E., Hiltner, a, & Systems, O. S. (2006). Biomimetic Gradient Index (GRIN) Lenses. Review Literature And Arts Of The Americas, 53–61.

2. Akmansoy, É., Gaufillet, F., & Akmansoy, É. (2016). Graded Photonic Crystals for Luneburg Lens. IEEE Photonics Journal, 8(1), 1–11. https://doi.org/10.1109/JPHOT.2016.2521261

3. Park, J.-M., Lee, S.-G., Park, H. Y., & Kim, J.-E. (2008). Efficient beaming of self-collimated light from photonic crystals. Optics Express, 16(25), 20354. https://doi.org/10.1364/oe.16.020354

KEYWORDS: spatially variant photonic crystals (SVPC), bioinspired, wide field of view, broadband

AF NUMBER: AF222-0002

TITLE: Automated Data Forensics for Collaborative Weapon Behaviors

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems; Battlespace

OBJECTIVE: Cooperative weapons can increase effectiveness of the warfighter against a peer adversary while providing increased protection of valuable air assets requiring increased stand-off range. More specifically, this work will enhance the effectiveness of collaborative weapons in multi-day campaigns against integrated air defense systems by delivering analytics, diagnostics, and algorithms that enable rapid reprogramming based on the prior day's battle data.

DESCRIPTION: US air superiority is being challenged by the fast-paced technological advances of opponent entities. At the same time, US DoD budgetary constraints limit the possible approaches that can mitigate these opponent advances. To maintain air superiority, while satisfying monetary constraints, one intriguing solution is to overwhelm the enemy through the deployment of teams or swarms of weapons. Using a number of significantly low-cost assets provides an economic advantage versus the deployment of a single highly expensive vehicle, and it flips the cost-exchange ratio of the conflict to favor US forces. Battle data analytics and forensics aims to improve cooperative weapon effectiveness through phase-based learning of multi-day or multi-wave missions. This program's intent is to improve decision-making for next day mission with regards to weapon tactics and selection of algorithms for engagement, purely in software. Updates to the weapon software rapidly hinges upon the ability to analyze the data sent back from the weapons regarding its performance. Hence, this work intends to develop and employ algorithms which analyze prior weapon data from previous missions in order to improve weapon and mission effectiveness for future battles. The improvement will come from updating particular models and parameters for the weapons, as well as, selecting appropriate and effective algorithms in real-time based on the analytic tools that are developed. The learning/analytics challenge can be broken into three broad focus areas: red force learning, blue force learning, and autonomy software based learning. Blue force learning is focused on updating parameters and models for blue weapons (e.g. aero model coefficients, control/guidance gains, seeker models, etc.) while red force learning is focused on updating models and parameters associated with red threats, targets, tactics, and capabilities. Autonomy tactics learning is focused on updating and improving cooperative algorithms, behaviors, and plays of the blue weapon salvos in order to improve mission effectiveness. The results of this work will then inform which data is most beneficial to weapon effectiveness, which can then be used to inform datalink and on-board recording requirements. In tandem with algorithm development, we seek to answer three key questions: What information is most important for communication and logging (at the algorithm/decision level)? How to design mechanisms for effective and rapid updating of parameters/algorithms? How to select algorithms based on whatever data is available at the time and how sparse is the data?

PHASE I: During phase I, the performers will determine their methodology to address a particular red, blue, or autonomy tactics analytic challenge. They will select a particular algorithmic approach for data analytics rooted in the appropriate areas (e.g., artificial intelligence or machine learning) for implementation for preliminary results. Extensive literature surveys and prior research highlighting the advantages and limitations of the chosen approach is required.

PHASE II: A successful phase II effort will constitute the full development of data analytic tools for the red/blue/autonomy challenges. The performer will implement the approach chosen in phase I within AFSIM or another (AFRL-approved) suitable software environment. Connections between offline tools and real-time swarm-based decisions must be developed. Full comparisons of multi-day collaborative missions using the tools with benchmarks against alternative methods are required. Documentation of the implementation including user manuals, theory manuals, examples, and source code with U.S. government data rights is required.

PHASE III DUAL USE APPLICATIONS: Phase III will consist of transitioning the software module proven in phase II to existing code bases employed by the DoD and its prime contractors developing next-generation networked munition concepts. This transition will focus on user support or consulting to effectively deploy the software in a R&D or T&E environment.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Kelleher, John D., Brian Mac Namee, and Aoife D'arcy. Fundamentals of machine learning for predictive data analytics: algorithms, worked examples, and case studies. MIT press, 2020; Rizk, Yara, Mariette Awad, and Edward W. Tunstel. "Cooperative heterogeneous multi-robot systems: A survey." ACM Computing Surveys (CSUR) 52.2 (2019): 1-31. Moubayed, Abdallah, et al. "E-learning: Challenges and research opportunities using machine learning & data analytics." IEEE Access 6 (2018): 39117-39138. Kibria, Mirza Golam, et al. "Big data analytics, machine learning, and artificial intelligence in next-generation wireless networks." IEEE access 6 (2018): 32328-32338. Kashyap, Hirak, et al. "Big data analytics in bioinformatics: A machine learning perspective." arXiv preprint arXiv:1506.05101 (2015). Alighanbari, Mehdi, and Jonathan P. How. "Decentralized task assignment for unmanned aerial vehicles." Proceedings of the 44th IEEE Conference on Decision and Control. IEEE, 2005.

KEYWORDS: artificial intelligence; data analytics; machine learning; collaborative weapons; heterogeneous agents

AF NUMBER: AF222-0003

TITLE: Cloud-based IoT Acceptance Test Methodologies for Air Force Systems Integration

TECH FOCUS AREAS: Cybersecurity; Network Command, Control and Communications; Autonomy; Artificial Intelligence/Machine Learning; 5G

TECHNOLOGY AREAS: Sensors; Information Systems

OBJECTIVE: Develop an automated Internet-of-Things Testing as a Service (IoT-TaaS) approach for assuring the resiliency and readiness of Air Force systems with embedded IoT technology

DESCRIPTION: The addition of IoT devices and systems to USAF networks and weapon systems poses a risk to readiness and mission operations. Additionally, IoT technology evolution is inconsistent and lacks assurance that upgrades and software configuration changes are adequately vetted for resiliency. Existing IoT testing capabilities do not address the nuances associated with embedding IoT into weapon system development programs. For example, it does not focus on all life cycle phases. The DoD Cybersecurity T&E Guidebook lacks a focus on IoT device integration.

PHASE I: Define and develop an initial architecture concept for a cloud-based IoT-TaaS capability. Include a high level capabilities design/description for a prototype that would be built in Phase 2.

PHASE II: Based on the results of Phase 1, develop a detailed framework and architecture design for a cloud-based IoT-TaaS capability. Develop and demonstrate a prototype cloud-based IoT acceptance test tool. Demonstrate the capability against a set of test scenarios.

PHASE III DUAL USE APPLICATIONS: Utilize the cloud-based IoT-TaaS capability developed in Phase 2 beyond the DoD. The true success of IoT capabilities is dependent on communication/interoperability with multiple sectors.

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KEYWORDS: IoT; methodology; Digital Twin; best practices; modeling; cyber resilience; data integrity

AF NUMBER: AF222-0004

TITLE: Next-Generation Focal Plane Array Semi-Active Laser Seeker Algorithms

TECH FOCUS AREAS: Microelectronics; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics

OBJECTIVE: Develop a suite of algorithms suited for next-generation focal plane array seekers which will be single devices capable of both semi-active laser sensing and passive imaging, demonstrating performance which meets or exceeds current fielded systems of each (and/or both) mode(s).

DESCRIPTION: A number of investigatory projects have shown feasibility of semi-active laser seekers in focal plane array format, leading to new development for single focal plane array, dual mode, and Semi-Active Lasers/Passive seekers. These seekers will require new algorithms capable of legacy SAL seeker performance in a new focal plane array format. Algorithms such as last significant pulse logic (LSPL) and spot jump inhibit (SJI) may need to be reinvented and tested. Data fusion of the semi-active laser + passive signals may provide new concept of operations, but also require new algorithms. With the contribution of hardware developers and/or COTS devices, creative concepts are sought which may meet current performance or leverage new hardware capabilities to greater performance. Proposals should describe a basic strategy for acquiring hardware, which may include Commercial Off the Shelf (COTS) components or participation with a prime contractor or other company. The priority is having a platform to demonstrate the relevant advances, it is not necessary that it be in a final configuration. For example, discrete boresighted Semi-Active Lasers/imager devices could be used in place of an imagined future dual-mode singular device. Proposals should include one of more of the following areas: 1) Mimicry of traditional semi-active laser algorithms onto new FPA-format hardware. 2) Advanced algorithms which may provide more performance when used with next-generation FPA SAL seekers. 3) Data fusion between SAL guidance signal and automatic target recognition. Of secondary interest is other novel concepts which may enable multi-use from a single device, such as autonomous navigation. Proposals including significant hardware development are not desired for this topic.

PHASE I: Complete analysis and design of software approach in conjunction with hardware downselection. Conceptual designs should include performance modeling and comparison with existing systems.

PHASE II: Produce a system design and prototype of Phase I concepts. Prototypes will be tested in both laboratory and field environments.

PHASE III DUAL USE APPLICATIONS: Successful demonstration will result in transition through hardware development partners to include approaches in new seeker designs which are being developed. Multi-use approaches which involve data fusion for active laser sensing combined with passive scene detection will be applicable to other industries such as vehicle advanced driver assistance systems (ADAS).

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: [1] J. Barth, A. Fendt, R. Florian, et al., "Dual-mode seeker with imaging sensor and semi-active laser detector," Proceedings of the SPIE Volume 6542 (2007); [2] J. English, R. White, "Semi-active laser (SAL) last pulse logic infrared imaging seeker," Proceedings of the SPIE Volume 4372 (2001); [3] Patent US 8,164,037, “Co-boresighted dual-mode SAL/IR seeker including a SAL spreader,” Raytheon Company, David D. Jenkins, Byron B. Taylor, David J. Markason, Apr. 24, 2012.

KEYWORDS: semi-active laser guidance; human-in-the-loop; autonomous guidance and control; laser designated; dual-mode seeker; automatic target recognition

AF NUMBER: AF222-0005

TITLE: Rapid Data and Sensor Fusion for Collaborative Automated Target Acquisition

TECH FOCUS AREAS: Network Command, Control and Communications; Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors; Information Systems

OBJECTIVE: AFRL is seeking innovative research to enable near-real-time data and information fusion on limited SWAP platforms to support collaborative automated target acquisition (ATA) in multi-target, multi-agent environments.

DESCRIPTION: The Munitions Directorate of the Air Force Research Laboratory is soliciting white papers under this Broad Agency Announcement (BAA) for research, development, and evaluation of technologies/techniques to enable near-real-time collaborative ATA based on data and sensor fusion in complex adversarial environments. As collaborative munitions become more pervasive, warfighters seek to maximize the benefits of swarming and autonomy to include employing near real time identification and tracking of multiple targets during their relatively short flight times (seconds-to-minutes). These operations will be carried out by platforms that have limited SWAP and modest communication capabilities that must be low-latency, using heterogeneous mixtures of sensing modalities in highly complex environments.

To combat these challenges future operational concepts will incorporate networked, heterogeneous, AI-enabled, real-time sensing systems on autonomous/semi-autonomous platforms. Such systems will support autonomous targeting in near-real-time (e.g., seconds). It has been recognized that diverse sensors and information types will be required to overcome a combination of obscured targets, multiple targets and confounders, and high-consequence actions. The successful proposal will address how to combine a priori data into a state-based construct that a) optimizes real-time data collection, and b) minimizes real-time communication requirements.

PHASE I: Conceptualize, develop, and model an algorithmic solution that provides near real-time collaborative ATA for heterogeneous sensors.

PHASE II: Implement, prototype, and demonstrate the near real-time collaborative ATA function.

PHASE III DUAL USE APPLICATIONS: Adapt and implement the collaborative ATA function into a selected collaborative munition system.

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REFERENCES: [1] Kim, Sungho, Woo-Jin Song, and So-Hyun Kim. "Robust ground target detection by SAR and IR sensor fusion using Adaboost-based feature selection." Sensors 16, no. 7 (2016): 1117; [2] Zhou, Y., Sun, X., Zha, Z.J. and Zeng, W., 2019. Context-reinforced semantic segmentation. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern

Recognition (pp. 4046-4055); [3] Volle, K., Rogers, J. and Brink, K., 2016. Decentralized cooperative control methods for the modified weapon–target assignment problem. Journal of Guidance, Control, and Dynamics, 39(9), pp.1934-1948.

KEYWORDS: sensor fusion; information fusion; data fusion; machine learning; target identification; swarms; swarming; collaborative munitions

AF NUMBER: AF222-0006

TITLE: Circularly Polarized High Power Antenna

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Electronics; Materials

OBJECTIVE: This topic is intended to develop a high gain, high power, circularly polarized mesoband coaxial-fed antenna for HPM field applications.

DESCRIPTION: Proposals to this topic should identify promising antenna topologies; model and simulate the excitation and radiation of the design; and build and test the antenna. This antenna should be capable of meeting the MIL-STD-810g shock and vibration. It should be rated to handle an input pulse with FWHM of 10 ns and peak powers of one gigawatt. The antenna design should be scalable to radiate L- and S-band, but not necessarily simultaneously. The L-band design should radiate with gain of at least 21 dB and emphasis on 1.1 GHz. The S-band design should radiate with gain of at least 27 dB and emphasis on performance at 2.8 GHz. The radiation pattern should be circularly polarized. The antenna or array should fit with a volume less than 1.5 cubic meters. The antenna design, modeling and simulation results, and experimentally validated antenna pattern should be delivered to AFRL.

PHASE I: During phase one, teams should identify an appropriate antenna architecture to meet the stated requirements. Teams should model this antenna using an appropriate modeling and simulation software, with emphasis on electrodynamic performance under one gigawatt drive. Antenna performance should be characterized, both as a function of frequency-dependent gain and radiation pattern. A preliminary analysis of shock and vibration hardiness should be performed. An antenna design, modeling and simulation results, and path forward to meeting phase two and three requirements must be submitted to the AFRL TPOCs.

PHASE II: During phase two, teams should construct both the L- and S-band antenna designs proposed in phase one. These antennas should be characterized experimentally using AFRL-supplied HPM sources, including frequency-dependent gain, antenna pattern, and polarization. Shock and vibration hardiness should also be analyzed. The completed antennas should be delivered to AFRL. A report detailing the antenna's characterization, including raw data sets, and path forward to meeting phase three requirements is also required.

PHASE III DUAL USE APPLICATIONS: During phase three, teams will work with AFRL on improving manufacturability, with emphasis on utilizing common or COTS materials and previously established supply chains. Further integration and operational tests with AFRL sources will also take place. Finally, improvements to the antenna should be proposed. A report detailing improvements to manufacturability, antenna performance, and operational test results will be due to AFRL.

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KEYWORDS: High Gain; Antenna; Circular Polarization; High Power Microwave; HPM

AF NUMBER: AF222-0007

TITLE: High Frequency High Gain High Power Microwave Antenna

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Electronics; Materials;Battlespace

OBJECTIVE: The objective of this SBIR is to design, build, and test high frequency, high gain antennas for High Power Microwave (HPM) applications [1]. There are two main thrusts to this effort. One is a compact mechanically or electrically phased antenna. At the end of the Phase III, the desired end state would be a full design, to include both electromagnetic simulations and mechanical drawings, as well as hardware that could be tested. The other thrust would be for a larger broadband antenna that can cover the entire X- and Ku-band. The desired end state of the Phase III of this effort would be a full design, to include both electromagnetic simulations and mechanical drawings.

DESCRIPTION: There are two main thrusts to this effort. One is the development of a phased array antenna suitable for HPM sources at GW power levels. Phased antennas have the benefit of reduced size, weight and power (SWaP) due to their low profile, potential conformal geometries to meet host platform requirements, and their ability to provide beam steering via phase shifting of their elements rather than bulk antenna movement. Phase shifting may be achieved by means of mechanical actuators (e.g. physical manipulation of individual elements) [2], or by means of controlling the electromagnetic fields at each element (e.g. high power phase shifters). The second thrust is for a large broadband antenna that can cover the entire X-band and Ku-band (8-18 GHz). Instantaneous full bandwidth is highly desired, but a tunable bandwidth covering this frequency range is acceptable. A wide bandwidth, high gain, steerable antenna will enable the next generation of HPM systems to deliver enhanced effects against a broader selection of targets.

PHASE I: The contractor must demonstrate through electromagnetic simulation a phased array antenna with at least 40 dBi of gain at discrete frequencies within the X- and Ku-band. The antenna shall be phase steerable with at least +/- 20 degrees in both azimuth and elevation as well as be capable of handling GW power levels. The contractor shall demonstrate through electromagnetic simulations a wideband antenna that covers the entire frequency range of X- and Ku-band. The antenna shall be slewable from -15 to 90 degrees in elevation, 360 degrees in azimuth as well as be capable of handling GW power levels.

PHASE II: The contractor shall design, build, and demonstrate a single element of the phased array antenna designed in Phase I. The module shall demonstrate all electromagnetic parameters needed in order to satisfy the full array requirements described in Phase I. The contractor shall work on improving the full array design to include customer requirements for platform and source integration, as well as determine the limiting factors and trade-offs as it relates to frequency bandwidths, steerability (precision, slew rates, and angular limits), and power handling. The contractor shall continue the design on the wideband slewable antenna. The contractor shall conduct a design review to address and resolve all critical system-wide performance parameters.

PHASE III DUAL USE APPLICATIONS: The contractor shall design, build, and demonstrate a module of at least 5 elements suitable for incorporating into the full array designed in Phase I and II. This module shall demonstrate all electromagnetic parameters needed in order to satisfy the full array requirements described in Phase II. The contractor shall provide the cost and schedule to fabricate and demonstrate the full phased array antenna. The contractor shall deliver a complete technical data package for the full array to include all electromagnetic simulations and manufacturing-ready drawings. The contractor shall complete the design of the wideband slewable antenna. The contractor shall conduct a design review to ensure that the antenna can meet the stated performance requirements. The contractor shall provide the cost and schedule to fabricate and demonstrate the antenna. The contractor shall deliver a complete technical data package for the antenna to include all electromagnetic simulations and manufacturing-ready drawings.

REFERENCES: Y. Rahmat-Samii, D. -. Duan, D. V. Giri and L. F. Libelo, "Canonical examples of reflector antennas for high-power microwave applications," in IEEE Transactions on Electromagnetic Compatibility, vol. 34, no. 3, pp. 197-205, Aug. 1992, doi: 10.1109/15.155830. ; L. F. Libelo and C. M. Knop, "A corrugated waveguide phase shifter and its use in HPM dual-reflector antenna arrays," in IEEE Transactions on Microwave Theory and Techniques, vol. 43, no. 1, pp. 31-35, Jan. 1995, doi: 10.1109/22.363011.

KEYWORDS: high power microwave; HPM; antenna

AF NUMBER: AF222-0008

TITLE: Bench-level laser guide star (LGS) Source and Turbulence Simulator

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Sensors; Electronics

OBJECTIVE: The objective of this project is to develop a bench-level source and turbulence simulator that can accurately simulate common laser guide star (LGS) beacons for LGS adaptive optics (AO) systems and test beds. Currently new LGS AO design concepts can only be tested in simulation or through expensive and man-power intensive on-sky testing. This project seeks to develop methods for accurately simulating an LGS beacon on an optics bench to enable rapid prototyping of new LGS AO technologies. The ideal bench source would accurately simulate sodium and Rayleigh beacons including atmospheric effects on the uplink and downlink propagation of the beacon, the temporal and spatial coherence properties of LGS beacons including beacon elongation, focus and angular anisoplanatism effects, user defined beacon jitter, and support multiple beacon constellations (including a mix of Rayleigh and sodium beacons, multiple Rayleigh, or multiple sodium beacons). In addition, the various parameters of the beacon being simulated should be reconfigurable (i.e. the user should be able to change the launch size of the beacon, beacon altitude, beacon elongation, number and type of beacons, different constellation configurations, side vs center vs full aperture launch, etc.). The final beacon and turbulence simulator must be fully characterized to ensure high confidence in the beacon parameters that are being simulated, provide a high degree of repeatability between experiments, and be easily configured to achieve desired beacon and turbulence parameters. The LGS beacon simulator must also support a broadband "natural" guidestar beacon to test the effectiveness of the LGS AO correction on a target of interest. In short, the objective is to create a bench-level source that accurately simulates LGS beacons in a repeatable and configurable atmospheric turbulence simulator to enable rapid and effective testing of LGS AO technology and dramatically speed up technology development.

DESCRIPTION: The goal of the project is to create a perfectly representative LGS source and atmospheric turbulence simulator; however, practical considerations will inevitably lead to trade-offs between accurately simulating different beacon parameters and practical trade-offs to ensure predictable and repeatable beacon and turbulence parameters, enable easy reconfiguration, and meet cost or schedule constraints. Thus a detailed sensitivity analysis and requirements flow down will be a critical part of the project. The initial target LGS AO system is a 1-4m class telescope with a side-launched sodium or Rayleigh beacon. While the primary focus of the development effort is on simulating LGS beacons, the simulator must also include atmospheric turbulence to be effective. The turbulence simulator should include at least two Komologrov phase screens and be capable of generating atmospheric parameters covering a range of coherence lengths: threshold of 3-15 cm, objective of 1.5-20 cm; isoplanatic angle: threshold of 4 – 15 µrad, objective of 2-20 µrad; and greenwood frequency: threshold: 0-500 Hz, objective 0-1000 Hz. It is also highly desirable to have an option to remove turbulence effects for alignment and troubleshooting work. The sensitivity analysis should at a minimum consider the effects of beacon parameters on the most common LGS AO wavefront sensor (WFS), the Shack-Hartmann WFS (SHWFS), but ideally the sensitivity analysis would consider multiple WFS or be WFS agnostic to ensure future testing of new WFS concepts is also supported. For example, it’s possible that the proposed method for simulating an elongated sodium beacon is not compatible with accurately simulating beacon jitter (i.e. jitter due to the laser launch telescope). At a minimum, the sensitivity analysis would be used to determine whether beacon jitter or beacon elongation has a more deleterious effect on the LGS AO performance of the baseline system and thus inform system development. Ideally, the sensitivity analysis would also include potential uses of the simulator for future development efforts. This additional analysis is more open ended and difficult, but a review of the current literature on LGS AO systems can be used to anticipate some possible use cases of a LGS source/turbulence simulator. A few examples include: laser tomography to mitigate focus anisoplanatism, uplink correction of the laser beacon, combining measurements from different beacon types (Rayleigh, Sodium, and/or natural), pulsed sodium systems to minimize beacon elongation, alternative WFS concepts (i.e. the Ingot WFS), etc. For example, when developing a method for generating multiple sodium beacons or multiple Rayleigh beacons, the effect of adding additional beacons on mitigating focus anisoplanatism can be estimated given the altitude of the beacons, the size of the telescope, and the turbulence profile. Thus a sensitivity analysis can be used to justify a limited number of beacons if necessary to meet system level trade-offs or budget constraints. In short, the initial stages of the project will focus not only on developing methods to simulate LGS beacons and atmospheric turbulence, but also the analysis necessary to make intelligent trade-offs in the final system design. The sensitivity analysis will also feed into requirements development and flow-down for development of techniques to simulate various aspects of the laser beacon. Requirements development should be done concurrently with the sensitivity analysis in an iterative process to identify limitations that may necessitate different designs or restrictions in capabilities. While most design and development work is anticipated to be based on computer simulation, any techniques that are key to the overall function and/or higher risk should be tested in a standalone hardware configuration. For example, the technique for generating an extended beacon is critical to the overall simulation of an LGS beacon and thus should be demonstrated with physical hardware. The demonstration can be at the component level and does not need to include the turbulence simulation or other aspects of the beacon simulation (jitter, Rayleigh scatter contamination, etc.). Once concepts are fully developed and critical concepts are demonstrated on an individual/component level, work will shift toward integration of the various components into a complete LGS source/turbulence simulator. The initial integration work will focus on simulating the most important LGS beacon parameters (as determined by the sensitivity analysis) in a turbulence simulator. The initial integrated design should be capable of simulating at least one beacon of each type (Rayleigh, Sodium, and a target or natural guidestar) with atmospheric turbulence effects (both uplink and downlink for LGS beacons), and demonstrate the capability to vary beacon and turbulence parameters with predictable and repeatable results. The design should include options for more advanced simulation scenarios, e.g. multiple beacons, uplink correction, etc., but initial testing will focus on thorough testing of basic system functionality and only move onto testing more complicated scenarios once basic functionality testing is successful. The integrated system should be small enough to fit on a standard optical bench (less than roughly 6'x8'x4' volume), have an optical output power of at least 1 μW/cm^2 to the AO system using Class 3B lasers (objective: optical efficiency >1%), and have an output beam of ~1" in diameter. The initial system should be capable of operating over visible wavelengths but does not need to use laser sources that match standard Rayleigh and Sodium wavelengths. Ideally the system would be wavelength agnostic so that the end user could integrate any desired beacon wavelength, but at a minimum the system needs to simulate two different wavelengths (one for Rayleigh and one for Sodium, separated by at least 50 nm) and support a visible or near infrared broadband target source (>100 nm bandwidth). Once initial functionality has been demonstrated and tested, additional capabilities will be integrated and tested with the goal of identifying any system limitations or shortfalls that can be mitigated or resolved in later designs. If the initial integration stage is successful, further development will focus on optimizing the design for integration onto a LGS AO system that is capable of on-sky testing, either through modifications and redesign of the initial system or a completely new system design. The primary goal of integrating with a full-up LGS AO system would be to enable comparison testing between on-sky and bench results. Once again, analysis and testing would focus on identifying system limitations and shortfalls that can be used to improve future

LGS ATS designs. Ultimately, the project should support the development of a robust LGS ATS capability that can be deployed onto multiple systems and be used to rapidly test new LGS AO technologies in support of Air Force and Space Force missions. The technology developed in this project can also be readily transitioned to support LGS AO systems on astronomical telescopes where a more realistic source/turbulence simulator could be very valuable for maximizing observation time. The sensitivity analysis will also feed into requirements development and flow-down for development of techniques to simulate various aspects of the laser beacon. Requirements development should be done concurrently with the sensitivity analysis in an iterative process to identify limitations that may necessitate different designs or restrictions in capabilities. While most design and development work is anticipated to be based on computer simulation, any techniques that are key to the overall function and/or higher risk should be tested in a standalone hardware configuration. For example, the technique for generating an extended beacon is critical to the overall simulation of an LGS beacon and thus should be demonstrated with physical hardware. The demonstration can be at the component level and does not need to include the turbulence simulation or other aspects of the beacon simulation (jitter, Rayleigh scatter contamination, etc.). Once concepts are fully developed and critical concepts are demonstrated on an individual/component level, work will shift toward integration of the various components into a complete LGS ATS system. The initial integration work will focus on simulating the most important LGS beacon parameters (as determined by the sensitivity analysis) in a unified LGS ATS. The initial integrated design should be capable of simulating at least one beacon of each type (Rayleigh, Sodium, and a target or natural guidestar) with atmospheric turbulence effects (both uplink and downlink for LGS beacons), and demonstrate the capability to vary beacon and turbulence parameters with predictable and repeatable results. The design should include options for more advanced simulation scenarios, e.g. multiple beacons, uplink correction, etc., but initial testing will focus on thorough testing of basic system functionality and only move onto testing more complicated scenarios once basic functionality testing is successful. The integrated system should be small enough to fit on a standard optical bench (less than roughly 6’x8’x4’ volume), have an optical output power of at least 1 µW/cm^2 to the AO system using Class 3B lasers (objective: optical efficiency >1%), and have an output beam of ~1” in diameter. The initial system should be capable of operating over visible wavelengths but does not need to use laser sources that match standard Rayleigh and Sodium wavelengths. Ideally the system would be wavelength agnostic so that the end user could integrate any desired beacon wavelength, but at a minimum the system needs to simulate two different wavelengths (one for Rayleigh and one for Sodium, separated by at least 50 nm) and support a visible or near infrared broadband target source (>100 nm bandwidth). Once initial functionality has been demonstrated and tested, additional capabilities will be integrated and tested with the goal of identifying any system limitations or shortfalls that can be mitigated or resolved in later designs. If the initial integration stage is successful, further development will focus on optimizing the design for integration onto a LGS AO system that is capable of on-sky testing. Either through modifications and redesign of the initial system or a completely new system design. The primary goal of integrating with a full-up LGS AO system would be to enable comparison testing between on-sky and bench results. Once again, analysis and testing would focus on identifying system limitations and shortfalls that can be used to improve future LGS ATS designs. Ultimately, the project should support the development of a robust LGS ATS capability that can be deployed onto multiple systems and be used to rapidly test new LGS AO technologies in support of Air Force and Space Force missions. The sensitivity analysis will also feed into requirements development and flow-down for development of techniques to simulate various aspects of the laser beacon. Requirements development should be done concurrently with the sensitivity analysis in an iterative process to identify limitations that may necessitate different designs or restrictions in capabilities. 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Either through modifications and redesign of the initial system or a completely new system design. The primary goal of integrating with a full-up LGS AO system would be to enable comparison testing between on-sky and bench results. Once again, analysis and testing would focus on identifying system limitations and shortfalls that can be used to improve future LGS ATS designs. Ultimately, the project should support the development of a robust LGS ATS capability that can be deployed onto multiple systems and be used to rapidly test new LGS AO technologies in support of Air Force and Space Force missions. The technology developed in this project can also be readily transitioned to support LGS AO systems on astronomical telescopes where a more realistic source/turbulence simulator could be very valuable for maximizing observation time. The sensitivity analysis will also feed into requirements development and flow-down for development of techniques to simulate various aspects of the laser beacon. Requirements development should be done concurrently with the sensitivity analysis in an iterative process to identify limitations that may necessitate different designs or restrictions in capabilities. While most design and development work is anticipated to be based on computer simulation, any techniques that are key to the overall function and/or higher risk should be tested in a standalone hardware configuration. For example, the technique for generating an extended beacon is critical to the overall simulation of an LGS beacon and thus should be demonstrated with physical hardware. The demonstration can be at the component level and does not need to include the turbulence simulation or other aspects of the beacon simulation (jitter, Rayleigh scatter contamination, etc.). Once concepts are fully developed and critical concepts are demonstrated on an individual/component level, work will shift toward integration of the various components into a complete LGS ATS system. The initial integration work will focus on simulating the most important LGS beacon parameters (as determined by the sensitivity analysis) in a unified LGS

ATS. The initial integrated design should be capable of simulating at least one beacon of each type (Rayleigh, Sodium, and a target or natural guidestar) with atmospheric turbulence effects (both uplink and downlink for LGS beacons), and demonstrate the capability to vary beacon and turbulence parameters with predictable and repeatable results. The design should include options for more advanced simulation scenarios, e.g. multiple beacons, uplink correction, etc., but initial testing will focus on thorough testing of basic system functionality and only move onto testing more complicated scenarios once basic functionality testing is successful. The integrated system should be small enough to fit on a standard optical bench (less than roughly 6'x8'x4' volume), have an optical output power of at least 1 µW/cm^2 to the AO system using Class 3B lasers (objective: optical efficiency >1%), and have an output beam of ~1" in diameter. The initial system should be capable of operating over visible wavelengths but does not need to use laser sources that match standard Rayleigh and Sodium wavelengths. Ideally the system would be wavelength agnostic so that the end user could integrate any desired beacon wavelength, but at a minimum the system needs to simulate two different wavelengths (one for Rayleigh and one for Sodium, separated by at least 50 nm) and support a visible or near infrared broadband target source (>100 nm bandwidth). Once initial functionality has been demonstrated and tested, additional capabilities will be integrated and tested with the goal of identifying any system limitations or shortfalls that can be mitigated or resolved in later designs. If the initial integration stage is successful, further development will focus on optimizing the design for integration onto a LGS AO system that is capable of on-sky testing. Either through modifications and redesign of the initial system or a completely new system design. The primary goal of integrating with a full-up LGS AO system would be to enable comparison testing between on-sky and bench results. Once again, analysis and testing would focus on identifying system limitations and shortfalls that can be used to improve future LGS ATS designs. Ultimately, the project should support the development of a robust LGS ATS capability that can be deployed onto multiple systems and be used to rapidly test new LGS AO technologies in support of Air Force and Space Force missions.

PHASE I: Phase I will consist of a sensitivity analysis to determine which properties of an LGS beacon are most relevant to an LGS AO system design on a 1-4m telescope. The sensitivity analysis will be critical to determining which areas to focus on for technical development and help resolve any potential trade-offs in future system design work. The sensitivity analysis will also feed into and be informed by requirements flow down and concept development, which will be based primarily on computer simulation but should include limited component level hardware design and testing for critical components to verify the adequacy of the technique in simulating a LGS beacon. Primary output of Phase One is a final report which covers the following topics: -Summary of the sensitivity analysis with key results showing which beacon parameters were found to be most important for an LGS beacon simulator -Detailed description of the preliminary design, highlighting key trade-offs and technical innovations in simulating an LGS beacon and the proposed method for integrating each component into a final integrated system -A top-level requirements flow-down and preliminary design of key components of the LGS source and turbulence simulator system, i.e. hardware generating extended beacons, phase wheels, laser sources, any active hardware (e.g. steering mirror, spatial light modulator, etc.), and any other custom or critical hardware -Summary of any component level testing, with comparison between test data and desired beacon/turbulence characteristics.

PHASE II: Phase II will move on to the design and development of an integrated bench-level source, demonstrating not only accurate simulation of the key properties of a laser beacon, but also the ability to readily vary the beacon parameters with predictable and repeatable results. Testing and characterization of the setup will be completed to identify any shortfalls in the system setup. At a minimum testing of the integrated system should include a SHWFS in an open-loop configuration, ideally testing would be done with a full LGS AO system or test bed to demonstrate the effectiveness of the final design in its end-use case. The primary deliverable of Phase II will be an integrated LGS source and turbulence simulator system meeting the following requirements: -Fits within 6'x8'x4' (width, length, height) volume (smaller is preferred) -Includes at least two phase screens and is capable of simulating a range of atmospheric turbulence parameters: coherence length (threshold of 3-15 cm, objective of 1.5-20 cm); isoplanatic angle (threshold of 4 – 15 µrad, objective of 2-20 µrad); and greenwood frequency (threshold: 0-500 Hz, objective 0-1000 Hz), also includes option for removing turbulence from beam path -Simulates at least one Rayleigh beacon, one Sodium beacon and a broadband target source concurrently, Rayleigh and Sodium beacons must be in the visible band and at different wavelengths (>50 nm separation) and target source must be in the visible or near infrared band (400- 1000 nm) with >100 nm spectral bandwidth -System simulates uplink and downlink atmospheric effects on the laser beacons including focus and angular anisoplanatism effects (uplink and downlink can have different turbulence paths but should have the same turbulence statistics) -Predictable and repeatable laser beacon and turbulence parameters (user should be able to configure the system to achieve desired beacon and turbulence parameters with 1% -Simulate user-defined beacon jitter and include option for uplink correction (this can just be a place holder for an SLM or deformable mirror) A final report is also required covering: -Final system design, with detailed drawings (Zemax or equivalent optical design drawings, Solidworks or equivalent mechanical drawings, electrical design drawings, etc.) and specifications and data sheets for all key components (optical and electrical components) -Test results from basic functionality testing comparing measured results to predicted results and to desired results -Characterization results showing the accuracy and repeatability of varying system configuration parameters and any software required to generate system configurations from user defined beam/turbulence parameters -Lessons learned and recommendations for future system designs.

PHASE III DUAL USE APPLICATIONS: If Phase II is successful, phase III will seek to further refine the initial design. The primary goal for phase III would be to adapt the phase II system for integration with an on-sky capable LGS AO system. This would either represent some modifications and redesign of the phase II system or a completely new design customized for optimal integration with the LGS AO system. Any redesign required would build on lessons learned from the phase II project. Once completed, testing would focus on comparing on-sky and bench level results to further validate the capabilities of the LGS source/turbulence simulator system. If the results of the on-sky comparison testing is favorable, the work would transition to designing and developing LGS source and turbulence simulator systems for specific Air Force and Space Force applications. The primary deliverable of Phase III will be an LGS source and turbulence simulator system integrated with an on-sky capable LGS AO system. The requirements of the system will be based on lessons learned from the phase II effort and the specific interface requirements of the LGS AO system. A final report will also be required at the conclusion of the Phase III effort which will focus primarily on the results of the comparison testing between on-sky and bench-level results but will also include all of the phase II final report topic areas.

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KEYWORDS: Laser guide star; adaptive optics; atmospheric turbulence

AF NUMBER: AF222-0009

TITLE: Hydrogenation enhancement of minority carrier lifetime in III-V-bismuth (Bi) alloys

TECH FOCUS AREAS: Quantum Sciences

TECHNOLOGY AREAS: Space Platform; Materials

OBJECTIVE: To evaluate the extent to which the minority carrier lifetime of III V semiconductor materials incorporating the heaviest group V element Bi can be improved by post-growth hydrogenation

DESCRIPTION: Incorporation of bismuth (Bi) into III-V semiconductor materials causes a strong reduction of the bandgap of the alloy without inducing significantly more strain than other constituents. Incorporated into an already small-bandgap material such as InAsSb, the resultant alloy InAsSbBi possesses all the ingredients of a high-performance focal plane array sensor capable of covering the mid- to long-wavelength infrared (MWIR-LWIR) spectrum. Specifically, this material system exhibits tunability across the infrared (3.5-14 μm), high-quality and large area lattice-matched substrate, mature processing technology, and as of this year demonstration of long minority carrier lifetimes necessary for high performance photo detection [1]. This recent demonstration of long minority carrier lifetime in InAsSbBi is significant because the lifetime reflects how long charge excited by incoming infrared radiation can transport in the material before it can no longer be collected by the EO/IR system, i.e. the likelihood that the photon is seen. Long lifetimes lead to efficient collection of charge and low dark currents, two key attributes of an efficient, high signal-to-noise image sensor. While other measures of performance are associated with the material’s fundamental nature (e.g. mobility, absorption, etc.), lifetime is fundamentally a measure of concentration of defects in the material and thus the lifetime is improved by innovation and advances in the material synthesis. As discussed in greater detail in Ref. [1], the challenge to further improving InAsSbBi for infrared-sensing applications is that higher growth temperatures are required to further improve the material’s minority carrier lifetime, but those temperatures significantly inhibit the incorporation of Bi. Increasing growth temperature shortens the maximum cutoff wavelength of the material as Bi, the element responsible for reducing the bandgap, incorporates less efficiently. The path forward for InAsSbBi will require either a novel growth approach that enables more effective incorporation of Bi in InAsSbBi at higher growth temperatures where the minority carrier lifetime is maximized, or a means of passivating defects present in InAsSbBi alloys grown at lower growth temperatures where Bi incorporates more efficiently. This topic seeks to evaluate post-growth hydrogenation as a means to passivate defects and improve the minority carrier lifetime in low-temperature-grown InAsSbBi alloys. Hydrogenation is commonly used to passivate defects in a multitude of materials, and has been shown to improve the minority carrier lifetime in other III-V infrared semiconductor materials. Given that the lifetime of InAsSbBi is not a function of the Bi mole fraction but rather the growth conditions utilized to synthesize the material, it is possible that the defects introduced at lower growth temperatures can be passivated, leading to long lifetime InAsSbBi alloys with sufficient Bi mole fraction to effectively cover the mid- to long-wave infrared spectrum.

PHASE I: Development of a hydrogenation recipe and test plan. Materials to be tested will be provided by the TPOC at AFRL/RVSU. Other materials suffering from non-optimal growth temperature constraints identified by the proposers may be included as well.

PHASE II: Execution of hydrogenation experiments. Hydrogenated materials will be returned to AFRL/RVSU for minority carrier lifetime testing and evaluation. An iterative process to optimize the hydrogenation technique will be performed.

PHASE III DUAL USE APPLICATIONS: If a successful hydrogenation recipe is identified, the process may be commercialized and utilized to improve InAsSbBi and other optoelectronic materials that suffer from non-optimal growth condition constraints.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

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KEYWORDS: Hydrogenation; bismide; InAsSbBi

AF NUMBER: AF222-0010

TITLE: Event Based Star Tracker

TECH FOCUS AREAS: Biotechnology Space; Nuclear

TECHNOLOGY AREAS: Nuclear; Sensors; Space Platform

OBJECTIVE: Develop a low SWAP, low cost, high angular rate star tracker for satellite and nuclear enterprise applications.

DESCRIPTION: Existing star tracking attitude sensors for small satellites and rocket applications are limited in their ability to operate above an angular rate of approximately 3-5 degrees/second, thus rendering them useless for both satellite high spin (i.e. lost in space) applications, as well as spinning rocket body applications. Recent advances in neuromorphic (a.k.a. event based) sensors have dramatically improved their overall performance2, which allows them to be considered for these high angular rate applications1. In addition, the difference between a traditional frame-based camera and an event based camera is simply a matter of how the sensor is read out, which should allow for electronic switching between event based (i.e. high angular rate) and frame (i.e. low angular rate) modes within the star tracker. Additional advantages inherent in an event based sensor include high temporal resolution (μs) and high dynamic range (140 dB), which could allow for multiple modes of continuous attitude determination (i.e. star tracking, sun sensor, earth limb sensor) within a single small, low cost sensor package. All technology solutions that meet the topic objective are solicited in this call, however, neuromorphic sensors appear ideally suited to meet the technical objectives and should therefore be considered in the solution trade space. The scope of this effort will be to first analyze the capability of event based sensors to meet a high angular rate star tracker application, define the trade space for the technical solution against the satellite and nuclear enterprise requirements, develop a working prototype and test it against the requirements, and finally in Phase 3 move to initial production of a commercial star tracker unit.

PHASE I: Acquire existing state of the art COTS neuromorphic (a.k.a. event based) sensor or modify existing star tracking sensor as appropriate. Perform analysis and testing of the event based sensor to determine feasibility in the high angular rate star tracking satellite and nuclear enterprise applications

PHASE II: Development of a prototype event based high angular rate star tracker. Ideally this prototype will have the ability to be operated in both event based mode, as well as switch back and forth to standard (i.e. frame) mode. Explore and document the technical trade space (maximum angular rate, minimum detection threshold, associated algorithm development, etc.) and potential military/commercial application of the prototype device.

PHASE III DUAL USE APPLICATIONS: Phase 3 efforts will focus on transitioning the developed high angular rate attitude sensor technology to a working commercial and/or military solution. Potential applications include commercial and military satellites, as well as missile applications.

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KEYWORDS: Event based camera; neuromorphic sensor; high angular rate star tracker; small satellite

AF NUMBER: AF222-0011

TITLE: Launch Hardened Modular Component Connector

TECH FOCUS AREAS: Autonomy

TECHNOLOGY AREAS: Space Platform

OBJECTIVE: The objective of the effort is to develop a docking mechanism designed to withstand space launch loads

DESCRIPTION: The US Space Force has a need for a launch hardened docking mechanism for on-orbit servicing and space logistics missions. Several docking mechanism concepts, designs, and prototypes exist today, but none of them can survive launch in the docked state. This topic is primarily seeking complete docking mechanism solutions that will survive the launch environment, but enabling technologies and subsystems will also be considered responsive. Offerors should deliver a functional prototype at the end of the effort.

PHASE I: A launch hardened modular component connector will be designed and at least two functional prototype connectors will delivered. The connector will have the following features: • Survive launch loads as defined by: NASA-GEVS and SpaceX PLUG in both axial and lateral orientations; • Capable of at least 200 engage/disengage cycles on the ground and on-orbit; • Include provisions for fuel transfer between the connected spacecraft/modules; • Provide for data and power pass-through between the connected spacecraft/modules; • No power required to maintain the mechanical connection; • Provide self-alignment within 2 degrees; • SWaP consistent with small scale spacecraft, (i.e. 1/2 ESPA to 27U CubeSat); • Have low recurring cost ($10k/unit for CubeSat-class mechanisms, $100k/unit for SmallSat-class mechanisms)

PHASE II: The Phase I connector design will be refined and at least two spaceflight capable connectors shall be delivered

PHASE III DUAL USE APPLICATIONS: Phase III instructions to be provided later.

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KEYWORDS: OSAM; connector; robotics; assembly; modular; servicing; docking; refuel; repair; logistics

AF NUMBER: AF222-0012

TITLE: Automated Malware Generation Technologies for Avionics Cyber Resiliency

TECH FOCUS AREAS: Cybersecurity; Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Develop a capability to automatically generate malware test samples to support cyber resiliency for next-generation avionics architectures.

DESCRIPTION: Next-generation avionics architectures require the ability to operate in a cyber-contested environment. This, in-turn, requires avionic mission systems to detect, respond, and adapt to targeted cyber-attacks and to quantitatively measure the effectiveness of cyber resiliency technologies. In order to build avionics malware detection tools and to quantify their effectiveness, a comprehensive repository of malware test samples must be created. Given the cost, time, and expertise needed to manually create these test samples, this topic focuses on developing automated malware generation tools to create this comprehensive repository. The lack of malware test samples impacts our ability to both develop effective malware detection algorithms as well as test existing cyber resiliency solutions against malware payloads that could, in principle, be created by our adversaries. The difficulty with creating such a repository is that it is dependent on the adversary's (vs. our own) knowledge about the security flaws of the targeted system, their ability to gain access to those flaws, and their ability to exploit those flaws [1], which is often unknown to the developers of the cyber protection solutions. While red teaming is often used as a means to measure the effectiveness of cyber protection solutions, these exercises are limited in scope and by the knowledge, skills, and resources of the red team, which do not necessarily reflect a determined nation-state adversary with nearly unlimited resources. The lack of quantitative measures of effectiveness is exacerbated by the fact that flaws may exist on the system that are unknown to the cyber protection developers and their red teams that could be uncovered and exploited by real adversaries. What is required is the ability to objectively simulate the attack creation process of our cyber adversaries and to proactively develop malware detection solutions in anticipation of those threats. The goal of this topic is to create the underlying technology necessary to automatically generate malware samples [2-4] that will be used to create a co-evolving protection system that can detect, respond, and adapt to otherwise unforeseen threats. In particular, the focus of this topic should be to develop techniques for generating supply chain malware that is surreptitiously embedded in representative avionics/ISR software and firmware. The techniques and tools for generating embedded malware samples developed under this topic would then be used by the Air Force internally to quantitatively test government developed malware detection algorithms in advance of a real-world attack, as well as for malicious feature extraction to improve malware detection tools [5] that are part of a cyber-resilient defense. The above approach requires innovative research and development of evolvable malware that targets a representative avionics system and an ability to evaluate the feasibility of the generation techniques and the effectiveness of the resulting malware samples, whether through instantiation on hardware or through software simulation. For the purpose of this topic, a suggested target platform includes, but is not limited to, a small testbed containing a sensor (e.g., camera, GPS), a post-processing computer (e.g., a single board computer) with corresponding software that operates on sensor data, and an analyst's workstation, that might be representative of an avionics mission system or intelligence, surveillance, reconnaissance (ISR) system.

PHASE I: Develop an approach, architecture and limited-scope prototype that demonstrates the ability to evolve malware samples that target representative avionics system software or firmware and cause a mission impact. These malware samples should be undetectable by at least one commonly used commercial off-the-shelf anti-virus program. Malicious features that are differentiable from the host software should be identified and explainable as to why they are considered malicious.

PHASE II: Expand the quantity and sophistication of the malware test samples generated, categorize the classes of attacks, and identify the distinguishing malicious features from the targeted host software or firmware. Determine the false positive and false negative rates of detection of the cyber protection system based on commercially available malware detection products or other available tool suites. The malware should not only avoid exposure by malware detection tools, but also by acceptance tests used to validate the legitimate host software/firmware.

PHASE III DUAL USE APPLICATIONS: The final product will have both commercial and military avionics system applications, as well as a broad class of embedded system applications, including Supervisory, Control, and Data Acquisition (SCADA) and Industrial Control Systems (ICS).

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KEYWORDS: Evolutionary Computing; Genetic Algorithms; Malware detection; Embedded System Security; Avionics Cyber Security

AF NUMBER: AF222-0013

TITLE: Automated/assisted target behavior model development

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Identify sources of intelligence reports describing behaviors of targets of interest and methods to extract the information in the reports into a machine readable format. Identify sensor data relevant to the targets of interest that can be extracted from multi-domain sources. The autonomous algorithms use the extracted data to develop adversary patterns of life for various activities. These can be temporal patterns or functional patterns. The algorithms would interpret the patterns and identify a workflow and patterns of operation. These automated extracted patterns would be converted into a format ingestible by Insight and other predictive analytics tools used to augment and potentially replace expert defined patterns. These patterns would be used to support predictive analytics and identify which collections are needed to increase confidence and confirm patterns the enemy is using. In addition, these patterns may need to support flexibility and adapt to variations that change over time.

DESCRIPTION: Develop tools that can extract relevant target behavior information from textual and machine readable reports. Using the extracted information automate or assist the analyst in the development Insight readable models of target behaviors, and link at least three different types of sensors and/or from 3 different sensors across 2 different sensing methods from 2 different operating domains to measure indications of the target behavior. The algorithms would produce either a functional or temporal pattern of life that would drive automated patterns of life implemented in Insight or other predictive analytics software tools.

PHASE I: Identify an initial domain and target behavior of interest. Identify reports describing the behaviors of target of interest. Identify a data set with sensing information containing the target and behaviors of interest. Prototype capabilities to demonstrate all of the required functions to extract the information from reports and create simple target behavior models for Insight.

PHASE II: Refine and integrate prototype capabilities developed in Phase 1. Demonstrate integrated tool for at least three different types of sensors and/or from 3 different sensors across 2 different sensing methods from 2 different operating domains to measure indications of the target behavior.

PHASE III DUAL USE APPLICATIONS: Potential to provide commercial functionality to multiple organizations across the Department of Defense for internal and external applications, civic and commercial applications for automated workflow applications linking information capture systems to define meaning and process steps. This provides the potential to accelerate the process development, reducing manpower requirements, while improving overall quality control.

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KEYWORDS: Natural language processing; Course of action modeling; Target behavior modeling; Time sequence modeling; indications and warnings; DARPA Insight; Automated model generation; Assisted model generation.

AF NUMBER: AF222-0014

TITLE: JITMMA/W Natural User/Technology Interfaces

TECH FOCUS AREAS: Network Command, Control and Communications; Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Bio Medical; Air Platform

OBJECTIVE: Develop a tool or set of tools and processes for enabling a useful and usable user interface when the content/learning material, the interaction model, and the target hardware may not be known in advance.

DESCRIPTION: To defeat near-peer adversaries in contested environments, the United State Air Force (USAF) will operate from an expeditionary position requiring significant resiliency and agility. Agile Combat Employment (ACE) is an operational concept that employs a network of existing bases and austere locations to deliver combat power to support expeditionary missions. Combat forces at these bases must be agile and be able to respond quickly with significantly reduced infrastructure and force footprint. Airmen operating at these austere forward operating locations, because of the reduced personnel footprint, will need to be multi-capable (i.e., able to perform multiple tasks across platforms and across specialties.) To enable that capability, the Air Force Research Laboratory (AFRL) has embarked on an applied research program called Just-in-time, Multi-mission airmen/warfighters (JITMMA/W), an integrated capability to support deployed personnel performing a wider variety of mission tasks across traditional AFSC and expertise boundaries. A technology gaps that exists within the JITMMA/W space is that of intelligent and naturalistic user/technology interfaces. Airman who will be supporting ACE tasks in forward and potentially austere locations will need user interfaces to be as easy to use as possible, to include user interfaces that require no manual control, given the likelihood that their hands will not be always available for interface navigation activities. In addition, the control and display hardware for these human-machine interfaces may not be known at the time the content is developed and the presentation modes may be undetermined.

PHASE I: Develop an approach and a roadmap for an iterative development of this capability, along with references to relevant research in this area. The outcome of the Phase I should be a clear development path for a tool or set of tools and/or processes that overcome the challenges of delivering training to ACE multi-mission airmen.

PHASE II: Implement the product roadmap features identified during the Phase I. Demonstrate a tool, set of tools, and or processes that can auto-tailor/match training content, delivery mechanisms, and/or target hardware to enable a seamless and robust training ecosystem that leverages existing computer-based training and AR/VR applications and new XR applications with advanced control and display technologies as a threshold for performance. An objective would be to show this approach that can adjust to learner performance. Validate the performance of the simulation tool. Document the design, the design process, and the validation results in a final report

PHASE III DUAL USE APPLICATIONS: The commercial electronic gaming industry is filled with multiple versions of popular games that must be custom-tailored for each platform and form factor in which each game is expected to run. This product could streamline the production and distribution of large numbers of games. In addition, USAF’s Air Education and Training Command (AETC), as well as the training commands of all sister services, could take advantage of technologies that auto-tailor content, delivery mechanisms, and target hardware to create a robust training content delivery ecosystem.

REFERENCES: Majumder, S., Mondal, T., Deen, M.J. Wearable sensors for remote health monitoring (2017) Sensors (Switzerland), 17 (1), art. no. 130, . Cited 444 times; Pandya, B., Pourabdollah, A., Lotfi, A. A cloud-based pervasive application for monitoring oxygen saturation and heart rate using fuzzy-as-a-service (2021) ACM International Conference Proceeding Series, pp. 69-75.; Mahmood, A.S., Jafer, E., Hussain, S., Fernando, X. Wireless body area network development for remote patient health observing (2017) IHTC 2017 - IEEE Canada International Humanitarian Technology Conference 2017, art. no. 8058193, pp. 26-31.Cited 6 times.

KEYWORDS: Flexible/Wearable Sensors; Cognitive state assessment; Task/activity performance monitoring and assistance; Performance assessment and prediction; Telemedicine and telemaintenance tools; deployed personnel

AF NUMBER: AF222-0015

TITLE: JITMMA/W Training Content Delivery in Low Data Throughput Networking Environment

TECH FOCUS AREAS: Network Command, Control and Communications; Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Bio Medical; Air Platform

OBJECTIVE: Develop a tool or set of tools and/or processes for data/content storage and application at the edge. These technologies and/or processes would have to intelligently deliver training content in a potentially low data throughput networking environment and on various hardware with potentially limited computing capability.

DESCRIPTION: To defeat near-peer adversaries in contested environments, the United State Air Force (USAF) will operate from an expeditionary position requiring significant resiliency and agility. Agile Combat Employment (ACE) is an operational concept that employs a network of existing bases and austere locations to deliver combat power to support expeditionary missions. Combat forces at these bases must be agile and be able to respond quickly with significantly reduced infrastructure and force footprint. Airmen operating at these austere forward operating locations, because of the reduced personnel footprint, will need to be multi-capable (i.e., able to perform multiple tasks across platforms and across specialties.) To enable that capability, the Air Force Research Laboratory (AFRL) has embarked on an applied research program called Just-in-time, Multi-mission airmen/warfighters (JITMMA/W), an integrated capability to support deployed personnel performing a wider variety of mission tasks across traditional AFSC and expertise boundaries. A technology gap that exists within the JITMMA/W space is that of agile intelligent delivery of training content to the tactical edge. Airman who will be supporting ACE tasks in forward and potentially austere locations will need the appropriate training content/courseware (i.e., lessons, demonstrations, assessments, etc.) available where and when they need it, regardless of connectivity to larger networks and data stores (e.g., cloud). These technologies will also need to tailor content delivery to the specific mission and airman requirements (such as familiarization training, differences training, etc.)

PHASE I: Develop an approach and a roadmap for an iterative development of this capability, along with references to relevant research in this area. The outcome of the Phase I should be a clear development path for a tool or set of tools and/or processes that propose to overcome the challenges of intelligent training content delivery to ACE multi-mission airmen.

PHASE II: Implement the product roadmap features identified during the Phase I. Demonstrate a tool, set of tools, and or processes that can intelligently deliver training content to the tactical edge, when and where needed. An objective would be to show that this approach can incorporate learning to improve content requirements prediction performance. Validate the performance of the content delivery mechanism. Document the design, the design process, and the validation results in a final report.

PHASE III DUAL USE APPLICATIONS: Industry engaged in rapid and responsive training of field or line personnel could leverage technologies like these to significantly reduce costs and improve efficiency without sacrificing safety. In addition, as the USAF's Air Education and Training Command (AETC), as well as the training commands of all sister services, begin to take advantage of the power of XR technologies to push training further into the field, they will need technologies that intelligently deliver training content.

REFERENCES: Majumder, S., Mondal, T., Deen, M.J. Wearable sensors for remote health monitoring (2017) Sensors (Switzerland), 17 (1), art. no. 130, . Cited 444 times; Pandya, B., Pourabdollah, A., Lotfi,

A. A cloud-based pervasive application for monitoring oxygen saturation and heart rate using fuzzy-as-a-service (2021) ACM International Conference Proceeding Series, pp. 69-75; Mahmood, A.S., Jafer, E., Hussain, S., Fernando, X. Wireless body area network development for remote patient health observing (2017) IHTC 2017 - IEEE Canada International Humanitarian Technology Conference 2017, art. no. 8058193, pp. 26-31.Cited 6 times.

KEYWORDS: Flexible/Wearable Sensors; Cognitive state assessment; Task/activity performance monitoring and assistance; Performance assessment and prediction; Telemedicine and telemaintenance tools. deployed personnel

AF NUMBER: AF222-0016

TITLE: Multi-Function Digital AESA and Sensor Resource Manager (SRM) Systems Engineering

TECH FOCUS AREAS: Autonomy; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors

OBJECTIVE: The objective of this topic is to explore the available configurations of multi-function digital active electronically scanned arrays (AESA) radars and the associated Sensor Resource Manager (SRM) to achieve Air Force mission objectives (https://www.doctrine.af.mil/). The USAF requires a mission engineering and modeling tool to evaluate the most appropriate combination of software and processing capability to achieve these ends. These capabilities should be captured and communicated in a SysML or other MBSE model. At minimum, this is for a single-ship configuration, but we will give preferred consideration for multi-platform configurations.

DESCRIPTION: Recent advancements in open architectures will enable the United States Air Force (USAF) to develop 'plug-and-play' or adaptable software-defined sensors for both attributable and non-attributable platforms. Systems of high-interest within this context are multi-function, digital active electronically scanned arrays (AESAs). These radars allow for advanced beam steering and beam control enabling multiple RF operating modes to run concurrently. In an operational context, tradeoffs will be necessary to tailor software and processing capability for specific missions. The goal of this topic is to explore the available configurations of multi-function digital AESA radars and the associated Sensor Resource Manager (SRM) to achieve Air Force mission objectives (https://www.doctrine.af.mil/). The USAF requires a mission engineering and modeling tool to evaluate the most appropriate combination of software and processing capability to achieve these ends. These capabilities should be captured and communicated in a SysML or other MBSE model. At minimum, this is for a single-ship configuration, but we will give preferred consideration for multi-platform configurations. This topic is not focused on a specific production radar and the expectation is to model a multi-function digital AESA radar at the logical and functional level. It is expected that in Phase III, the performer will implement an open architecture interface at the physical level for a specific radar to include the hardware, software, processor, modes and algorithms. An example for consideration is the Arrays at Commercial Timescales (ACT) radar (https://www.darpa.mil/program/arrays-at-commercial-timescales).

PHASE I: Demonstrate understanding of current capabilities of multi-function AESA and how those relate to AF mission sets. Demonstrate understanding of SysML and MBSE tools as well as the understanding of how to represent highly complex sensors (AESA) in this format. Demonstrate understanding of AFSIM capabilities and methods to represent complex sensors in this format. Demonstrate understanding of Sensor Resource Managers (SRMs) and challenges associated with integrating SRMs with other airborne systems and open architectures.

PHASE II: Develop optimal configurations for multi-function AESA mapped to Air Force mission sets at a functional level. Present hardware-agnostic model of the radar, processor, modes, algorithms and SRM using SysML or other Model Based Systems Engineering (MBSE) tools and best practices. Develop ways to represent complex, multi-purpose systems in SysML or other MBSE tools for effective analysis. Develop and present an unclassified AFSIM scenario(s) to demonstrate the multi-function AESA and modeling the desired SRM to capture effectiveness of a multi-function AESA compared to traditional approaches. Capture all documentation and results in the model based form that can be shared and re-used by other developers and/or RY divisions.

PHASE III DUAL USE APPLICATIONS: Implement an open architecture interface at the physical level for a specific radar to include the hardware, software, processor, modes and algorithms. As an example, the Arrays at Commercial Timescales (ACT) radar (https://www.darpa.mil/program/arrays-at-commercial-timescales).

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: A. Farina, P. Holbourn, T. Kinghorn and L. Timmoneri, "AESA radar — Pan-domain multi-function capabilities for future systems," 2013 IEEE International Symposium on Phased Array Systems and Technology, 2013, pp. 4-11, doi: 10.1109/ARRAY.2013.6731792.

KEYWORDS: Active electronically scanned array (AESA), digital at the element; multi-function radar; AESA; Sensor Resource Manager; Resource Manager; Sensors; Radio Frequency; Radar; Model Based Systems Engineering; MBSE; SysML

AF NUMBER: AF222-0017

TITLE: Energetic particle diagnostics suitable for cubesats

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Space Platform

OBJECTIVE: The objective of this effort is the development of an energetic particle diagnostic suitable for deployment on cubesats while being capable of measuring electron and ion energy distribution functions ranging from a few eV up to 2 MeV in plasma outflows in the space environment. The development of this class of sensor on a cubesat platform allows rapid deployment and the capability to measure at a number of points in space via flying constellations of cubesats.

DESCRIPTION: This effort will develop diagnostics capable of measuring electron and ion precipitation and outflows during both quiet and storm conditions in the ionosphere while being suitable for deployment on a cubesat. It will allow bi-directional measurement of particle fluxesto be directly observed to directly measure the current flows in an environment consistent with the mid-altitude ionospheric regions. In particular, it will be able to 1. Observe bi-directional electron velocity distribution functions from ~100eV to 500keV 2. Observe bi-directional ion velocity distribution functions from ~100eV to 500keV 3. Seperate ion observations into total and species specific ion fluence.

PHASE I: Phase I will analyze and design a diagnostics suitable to achieve the measurement goals described above. Additionally, this design will be suitable for deployment on a cubesat platform so assement of size, power, weight, etc of the sensor system must be performed.

PHASE II: Phase II will develop a build and impliment the sensor design developed during phase I and package it such that is it suitable for deployment as a payload on a cubesat system. Details on the necessary specifications for the cubesat to host the sensors will be developmed and provided.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of AFOSR programs reflects potential for a novel energetic particle sensor to be deployed beyond the natural space domain enviroment. For example, characterization of particles flows in high-power directed energy devices and Hall thrusters would be suitable for health/performance monitoring for these devices as well as deployment on developmental high-energy density devices.

REFERENCES: Milikh, G. M., Mishin, E., Galkin, I., A. Vartanyan, C. Roth, B. W. Reinisch, “Ion outflows and artificial ducts in the topside ionosphere at HAARP”, GRL, 37, L18102, 2010; Moore, T. E., M.-C. Fok, K. Garcia-Sage, “The ionospheric outflow feedback loop”, JASTP, 115116, 59-66, 2014;

KEYWORDS: plasma; ionosphere; outflows; ring current; diagnostics; cubesats

AF NUMBER: AF222-0018

TITLE: Laser-based diagnostic for plasma-surface interactions

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: We seek novel laser-based non-destructive Evalution diagnostics for surface-plasma interactions that can be integrated into devices with materials that are both under vacuum and are energized by high-field and high-power drivers.

DESCRIPTION: The highly energetic species in plasma environments that interact with surfaces lead to a range of kinetic processes that exist over several lengths and time scales. These processes can lead to heating, structural modifications, surface etching, emission, chemical reactions, etc that are intimately related to the irradiating plasma characteristics and structural, chemical and thermal properties of the materials being irradiated. Novel laser-based metrologies have recently emerged as unique diagnostic tools to provide real-time surface characterization of materials being irradiated with energetic plasmas. These metrologies have the advantage of providing rapid and highly sensitive NDE measurements of surfaces while achieving relatively spatially localized measurements with micron scale resolution. Further, the spatial manipulation of the laser focal plane can generate surface maps of thermal and chemical gradients on a plasma irradiated surface. Here we seek an advanced plasma diagnostic tool capable of spatially resolving the thermal and chemical gradients of a plasma exposed surface with real time NDE functionality. This diagnostic approach should be able to measure local thermal and chemical property variations on a plasma irradiated surface, and be adaptable for in situ testing under vacuum and other high field environments. Spatial resolution of surface thermal and chemical dynamics < 10 microns is desired. This diagnostic capability will need to be integrated into both vacuum systems as well as high-power drivers up to and including typical high-power electroamgnetic sources.

PHASE I: Phase I will work to research and asssess if a novel fiber optic based diagnostic system with the following capability: -Thermoreflectance in integrated fiber optic assembly capable of detecting thermal property changes of materials exposed to plasma -Spatial control of focused laser location on sample surface via integrated fiber optics and modulated piezo mirrors instead of physically moving sample (making this tool assessable and integrable into vacuum assemblies -Temporal resolution of continuous wave reflected probe intensity through electronic detection scheme of reflected probe light trigged with modulated laser or plasma source -Detection of both thermoreflectance and Raman signals from focused laser spot on samples surface using single element detection and all-in-fiber spectroscopy This assessment will including vacuum and field/power parameters and constraints for the systems with which the diagnostic can be integrated.

PHASE II: Based on the Phase I assessment, the Phase II effort will impliment and test a novel laser-based diagnostic system for plasma-surface interaction.

PHASE III DUAL USE APPLICATIONS: The fundamental nature of the AFOSR programs reflects the potential to extend beyond directed energy applications, and re-vector this diagnostic for any kind of energetic surface-plasma systems such as pulsed power, plasma processing, advanced space thrusters, radar/communication/electronic warfare sources. and plasma combustion ignition.

REFERENCES: Tomko et. al., "Plasma-based Surface Cooling." Arxiv: 2018.02047, 2021

KEYWORDS: laser diagnostics; plasma-surface interaction; thermoreflectivity; and Raman;

AF NUMBER: AF222-0019

TITLE: Vacuum packaged microfabricated rubidium vapor cells

TECH FOCUS AREAS: Quantum Sciences; 5G

TECHNOLOGY AREAS: Sensors; Space Platform; Air Platform

OBJECTIVE: Demonstration of a vacuum packaged microfabricated rubidium vapor cell with low helium permeation and temperature control stable to below 10 mK.

DESCRIPTION: Atomic clocks have become pervasive in multiple industries for position, navigation, and timing. However, their full potential to the everyday consumer and military was not fully realized until the advent of chip-scale atomic clocks (CSAC) [1] that provide an atomic reference with small C-SWaP. Requirements for more precise clocks beyond the CSAC (1010 1/Hz1/2) push into optical clocks (1012 1/Hz1/2). This requires a move away from buffer filled microfabricated cells, finer control over temperature, and reduced helium permeation. To fully realize the same impact as a CSAC, the technology must be in line with a mass producible, low cost, architecture. The objective of this project is to create a microfabricated rubidium vapor cell that is vacuum packaged, demonstrates a low permeation to helium, anti-reflection coating at 780 nm, and demonstrate sub 10-mK temperature drifts while creating less than 1 nT of residual magnetic field. The fabrication method must show a path towards mass fabrication.

PHASE I: Demonstration and delivery of a microfabricated rubidium vapor cell (inner cell dimensions of 3 mm x 3 mm x 3 mm) with anti-reflection coated glass at 780 nm with a bandwidth of 10 nm. Design of final cell structure that cannot exceed 1 cm x 1 cm x 1 cm. A path outlined towards low helium permeation and fine temperature control/stability via electrical heating with sub nT fields.

PHASE II: Demonstration and delivery of vacuum packaged rubidium cells with an inner volume of 3 mm x 3 mm x 3 mm and total outer dimensions of 1 cm x 1 cm x 1 cm. All windows must be anti-reflection coated for 780 nm with a bandwidth of 10 nm and demonstrated low helium permeation. The package must demonstrate electrical heating of the cell to 120 C in an ambient environment (22 C) with a package temperature below 30 C. The package must hold the temperature stability to below 1 mK over the course of a week. The package should also include temperature measurement devices, both a primary and a witness. The residual magnetic field created from the heater and temperature measurements must not exceed 1 nT.

PHASE III DUAL USE APPLICATIONS: Vacuum packaged vapor cells are a critical component for the miniaturization of optical clocks. Beyond DoD needs, low cost chip-scale atomic clocks are useful for PNT systems used by the oil and gas industry. Furthermore, this technology directly translates to low SWaP chip-scale magnetometers used for DoD applications (magnetic navigation, magnetic anomaly detection, and communications) as well as commercial applications (medical imaging, communications, navigation).

REFERENCES: [1] S Knappe, V Shah, PDD Schwindt, L Hollberg, J Kitching, LA Liew, Moreland, J., “A microfabricated atomic clock,” Applied Physics Letters 85 (9), 1460-1462.

KEYWORDS: Microfabricated vapor cells; atomic clocks

AF NUMBER: AF222-0020

TITLE: Ultra-wideband High Efficiency Power Amplifier for Multifunction RF Systems

TECH FOCUS AREAS: Microelectronics

TECHNOLOGY AREAS: Sensors; Electronics

OBJECTIVE: Research and develop ultra wideband, high efficiency power amplifier (PA) technology suitable for multifunction transmitter systems.

DESCRIPTION: The proliferation of wireless technologies has posed significant challenges to future DoD systems. One of the challenges for sensor technology is the near-peer threats creating highly contested and congested EM environment. The net result is the demand for efficient transmit power ever more critical to achieving battlespace dominance with increase power, efficiency, and spectral coverage. In order to support this vision, this topic is seeking the development and demonstration of multifunctional power amplifier technology capable of wideband and high efficiency operation. The bandwidth coverage may be either instantaneous or tunable for contiguous wideband operation. In essence, we are seeking novel power amplifier concepts to enable wideband coverage, while attaining narrow band like efficiency performance with a size suitable to fit within a Ku-band phased array grid. In this research, ultra wideband power amplification technologies will be explored. This includes the investigation of novel PA topologies to take advantage of advanced processes such as gallium nitride (GaN) where it has the combination of high breakdown and gain bandwidth product. Critical performance parameters for the novel PA include ultra-wideband (2-18 GHz), high gain (saturated power gain > 15 dB), medium output power (Pout > 2W, 10W max.), and high power added efficiency (PAE > 50%). The improved PA performance will enable development of next generation transmit/receive (T/R) modules suitable for airborne and space applications. Current state-of-the-art PA technology provides broadband performance (multi-octave bandwidth), but operates at relatively low efficiency (PAE < 30%). The aim of this research is to explore advanced PA design techniques leveraging advanced technologies to yield the combined contiguous wideband and high efficiency performance suitable for future DoD radar, communication, and EW systems.

PHASE I: Perform trade study to provide power amplifier architecture & specifications. Research candidate fabrication technologies and explore design topologies to achieve an ultra-wideband, medium output power, and high efficiency power amplifier.

PHASE II: Design and build a prototype of the power amplifier to demonstrate the proof of concept. The proof of concept should be demonstrated in a packaged environment.

PHASE III DUAL USE APPLICATIONS: Improve power amplifier bandwidth and efficiency for multifunction RF applications; radar and EW techniques.

REFERENCES:

J. Gassmann, P. Watson, & L. Kehias, “Wideband, High-Efficiency GaN Power Amplifiers Utilizing a Non-Uniform Distributed Topology”, IEEE MTT-S International Microwave Symposium digest. IEEE MTT-S International Microwave Symposium, 2007 ;

C. Campbell, C. Lee, V. Williams, M. Kao, H. Tserng, P. Saunier, and T. Balisteri, “A Wideband Power Amplifier MMIC Utilizing GaN on SiC HEMT Technology,” IEEE Journal of Solid-State Circuits, vol. 44, no. 10, pp. 2640–2647, 2009 ;

H. Wu, Q. Lin, L. Zhu, S. Chen, Y. Chen, and L. Hu, “A 2 to 18 GHz Compact High-Gain and High-Power GaN Amplifier,” in 2019 IEEE MTT-S International Microwave Symposium (IMS), 2019, pp.

710–713. ;

U. Schmid, H. Sledzik, P. Schuh, J. Schroth, M. Oppermann, P. Bruckner, F. van Raay, R. Quay, and M. Seelmann-Eggebert, “Ultra- ̈ Wideband GaN MMIC Chip Set and High Power Amplifier Module for Multi-Function Defense AESA Applications,” IEEE Trans. Microw. Theory Techn., vol. 61, no. 8, pp. 3043–3051, 2013.

KEYWORDS: microelectronics; power amplifier; transmitter

AF NUMBER: AF222-0021

TITLE: Resilience-Aware Human-on-the Loop Positioning, Navigation, and Timing (PNT) Equipment

TECH FOCUS AREAS: Cybersecurity; Network Command, Control and Communications; Autonomy

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Information Systems

OBJECTIVE: Identify and develop resilience conformance framework and human factors applied to Positioning, Navigation, and Timing (PNT) user equipment, PNT systems of systems, integrated PNT receivers, and PNT source components such as Global Navigation Satellite Systems (GNSS) chipsets.

DESCRIPTION: With the automation and multi-level resilience of prevent, respond, and recover functions involved in Positioning, Navigation, and Timing (PNT) equipment, human presence is almost inevitable in such systems. The vast majority of PNT services mandate the presence of end users with supervisory roles (Human-on-the-Loop), such as resilience level settings, risk tolerances, budgets, dual-purpose civil and military applications and interferences in situations unfamiliar to the autonomous PNT equipment. Hence, it is vital to understand how this presence affects the application performance requirements of accuracy, availability, integrity, continuity, and/or coverage and expected behaviors in resilient PNT equipment at the design phase. Moreover, this understanding supports a radical change in the design paradigm: can we design autonomous PNT equipment that utilizes human presence to improve the resilience guarantee or aid in situations of higher degrees of uncertainty? The SBIR topic focuses on answering this question for future resilience-proofing and is broadly applicable across civil and military PNT sources; e.g. GNSS-dependent time and frequency sources and receivers. Specifically, prospective options shall examine the human role in guaranteeing resilience and/or security when PNT equipment is susceptible to jamming and spoofing attacks. The technical challenges the government is following on this topic are threefold: i) understanding human behavior; ii) developing conformance frameworks for PNT resilience agnostic to all critical infrastructure, all applications, all PNT sources or services, and all threats; and iii) synthesizing expected behaviors and outcomes for resilient PNT user equipment. Offerors are encouraged to work with Military Grade User Equipment prime contractors and developers to help ensure applicability of their efforts and begin work towards technology transition.

PHASE I: Develop a multi-level conformance framework for PNT resilience, starting from: i) underlying GNSS chipsets for fundamental PNT measurements; moving to ii) an integrated receiver, including a GNSS chipset, PNT processor, and clock/oscillator; and finally applying to iii) systems of systems approaches; e.g. an integrated receiver, an anti-jamming antenna, any other connected devices used to deliver PNT data, and human-on-the-loop. Conduct an analysis and use-case simulations; e.g. for application {X}, subject to threat {Y}, technology/solution {Z} can provide timing at Resilience Level 3 with an accuracy threshold of 1.8 microseconds 99.9% of the time, and a post-threat recovery time of 80 seconds 95% of the time to demonstrate how the human power of inductive reasoning and ability to provide context, particularly during an attack, affect overall PNT resilience and/or security guarantee.

PHASE II: Design, implement, integrate, and test a live, synthetic, blended and extendable digital twin and virtual platform that facilitates trade-offs with respect to the impact that human-on-the-loop has on the resilience of PNT user equipment with varying levels of autonomy and resilience. Assess implementation complexity of increasing resilience along the signal processing and PNT solution generation chain. Cooperate with one or more GNSS receiver manufacturers and military navigation system integrators. Demonstrate a non-resilient chipset (a chipset that does not meet any resilience level as defined in Phase I) but integrate it in a receiver in a way that that will ultimately result in its resilience. Testing should include validation and verification of manufacturer specifications and end-user requirements. Manufacturers should test against their product's specifications, while end-users should test against their application requirements.

PHASE III DUAL USE APPLICATIONS: In cooperative efforts with end-users, operate “systems-of-systems” to increase resilience levels through the design, integration, configuration, and deployment of their systems, utilizing laboratory and field tests in representative operational and GNSS-denied environments. Evaluate transition opportunities for utilization in approved Government-civilian applications.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: 1. National R&D Plan for Positioning, Navigation, and Timing Resilience, Jan 2021; 2. Presidential Policy Directive -- Critical Infrastructure Security and Resilience/PPD-21

KEYWORDS: resilient PNT user equipment; human on the loop; resilient conformance framework; virtual platform; digital engineering; integrated receiver; GNSS chipset; clock/oscillator; PNT sources

AF NUMBER: AF222-0022

TITLE: Knowledge Graph Model of Red-Force Behavior for ISR Planning

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop knowledge graph based analytical software to enable knowledge acquisition at finger tips and meaning making at scale on red force behavior and operation dynamics from all-source intelligence data to support ISR operation planning and management.

DESCRIPTION: Through the entire Joint Air Tasking Cycle (JATC), many ISR planning and analytical tasks require a good understanding of red force behavior and operation dynamics. For example, in order for ISR analysts to translate the commander's intent into a clear, concise, accurate, and relevant set of collection requirements (CRs), they have to acquire and constantly update the knowledge on an adversary's conducts, states, and intentions from all-source intelligence. However, the helpful information is often buried in huge volumes of disparate and uncorrelated raw intelligence data without apparent answers to these questions. This makes the current time-bound CR development a cognitively intensive manual process. It is difficult to scale it up into a high-intensity near-peer operational environment where the hidden dynamics of a large red force operation are too complex for any individual analysts to mentally digest and remember in real time. Therefore, there is a critical need in the area of integrated ISR by the Air Combat Command (ACC) for new machine-assisted knowledge acquisition and meaning making capability to augment analysts for continuous acquiring, retaining, analyzing, understanding, and forecasting of red force behavior and operation dynamics from massive and noisy real-time as well as historical all-source intelligence data. The advancement in the artificial intelligence has offered some potential solutions to address the problem, particularly in the domain of knowledge graph (KG) which has witnessed large commercial success in Google search and Amazon's Alexa for providing comprehensive search returns on individual query targets as well as their correlated entities. In this effort, AFRL is seeking innovative solutions on KG model and additional machine inference of red force operational behavior and dynamics so analysts can have relevant red force information at finger tips and mean-making at scale when working on analytical JATC tasks. The definition of KG is broad in this effort and not limited to specific modeling technology such as the traditional ontology-based models. Any connectivity-focused, analytical solutions are highly encouraged. More specifically, AFRL looks for a software solution that can deliver a scalable KG design and corresponding graph database, data processing modules, data analytical engine, and front-end graphical user interface (GUI) and visualization. It should be capable of modeling, detecting, forecasting, and visualizing red force operational tactics, techniques, and procedures (TTP) in the form of spatial-temporal operational patterns of units and weapon systems, indicators of state changes, and group interactions at tactical and joint operational levels. The KG design should include relevant combat, support, and command and control components with group behavior and risk models in order to derive information on red force's posture, intent, operation mode, and psychological state. It also needs to be flexible on architecture and fault-tolerating with respect to missing or uncertain intelligence data. The analytical engine should provide confidence levels in its analytical results and summary statistics to facilitate sound decision making process. The data processing modules need to be able to extract and parse spatial-temporal information from multiple representative intelligence sources, including open sources. The GUI should allow analysts to easily construct query and provide user-friendly presentation of analytical results in the form of annotated graphs, maps, tables, and/or charts, etc. The operational scenarios may include, but not limited to, ground to air and air to air engagements. AFRL will provide a limited number of simulated datasets for phase I and II. The use of government datasets is optional as long as the offeror’s own datasets are clearly identified in the proposal. Open source datasets are highly encouraged. No other government furnished materials, equipment, data, or facilities will be provided.

PHASE I: Design and develop the initial software architecture and critical components for a proof-of-concept demonstration involving a few tactical level scenarios using simulated and open source data. The focus is on graph model and backend analytic engine. Provide trade-off analysis on the best technical development path, algorithm and method choice, data management and software framework decision, and potential risk and negation strategy.

PHASE II: Develop all aspects of a fully functional prototype with a user-friendly front interface and scalable backend data process and management. It needs to deliver a seamless modeling and analysis pipeline at both tactical and joint operation levels of the red forces using simulated, multi-domain open source, and other DoD internal data. Conduct test and validation with AFRL and ACC analysts to demonstrate the human performance difference against current practice for a specific JATC task, for example, development of PIRs (Priority Intelligence Requirements) or EEIs (Essential Elements of Information) and/or facilitating asset management and task assignment.

PHASE III DUAL USE APPLICATIONS: Adapt, refine, and optimize the Phase II prototype into a mature product directly integrated with analytical systems at one of ACC’s Air Operation Centers to support multiple JATC tasks, for example, CR development, asset/task pairing, and battle damage assessment, using real mission data. Expand the software into other DoD branches such as the Space Force as well as the commercial world for applications in disaster relief [1], law enforcement [2], and many other areas [3].

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: 1. Gaur, M., Shekarpour, S., Gyrard, A. and Sheth, A., “empathi: an ontology for emergency managing and planning about hazard crisis,” Proc. IEEE 13th International Conference on Semantic Computing (ICSC), pp. 396-403, (2019). 2. Kejriwal, M., Szekely, P. and Knoblock, C., “Investigative knowledge discovery for combating illicit activities,” IEEE Intelligent Systems, 33(1), pp.53-63 (2018). 3. https://neo4j.com/use-cases/

KEYWORDS: Multi-Domain Command and Control; Integrated ISR; ISR Collection Management; Knowledge Representation and Inference

AF NUMBER: AF222-0023

TITLE: Hardware to Enhance Resilience of Satellites to Directed Energy Threats

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Space Platform; Materials

OBJECTIVE: Provide hardware suitable to enhance the resilience of satellites to directed energy threats. Hardware that disrupts any link in the 'kill chain' is of interest. Technologies that lessen the cost of defending satellites against DE threats or impose greater costs on the source of the DE threat are of particular interest.

DESCRIPTION: Directed Energy (DE) threats pose a growing threat to satellites. DE is of particular concern for the field of satellite resiliency because such action is not necessarily attributable or immediately detectable and because the cost of defense is greater than the cost of offense. Proposed solutions must balance the needs of efficacy, cost, and compatibility with the design and operation of existing and future spacecraft. Proposers must clearly show why their technology is not only effective, but cost-effective and compatible with operating in the space and spacecraft environment. Solutions may be either existing technology adapted to the needs of spacecraft DE resilience or they may be novel technology designed for spacecraft DE resilience. Hardware solutions that protect against any failure mechanism caused by DE threats are of interest. Creative responses are encouraged but adherence to fundamental physics and good design practice are required.

PHASE I: Define requirements to survive and operate within intended space, spacecraft, and DE threat environments. Perform modeling to estimate efficacy of the technology and any constraints it imposes on operation of the spacecraft. Characterize the applicability of the technology to spacecraft with different missions, orbits, et cetera. Orbits of interest include low, medium, highly elliptical, and geosynchronous earth orbits. Proposers adapting existing technology may perform a demonstration in a simulated DE threat environment. Prepare technology transition plans.

PHASE II: Design, analyze, build, and ground test the technology, showing capability to survive and perform in the space, spacecraft, and DE threat environment. If possible, space qualification testing should be performed such that the offeror is prepared to sell the product to the space market at the end of Phase 2.

PHASE III DUAL USE APPLICATIONS: Design, build, deliver, and support an experiment to allow the USSF to demonstrate the technology in a combined effects environment.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: 1. Gilmore, D. G., Spacecraft Thermal Control Handbook Volume I: Fundamental Technologies, 2nd Ed, The Aerospace Press, El Segundo, CA, 2002; 2. Wertz, J.R., Larson, W.J., Space Mission Analysis and Design, Microcosm Inc. Hawthorne, CA, 10th Ed, 2008.; 3. Fortescue, P., Stark, J., Swinerd, G., Spacecraft Systems Engineering, 3rd Ed., John Wiley and Sons, West Sussex, England, 2003.

KEYWORDS: Resilience; Directed Energy Threat; DE threat; hardware

AF NUMBER: AF222-0024

TITLE: Novel method of estimating moving target spatial dynamics for radar imaging

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Estimation of moving target spatial dynamics is an important step in the radar imaging of critical mobile targets. Spatical dynamics are the time evolution of position (latitude, longitude, altitude) and orientation (roll, pitch, yaw). Well known methods of estimating spatial dynamics involve accurately tracking individual radar scatterers and solving for target orientation subject to rigid body constraints. The objective is to develop new and novel methods for recovering spatial dynamics of moving targets with radar measurements not depending on tracking of individual scattering features. This estimation problem is considered to be so challenging that a novel alternative algorithmic method could be of great importance to national defense.

DESCRIPTION: Work will consist of defining reference radar collection topologies and waveform sets which can include one or more airborne and spaceborne radar sensors. Individual radar sensors can be monostatic or bistatic. Primary emphasis will be on developing 6-DOF motion esitimation algorithms suitable for the selected reference topologies. Algorithms will be tested on simulated and real data provided by the government, and development will progress towards real-time software implementations which could be "dropped in" to operational radar signal processing chains.

PHASE I: Phase 1 work on this project will first define one or more radar collection topologies suitable or 6-DOF moving target dynamics. Radar collection topologies can include one or more airborne and/or space based platforms. Basic radar characteristics including power and instantaneous bandwidth will also be defined, but there is no requirement for detailed radar system engineering. The main emphasis will be on algorithm development. For a given topology and radar characteristics, one or algorithms for recovering spatial dynamics will be demonstrated using a signal simulation developed by each Phase 1 awardee.

PHASE II: The Phase 2 awardees will fully develop the algorithmic framework based on simulated and real data provided by the government. Awardees will develop portable software suitable for inclusion in a a radar ground station. Software will be provided in either C++ or the Julia computer language.

PHASE III DUAL USE APPLICATIONS: Novel techniques for extracting 6-DOF information from complex radar data could have applications to automotive radars and airborne see-and-avoid radars. Estimating 6-DOF motion parameters is a critical part of the processing chain in imaging and then recognizing complex distributed targets which are in motion. Both automotive and see-and-avoid radar systems would benefit greatly from being to more accurately recognize moving targets. This is part of a broad revolution in radar processing where targets are not just dots on a screen, but much more detailed information about the target is derived from radar signals. Both automotive and see-and-avoid radars might use two or more separated sensors (multistatic sensing) combined with 6-DOF estimation techniques to help build internal images of external moving objects which are then used to classify or recognize the types of objects they are sensing. Another dual-use application of this technology would be to include this technology in radars monitoring both land and sea movements at major ports using a tethered aerostat or one or more UAVs.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration

Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: M. Stuff, M. Biancalana, G. Arnold and J. Garbarino, "Imaging moving objects in 3D from single aperture synthetic aperture radar," Proceedings of the 2004 IEEE Radar Conference (IEEE Cat. No.04CH37509), 2004, pp. 94-98,; 10.1109/NRC.2004.1316402.

KEYWORDS: radar adaptive motion estimation; radar imaging of moving targets; three dimensional radar imaging; sparse aperture reconstruction; six degree of freedom motion estimation; contrast maximization; manifold learning

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions
AMENDMENT 5
9 June 2022

This Amendment accomplishes the following revisions:

1. Section H(I)(d), Lines 6-9, is revised to read:

The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-halfof the total contract price, unless otherwise approved in writing by the Contracting Officer.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions
AMENDMENT 4
20 May 2022

This Amendment accomplishes the following revisions:

1. The numbering scheme for the “Topics” section has been revised to delineate between Air Force and Space Force topics.
2. Topic SF222-D009 “Non-Standard Space Domain Information” is added to the Phase II Topic Index Table.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions
AMENDMENT 3
13 May 2022

This Amendment accomplishes the following revisions:

1. Chart 1 is deleted in its entirety.
2. The TPOC information associated with topic AF222-D027 is changed.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions
AMENDMENT 2
5 May 2022

The purpose of this amendment is to incorporate the following revisions:

1. Modify the topic numbers to align with the topic numbers in the Phase II Topic Index table.

All other solicitation provisions remain unchanged as a result of this Amendment.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions
AMENDMENT 1
28 April 2022

The purpose of this amendment is to incorporate the following revisions:

1. AF 22.2 SBIR Direct to Phase II Topic Index table is replaced in its entirety to include Technical Volume page limits.

Topic Number	**Topic Title**	**Base Cost Max**	**Base Duration Max (in months)**	**Vol 2 Technical Volume Page Limit**
AF222-D002	Autonomous monitoring of Isolated Person (IP) to determine resupply needs	$1,250,000.00	27	50
AF222-D003	Dual Mode Semi Active Laser (SAL) Imaging Seeker	$1,250,000.00	27	50
AF222-D004	System Level Initiatives for rocket Cargo (SLICk)	$1,250,000.00	27	50
AF222-D005	Rocket cargo Applications and adaptations of Commercial (K)containers (RACK)	$1,250,000.00	27	50
AF222-D006	Rapidly applied Applications to Initiate Launch (RAIL)	$1,250,000.00	27	50
AF222-D007	Experiments in Joint (Commercial/DoD) Ejection Concepts, Technology and Operations for Rocket cargo (EJECTOR)	$1,250,000.00	27	50
SF222-D009	Non-Standard Space Domain Information	$1,250,000.00	27	50
AF222-D008	Analytical Toolkit for SATCOM Analysis in Contested Environments	$1,250,000.00	27	50
AF222-D010	Energy Needs for Expeditionary forces supplied by Rocket cargo Generated deliverY (ENERGY)	$1,250,000.00	27	50
AF222-D011	Technology Enablers for Just In Time Multimission Airmen/Warfighters (JIT MMA/W)	$1,250,000.00	27	50
AF222-D012	POINT: Processes for Optical Imaging Next generation Technologies	$1,250,000.00	27	50
SF222-D013	Metamaterial Applications for Space-Based Active Phased Arrays	$1,250,000.00	27	50
SF222-D014	Advanced Materials for Satellite Propulsion Components that use ASCENT (Advanced Spacecraft Energetic Non-Toxic) propellant	$1,250,000.00	27	50
AF222-D015	Wear-protection Coatings for 5th/6th Generation Systems	$1,250,000.00	27	50
AF222-D016	GNSS-Denied Positioning Solution for Unmanned Aerial Systems Using Existing Camera Turrets	$1,250,000.00	27	50

AF222-D017	Cross Security Domain Linking of Partitioned Human Performance and Training Data Sets	$1,250,000.00	27	50
AF222-D018	Generalized Enrichment of Pilot Training Data Through Automated Classification of Pilot training Objectives, Scenarios, and Performance	$1,250,000.00	27	50
AF222-D019	Efficient Processing of Printed Resistive Film Coatings	$1,250,000.00	27	50
AF222-D020	Generation of Synthetic Exemplar Data with Relevant Tactics	$1,250,000.00	27	50
AF222-D021	Detecting and Tracking Trends in Large-Force Performance Over Time	$1,250,000.00	27	50
AF222-D022	Manufacturing Process Informatics for Composite Curing (M-PICC)	$1,250,000.00	27	50
AF222-D023	Liquid Crystalline Devices for Non-mechanical Beam Steering for Air and Space Applications	$1,250,000.00	27	50
AF222-D024	High Temperature Paste Adhesives and Sealants	$1,250,000.00	27	50
AF222-D025	Advanced Signal Processing Library	$1,730,000.00	15	50
AF222-D026	Navigation Warfare on Autonomous Threats (NWAT)	$1,730,000.00	15	50
AF222-D027	Detect-and-Avoid on Long-Endurance Platform	$1,730,000.00	15	50
SF222-D028	Cislunar Space Domain Awareness Sensor	$1,730,000.00	15	50
AF222-D029	Dynamic Materials for Customizable Impact Protection	$1,250,000.00	27	50
AF222-D030	Reconfigurable free-space metasurfaces for infrared photonics	$1,250,000.00	27	50
AF222-D031	Bulk Optical Materials Supplier for the Infrared - BOMSIr	$1,250,000.00	27	50
SF222-D032	Infrared Coating Process Improvements for Detectors	$1,250,000.00	27	50
AF222-D033	SiGeSn LADAR Receiver	$1,250,000.00	27	50

2. All other content remains unchanged and in full effect.

AIR FORCE (AF)
22.2 Small Business Innovation Research (SBIR) Direct to Phase II (D2P2)
Proposal Submission Instructions

AF Phase II proposal submission instructions are intended to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Firms must ensure proposals meet all requirements of the 22.2 SBIR BAA posted on the DoD SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

Complete proposals **must** be prepared and submitted via https://www.dodsbirsttr.mil/submissions/ (DSIP) on or before the date published in the DoD 22.2 SBIR BAA. Offerors are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The AF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the AF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "22.2 Address Change".

Points of Contact:

- General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD 22.2 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  Mr. Daniel Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, http://www.airforcesmallbiz.af.mil/. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), http://www.aptacus.us.org. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

The AF recommends early submission, as computer traffic gets heavy near the proposal submission date/time and could slow down the system. **Do not wait until the last minute.** The AF is not responsible for incomplete proposal submission due to system lag or inaccessibility. Please ensure contact information, i.e., names/phone numbers/email addresses, in the proposal is current and accurate. The AF is not responsible for ensuring notifications are received by firms for which this information changes after proposal submission without proper notification. Changes of this nature shall be sent to the Air Force SBIR/STTR One Help Desk.

I. DIRECT TO PHASE II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small

business concern was provided an award under Phase I of an SBIR program with respect to such project. AF is conducting a "Direct to Phase II" implementation of this authority for these 22.2 SBIR topics and does not guarantee D2P2 opportunities will be offered in future solicitation. Each eligible topic requires documentation to determine whether the feasibility requirement described in the Phase I section of the topic has been met.

II. <u>**INTRODUCTION**</u>: Direct to Phase II proposals must follow the steps outlined below:

1. Offerors must create a Cover Sheet in DSIP; follow the Cover Sheet instructions provided in the DoD SBIR Program BAA.Offerors must provide documentation satisfying the Phase I feasibility requirement* to be included in the Phase II proposal. Offerors must demonstrate completion of research and development through means other than the SBIR/STTR Programs to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description.
2. Offerors must submit D2P2 proposals using the instructions below.

*NOTE: AF will not consider the offeror's D2P2 proposal if the offeror fails to demonstrate technical merit and feasibility have been established. It will also not be considered if it fails to demonstrate the feasibility effort was substantially performed by the offeror and/or the principal investigator (PI). Refer to the topics' Phase I descriptions for minimum requirements needed to demonstrate feasibility. <u>Feasibility documentation MUST NOT be solely based on work performed under prior or on-going Federally funded SBIR and/or STTR work.</u>

II. <u>PROPOSAL SUBMISSION</u>

The complete proposal must be submitted electronically through DSIP. Ensure the complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. **VIRUS-CHECK ALL SUBMISSIONS.**

Complete proposals must include all of the following:
Volume 1: DoD Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents, e.g., SBIR/STTR Environment, Safety and Occupational Health (ESOH) Questionnaire; DoD Form 2345, Militarily Critical Data Agreement (if applicable); etc.
Volume 6: Fraud, Waste, and Abuse Training Completion

Phase II proposals require a comprehensive, detailed description of the proposed effort. AF D2P2 efforts are to be proposed in accordance with the information in these instructions and Chart 1 (above). Commercial and military potential of the technology under development is extremely important. Proposals emphasizing dual-use applications and commercial exploitation of resulting technologies are sought.

All D2P2 research or research and development (R/R&D) must be performed by the small business and its team members in the United States, as defined in the DoD SBIR 22.2 BAA. The Principal Investigator's (PI's) primary employment must be with the small business concern at the time of award and during the entire period of performance. Primary employment means more than one-half the PI's time is spent in the small business' employ. This precludes full-time employment with another entity.

Knowingly and willfully making false, fictitious, or fraudulent statements or representations may be a felony under18 U.S.C. Section 1001, punishable by a fine up to $250,000, up to five years in prison, or both.

III. PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

See Chart 1 (above). Advocacy letters, if any; SBIR/STTR Environment, Safety and Occupational Health (ESOH) Questionnaire; and the additional cost proposal itemized list, 17.a-j, should be included in Volume 5, Supporting Documentation. This documentation and the Cover Sheet will not count toward the technical volume limits. There is no set format requirement for white papers or slide decks, if required.

Please note the Fraud, Waste and Abuse Training **must** be completed prior to proposal submission. This is accomplished under Volume 6 within DSIP. When the training is complete and certified, DSIP will indicate so in the proposal, completing the Volume 6 requirement. **The proposal cannot be submitted until the training has been completed.** The complete proposal must be submitted via DSIP on or before the date published in the DoD 22.2 SBIR BAA. Submissions outside DSIP including, but not limited to, email, hardcopy, or other media will not be accepted.

Complete the SBIR/STTR Environment, Safety, and Occupational Health (ESOH) Questionnaire found at:https://www.afsbirsttr.af.mil/Portals/60/Pages/Overview/Air%20Force%20SBIR_STTR%20Environment%20Safety%20and%20Occupational%20Health_ESOH_Oct%202021_JSH.pdf . Include the completed document in the proposal under Volume 5, Other Documents.

A. Proposal Requirements. A Phase II proposal shall provide sufficient information to persuade the AF the proposed technology advancement represents an innovative solution to the scientific or engineering problem worthy of support under the stated criteria. All sections below count toward the page limit, unless otherwise specified.

B. Proprietary Information. Information constituting a trade secret, commercial/financial information, confidential personal information, or data affecting National Security must be clearly marked. It shall be treated in confidence to the extent permitted by law. Be advised, in the event of proposal selection, the Work Plan will be incorporated into the resulting contract by reference. Therefore, DO NOT INCLUDE PROPRIETARY INFORMATION in the work plan. See the DoD BAA regarding proprietary information marking.

C. General Content. Proposals should be direct, concise, and informative. Type shall be no smaller than 11-point on standard 8 ½ X 11 paper, with one-inch margins and pages consecutively numbered. Offerors are discouraged from including promotional and non-programmatic items. If included, such material will count toward the page limit.

D. Proposal Format. The technical proposal includes all items listed below in the order provided.

(1) **Proposal Cover Sheet:** Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. The technical abstract should include a brief description of the program objective(s), a description of the effort, anticipated benefits and commercial applications of the proposed research, and a list of keywords/terms. The technical abstract of each successful proposal will be submitted to the Office of the Secretary of Defense (OSD) for publication and, therefore, must not contain proprietary or classified information. The term "Component" on the Cover Sheet refers to the AF organization requesting the Phase II proposal.

(2) **Table of Contents:** A table of contents should be located immediately after the Cover Sheet.

(3) **Glossary:** Include a glossary of acronyms and abbreviations used in the proposal.

(4) **Milestone Identification:** Include a program schedule with all key milestones identified.

(5) **<u>Identification and Significance of the Problem or Opportunity</u>:** Briefly reference the specific technical problem/opportunity to be pursued under this effort.

(6) **<u>Phase II Technical Objectives</u>:** Detail the specific objectives of the Phase II work and describe the technical approach and methods to be used in meeting these objects. The proposal should also include an assessment of the potential commercial application for each objective.

(7) **<u>Work Plan</u>:** The work plan shall be a separate and distinct part of the proposal package, using a page break to divide it from the technical proposal. It must contain a summary description of the technical methodology and task description in broad enough detail to provide contractual flexibility. The following is the recommended format for the work plan; begin this section on a new page. **DO NOT include proprietary information.**

a) <u>1.0 – Objective</u>: This section is intended to provide a brief overview of the specialty area. It should explain the purpose and expected outcome.
b) <u>2.0 – Scope</u>: This section should provide a concise description of the work to be accomplished, including the technology area to be investigated, goals, and major milestones. The key elements of this section are task development and deliverables, i.e., the anticipated end result and/or the effort's product. This section must also be consistent with the information in Section 4.0 below.
c) <u>3.0 – Background</u>: The offeror shall identify appropriate specifications, standards, and other documents applicable to the effort. This section includes information or explanation for, and/or constraints to, understanding requirements. It may include relationships to previous, current, and/or future operations. It may also include techniques previously determined ineffective.
d) <u>4.0 – Task/Technical Requirements</u>: The detailed individual task descriptions for accomplishing proposed work are considered to be legally binding on the offeror. Therefore, it must be developed in an orderly progression with sufficient detail to establish overall program requirements and goals. The work effort must be segregated into major tasks and identified in separately numbered paragraphs.

Each numbered major task should delineate the work to be performed by subtask. The work plan MUST contain every task to be accomplished in definite, realistic, and clearly stated terms. Use "shall" whenever the work plan expresses a binding provision. Use "should" or "may" to express a declaration or purpose. Use "will" when no contractor requirement is involved, i.e., "... power will be supplied by the Government."

(8) **<u>Deliverables</u>:** Include a section clearly describing the specific sample/prototype hardware/ software to be delivered, as well as data deliverables, schedules, and quantities. Be aware of the possible requirement for unique item identification IAW DFARS 252.211-7003, Item Identification and Valuation, for hardware. If hardware/ software will be developed but not delivered, provide an explanation. At a minimum, the following reports will be required under ALL Phase II contracts.

a) <u>Scientific and Technical Reports</u>: Rights in technical data, including software, developed under the terms of any contract resulting from a SBIR Announcement generally remain with the contractor. The Government obtains SBIR/STTR data rights in all data developed or generated under the SBIR/STTR contract for a period of 20 years, commencing at contract award. Upon expiration of the 20-year SBIR/STTR license, the Government has Government purpose rights to the SBIR data.

i. Final Report: The draft is due 30 days after Phase II technical effort. The first page of the final report will be a single-page project summary, identifying the work's purpose, providing a brief description of the effort accomplished, and listing potential result applications. The summary may be published by DoD. Therefore, it must not contain any proprietary or classified information. The

remainder of the report should contain details of project objectives met, work completed, results obtained, and technical feasibility estimates.

ii. Status Reports: Status reports are due quarterly at a minimum.

iii. Small Business Online Success Stories: Success Story submissions are due at the end of the technical effort via http://launchstories.org. If selected, refer to the Contract Data Requirements List (CDRL) in the contract for submission instructions.

b) Additional Reporting: AF may require additional reporting documentation including:
   i. Software documentation and users' manuals;
   ii. Engineering drawings;
   iii. Operation and maintenance documentation
   iv. Safety hazard analysis when the project will result in partial or total development and delivery of hardware; and
   v. Updates to the commercialization results.

(9) **Related Work:** Describe significant activities directly related to the proposed effort, including any previous programs conducted by the Principal Investigator, proposing firm, consultants, or others, and their application to the proposed project. Also list any reviewers providing comments regarding the offeror's knowledge of the state-of-the-art in the specific approach proposed.

(10) Company Commercialization Report (CCR)/Commercialization Potential:

a) Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

b) The DoD requires a commercialization plan be submitted with the Phase II proposal, specifically addressing the following questions:
   i. What is the first planned product to incorporate the proposed technology?
   ii. Who are the probable customers, and what is the estimated market size?
   iii. How much money is needed to bring this technology to market and how will it be raised?
   iv. Does your firm have the necessary marketing expertise and, if not, how will your firm compensate?
   v. Who are the probable competitors, and what price/quality advantage is anticipated by your firm.

c) The commercialization strategy plan should briefly describe the commercialization potential for the proposed project's anticipated results, as well as plans to exploit it. Commercial potential is evidenced by:

i. The existence of private sector or non-SBIR/STTR Governmental funding sources demonstrating commitment to Phase II efforts/ results.
ii. The existence of Phase III follow-on commitments for the research subject.
iii. The presence of other indicators of commercial technology potential, including the firm's commercialization strategy.

d) If awarded a D2P2, the contractor is required to periodically update the commercialization results of the project via SBA. These updates will be required at completion of the effort, and subsequently when the contractor submits a new SBIR/STTR proposal to DoD. Firms not submitting a new proposal to DoD will be requested to provide updates annually after the D2P2 completion.

(11) **Military Applications:** Briefly describe the existing/potential military requirement and the military potential of the SBIR/STTR Phase II results. Identify the DoD agency/organization most likely to benefit from the project. State if any DoD agency has expressed interest in, or commitment to, a non-SBIR, Federally funded Phase III effort. This section should include not more than one to two paragraphs. Include agency point of contact names and telephone numbers.

(12) **Relationship with Future R/R&D Efforts**:
i. State the anticipated results of the proposed approach, specifically addressing plans for Phase III, if any.
ii. Discuss the significance of the D2P2 effort in providing a basis for the Phase III R/R&D effort, if planned.

E. **Key Personnel:** In the technical volume, identify all key personnel involved in the project. Include information directly related to education, experience, and citizenship. A technical resume for the Principal Investigator, including publications, if any, must also be included. Concise technical resumes for subcontractors and consultants, if any, are also useful. Identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For these individuals, in addition to technical resumes, please provide countries of origin, type of visas or work permits held, and identify the tasks they are anticipated to perform.

Foreign Nationals (also known as Foreign Persons) means any person who is NOT:
a. a citizen or national of the United States; or
b. a lawful permanent resident; or
c. a protected individual as defined by 8 U.S.C. § 1324b

ALL offerors proposing to use foreign nationals MUST follow the DoD 22.2 BAA and disclose this information regardless of whether the topic is subject to ITAR restrictions.

When the topic area is subject to export control, these individuals, if permitted to participate, are limited to work in the public domain. Further, tasks assigned must not be capable of assimilation into an understanding of the project's overall objectives. This prevents foreign citizens from acting in key positions, such as Principal Investigator, Senior Engineer, etc. Additional information may be requested during negotiations in order to verify foreign citizens' eligibility to perform on a contract awarded under this BAA.

The following will apply to all projects with military or dual-use applications developing beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.
(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.
(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.
(4) The Contractor shall be responsible for ensuring that these provisions apply to its subcontractors.

F. **Facilities/Equipment:** Describe instrumentation and physical facilities necessary and available to carry out the D2P2 effort. Justify equipment to be purchased (detail in cost proposal). State whether proposed performance locations meet environmental laws and regulations of Federal, state, and local Governments for, but not limited to, airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

G. **Consultants/Subcontractors**: Private companies, consultants, or universities may be involved in the project. All should be described in detail and included in the cost proposal. In accordance with the Small Business Administration (SBA) SBIR Policy Directive, a minimum of 50% of the R/R&D must be performed by the proposing firm, unless otherwise approved in writing by the Contracting Officer. Signed copies of all consultant or subcontractor letters of intent must be attached to the proposal. These letters should briefly state the contribution or expertise being provided. Include statements of work and detailed cost proposals. Include information regarding consultant or subcontractor unique qualifications. Subcontract copies and supporting documents do not count against the Phase II page limit. Identify any subcontract/consultant foreign citizens per E above.

H. Prior, Current, or Pending Support of Similar Proposals or Awards:
WARNING: While it is permissible, with proper notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous Federal program solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. Any potential for this situation must be disclosed to the solicitation agency(ies) before award. If a proposal submitted in response to BAA is substantially the same as another proposal previously, currently, or in process of being funded by another Federal agency/DoD Component or the same DoD Component, the company must so indicate on the Cover Sheet and provide the following:

a) The name and address of the Federal agency(ies) or DoD Component(s) to which proposals were or will be submitted, or from which an awarded is expected or has been received;
b) The proposal submission or award dates;
c) The proposal title;
d) The PI's name and title for each proposal submitted or award received; and

e) Solicitation(s) title, number, and date under which the proposal was or will be submitted, or under which an award is expected or has been received.
f) If award was received, provide the contract number.
g) Specify the applicable topics for each SBIR proposal submitted or award received.

NOTE: If this section does not apply, state in the proposal, “No prior, current, or pending support for proposed work.”

I. **Cost Proposal:** A detailed cost proposal must be submitted. Cost proposal information will be treated as proprietary. Proposed costs must be provided by both individual cost element and contractor fiscal year (FY) in sufficient detail to determine the basis for estimates, as well as the purpose, necessity, and reasonableness of each. This information will expedite award if the proposal is selected. Generally, firm fixed price contracts are appropriate for Phase II awards. In accordance with the SBA SBIR/STTR Policy Directive, Phase II contracts must include profit or fee.

Cost proposal attachments do not count toward proposal page limitations. The cost proposal includes:

a) **Direct Labor:** Identify key personnel by labor category. Number of hours, actual hourly rates, labor overhead, and/or fringe benefits per contractor FY is also required.

b) **Direct Materials:** Costs for materials, parts, and supplies must be justified and supported. Provide an itemized list of types, quantities, prices, and, where appropriate, purpose. If computer or software purchases are planned, detailed information such as manufacturer, price quotes, proposed use, and support for the need will be required.

c) **Other Direct Costs:** This includes specialized services such as machining or milling, special test/analysis, and costs for temporary use/lease of specialized facilities/ equipment. Provide usage (hours) expected, rates, and sources, as well as brief discussion concerning the purpose and justification. Proposals including leased hardware must include an adequate lease versus purchase rationale. Special tooling/test equipment/material costs are acceptable but will be carefully reviewed to determine the need/appropriateness of the work proposed. The Contracting Officer must decide whether these purchases are advantageous to the Government and are directly related to the proposed effort. Title to property furnished by the Government will be vested with the AF unless determined to be more cost-effective for transfer to the contractor. The Government’s intention is not to directly fund purchase of general-purpose equipment.

d) **Subcontracts:** Subcontract costs must be supported with copies of subcontract agreements. Agreement documents must adequately describe the work to be performed and cost bases. The agreement document should include a SOW, assigned personnel, hours and rates, materials (if any), and proposed travel (if any). A letter from the subcontractor agreeing to perform a task or tasks at a fixed price is not considered sufficient. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price, unless otherwise approved in writing by the Contracting Officer.

The prime contractor must accomplish price analysis, including reasonableness, of the proposed subcontractor costs. If based on comparison with prior efforts, identify the basis upon which the prior prices were determined reasonable. If price analysis techniques are inadequate or the FAR requires subcontractor cost or pricing data submission, provide a cost analysis. Cost analysis includes but is not limited to, consideration of materials, labor, travel, other direct costs, and proposed profit rates.

e) **Consultants:** For each consultant, provide a separate agreement letter briefly stating the service to be provided, hours required, and hourly rate, as well as a short, concise resume.

f) **Travel:** Each effort should include, at a minimum, a kickoff or interim meeting. Travel costs must be justified as required for the effort. Include destinations, number of trips, number of travelers per trip, airfare, per diem, lodging, ground transportation, etc. Per Diem and lodging rates may be found in the Joint Travel Regulation (JTR), Volume 2, www.defensetravel.dod.mil.

g) **Indirect Costs:** Indicate proposed rates' bases, e.g., budgeted/actual rates per FY, etc. The proposal should identify the specific rates used and allocation bases to which they are applied. Do not propose composite rates; proposed rates and applications per FY throughout the anticipated performance period are required.

h) **Non-SBIR Governmental/Private Investment:** Non-SBIR Governmental and/or private investment is allowed. However, it is not required, nor will it be a proposal evaluation factor.

i) **DD Form 2345:** For proposals submitted under export-controlled topics (either ITAR or EAR), a certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission, must be included. The form, instructions, and FAQs may be found at the US/Canada Joint Certification Program website, http://www.dlis.dla.mil/jcp/. DD Form 2345 approval will be verified if the proposal is selected for award.

J. **Feasibility Documentation –** Should be uploaded to Volume 5, Supporting Documents

a. If appropriate, include a reference or works cited list as the last page.
b. Feasibility efforts detailed must have been substantially performed by the offeror and/or the PI. If technology in the feasibility documentation is subject to intellectual property (IP) rights, the offeror must provide IP rights assertions. Provide a good faith representation all other IP utilized in the proposal is owned or possessed. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights describing restriction's nature and intellectual property intended for use in the proposed research. Please see DoD SBIR 22.2 BAA for technical data rights information.
c. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated and WILL be redacted.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The Air Force does not participate in the Discretionary Technical and Business Assistance (TABA) Program. Proposals in response to Air Force topics should not include TABA.

IV. METHOD OF SELECTION AND EVALUATION CRITERIA

A. Introduction: D2P2 proposals are evaluated on a competitive basis by subject matter expert (SME) scientists, engineers, or other technical personnel. Throughout evaluation, selection, and award, confidential proposal and evaluation information will be protected to the greatest extent possible. D2P2 proposals will be disqualified and not evaluated if the Phase I equivalency documentation does not establish the proposed technical approach's feasibility and technical merit.

B. Evaluation Criteria: Phase II proposals will be reviewed for overall merit based on the criteria discussed in the DoD 22.2 BAA.

NOTE: Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors: APEX, Peerless Technologies, Engineering Services Network, HPC- COM, Mile Two, REI Systems, MacB (an Alion company), and Infinite Management Solutions. In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space Force may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. **Contact the AF SBIR/STTR Contracting Officers with concerns about any of these contractors**.

V. CERTIFICATIONS

In addition to the standard Federal and DoD procurement certifications, the SBA SBIR/STTR Policy Directive requires the collection of certain information from firms at the time of award and during the award life cycle. Each firm must provide these certifications at the time of proposal submission, prior to receiving 50% of the total award amount, and prior to final payment.

VI. FEEDBACK

The PI and Corporate Official indicated on the Proposal Cover Sheet will be notified by email regarding proposal selection or non-selection. The small business will receive one notification for each proposal submitted. Please note the referenced proposal number and read each notification carefully. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF via AF SBIR/STTR One Help Desk.**

Feedback requests will be provided to offerors with proposals determined "Not Selectable" ONLY. The notification letter will include instructions for submitting a feedback request. Offerors are entitled to no more than one feedback per proposal. NOTE: Feedback is not the same as a FAR Part 15 debriefing. Acquisitions under this solicitation are awarded via "other competitive procedures." Therefore, offerors are neither entitled to nor will they be provided FAR Part 15 debriefs.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Air Force SBIR/STTR Contracting Officer Daniel Brewer, Daniel.Brewer.13@us.af.mil.

AF 22.2 SBIR Direct to Phase II Topic Index

Topic Number	Topic Title	Base Cost Max	Base Duration Max (in months)	Vol 2 Technical Volume Page Limit
AF222-D002	Autonomous monitoring of Isolated Person (IP) to determine resupply needs	$1,250,000.00	27	50
AF222-D003	Dual Mode Semi Active Laser (SAL) Imaging Seeker	$1,250,000.00	27	50
AF222-D004	System Level Initiatives for rocket Cargo (SLICk)	$1,250,000.00	27	50
AF222-D005	Rocket cargo Applications and adaptations of Commercial (K)containers (RACK)	$1,250,000.00	27	50
AF222-D006	Rapidly applied Applications to Initiate Launch (RAIL)	$1,250,000.00	27	50
AF222-D007	Experiments in Joint (Commercial/DoD) Ejection Concepts, Technology and Operations for Rocket cargo (EJECTOR)	$1,250,000.00	27	50
AF222-D008	Analytical Toolkit for SATCOM Analysis in Contested Environments	$1,250,000.00	27	50
SF222-D009	Non-Standard Space Domain Information	$1,250,000.00	27	50
AF222-D010	Energy Needs for Expeditionary forces supplied by Rocket cargo Generated deliverY (ENERGY)	$1,250,000.00	27	50
AF222-D011	Technology Enablers for Just In Time Multimission Airmen/Warfighters (JIT MMA/W)	$1,250,000.00	27	50
AF222-D012	POINT: Processes for Optical Imaging Next generation Technologies	$1,250,000.00	27	50
SF222-D013	Metamaterial Applications for Space-Based Active Phased Arrays	$1,250,000.00	27	50
SF222-D014	Advanced Materials for Satellite Propulsion Components that use ASCENT (Advanced Spacecraft Energetic Non-Toxic) propellant	$1,250,000.00	27	50
AF222-D015	Wear-protection Coatings for 5th/6th Generation Systems	$1,250,000.00	27	50
AF222-D016	GNSS-Denied Positioning Solution for Unmanned Aerial Systems Using Existing Camera Turrets	$1,250,000.00	27	50
AF222-D017	Cross Security Domain Linking of Partitioned Human Performance and Training Data Sets	$1,250,000.00	27	50
AF222-	Generalized Enrichment of Pilot Training	$1,250,000.00	27	50

D018	Data Through Automated Classification of Pilot training Objectives, Scenarios, and Performance			
AF222-D019	Efficient Processing of Printed Resistive Film Coatings	$1,250,000.00	27	50
AF222-D020	Generation of Synthetic Exemplar Data with Relevant Tactics	$1,250,000.00	27	50
AF222-D021	Detecting and Tracking Trends in Large-Force Performance Over Time	$1,250,000.00	27	50
AF222-D022	Manufacturing Process Informatics for Composite Curing (M-PICC)	$1,250,000.00	27	50
AF222-D023	Liquid Crystalline Devices for Non-mechanical Beam Steering for Air and Space Applications	$1,250,000.00	27	50
AF222-D024	High Temperature Paste Adhesives and Sealants	$1,250,000.00	27	50
AF222-D025	Advanced Signal Processing Library	$1,730,000.00	15	50
AF222-D026	Navigation Warfare on Autonomous Threats (NWAT)	$1,730,000.00	15	50
AF222-D027	Detect-and-Avoid on Long-Endurance Platform	$1,730,000.00	15	50
SF222-D028	Cislunar Space Domain Awareness Sensor	$1,730,000.00	15	50
AF222-D029	Dynamic Materials for Customizable Impact Protection	$1,250,000.00	27	50
AF222-D030	Reconfigurable free-space metasurfaces for infrared photonics	$1,250,000.00	27	50
AF222-D031	Bulk Optical Materials Supplier for the Infrared - BOMSIr	$1,250,000.00	27	50
SF222-D032	Infrared Coating Process Improvements for Detectors	$1,250,000.00	27	50
AF222-D033	SiGeSn LADAR Receiver	$1,250,000.00	27	50

AF NUMBER: AF222-D002

TITLE: Autonomous monitoring of Isolated Person (IP) to determine resupply needs

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors; Battlespace

OBJECTIVE: An Isolated Person (IP) can result from aircraft mishap, inadvertent separation from ground forces, or other miscellaneous scenarios. Advance planning is designed to enable survival for the initial 48 hours. Following those 48 hours, supplies are required to enable survival and evasion until rescue can occur. This technology monitors the IP, their surroundings, and expendable items to provide an optimized resupply survival kit. The survival kit will then be delivered to the IP via existing methods or though new approaches in development.

DESCRIPTION: The resupply of an IP in austere or hostile environments is an ongoing challenge. Recent advances in sensing and connectivity have created an opportunity to advance the state-of-the-art by developing and introducing an autonomous monitoring system to determine resupply needs of an IP. The autonomous system should generate a list of essential supplies to enable survival and evasion until rescue can occur. The system should include a functional user interface (such as the Android Tactical Assault Kit (ATAK)). Additionally, such a system might also be useful for commercial purposes, such as search and rescue or remote package delivery. Potential resupplies could include, but not be limited to, the following: medical supplies, batteries, communication/signal devices, food and water, and clothing. The system should autonomously monitor human performance parameters (hydration, body temperature, respiration, etc.), characterize environmental conditions, and track expendable supplies (battery life, munitions). Depending on the input, the system should generate a prioritized resupply list. This list should be displayed to the IP for verification (if IP is able to respond) and then transmit the prioritized resupply list to rescue personnel. Additional supplies could include, but not be limited to, the following: resealable plastic bags, parachute cord (100’), insect repellent, un-scented suntan lotion, pressurized water bag with pump and filter, dry food meals, flash/backpack cooking system, and flashlights. Autonomous monitoring would be performed by fitting the warfighter with a suite of sensors to inform an artificial intelligence system that would track and anticipate resupply needs. A specific example is ammunition. The sensor suite should be small format and unobtrusive like a wireless enabled wearable technology or wristwatch.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include the assessment of emerging wearable human performance monitors. The result of Phase I-type efforts is to assess and demonstrate whether wearable human performance monitors can support Personnel Recovery needs to monitor and assess IP needs.

PHASE II: Evaluate existing sensor capabilities to monitor human performance parameters (hydration, body temperature, respiration, etc.), characterize environmental conditions, and track expendable supplies (battery life, munitions). Explore integration schemes and communication requirements. Propose system level design to meet requirements. Identify or design and develop required sensors. Integrate sensors into prototype device. Evaluate prototype device in laboratory and outdoor environment.

PHASE III DUAL USE APPLICATIONS: Refine prototype device based on customer feedback. Evaluate prototype device in relevant environment. Develop manufacturing plan or partner with others for system production.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation

(ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Heikenfeld, J., Jajack, A., Feldman, B. et al. Accessing analytes in biofluids for peripheral biochemical monitoring. Nat Biotechnol 37, 407–419 (2019). ;

https://doi.org/10.1038/s41587-019-0040-3;

Michael C. Brothers, Madeleine DeBrosse, Claude C. Grigsby, Rajesh R. Naik, Saber M. Hussain, Jason Heikenfeld, and Steve S. Kim. Achievements and Challenges for Real-Time Sensing of Analytes in Sweat within Wearable Platforms. Acc. Chem. Res. 2019, 52, 2, 297–306. ;

https;//doi.org/10.1021/acs.accounts.8b00555;

Harshman SW, Pitsch RL, Smith ZK, O’Connor ML, Geier BA, Qualley AV, et al. (2018) The proteomic and metabolomic characterization of exercise-induced sweat for human performance monitoring: A pilot investigation. PLoS ONE 13 (11). ;

https://doi.org/10.1371/journal.

KEYWORDS: Human Performance Measure; Human Performance Monitor; Human Performance Report; Weather Monitor; Weather Report; Supply Track

AF NUMBER: AF222-D003

TITLE: Dual Mode Semi Active Laser (SAL) Imaging Seeker

TECH FOCUS AREAS: Microelectronics; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics

OBJECTIVE: Achieve prototype seeker capable of simultaneous operation in both semi-active seeker and passive imager roles with a single focal plane array and optical path. Project should address the core technical challenges to result in a prototype fundamentally capable to meet or exceed performance of existing seekers in each mode.

DESCRIPTION: Passive imager and semi-active laser (SAL) seekers are two common technologies used for missile guidance - each with complementary CONOPS to fulfill automatic target recognition (ATR) and man-in-the-loop designation needs. Unfortunately, complex seekers with discrete multi-mode sensors are prohibitively expensive in terms of cost, size, weight and power (CSWaP). Warfighters continue to demand "more with less". This call seeks to fund focal plane array (FPA) or similar concepts which are capable of simultaneous operation in each mode in a singular device, with a low-CSWaP optical path. It is critical to meet the performance of existing SAL seekers, which have precise algorithms - to ensure reliability - that currently rely on accurate, fast detectors. This is difficult in an imaging FPA. Proposals should describe details of concept parameters such at timing accuracy, pulse width measurement, pixel reset time, readout rate, and show fundamental first-order analysis comparison to existing SAL seeker capabilities such as countermeasure rejection and multi-path pulse discrimination. First-order analysis of solar noise rejection for the FPA should be explored in the proposal, and compared with traditional quad-sensors which can employ narrow bandpass filters. Additionally, typical characterizations of imaging performance will be an important but secondary consideration. Seeker diameters of 5in (threshold) and 2.75in (objective) may be assumed. Systems which are at least compatible with the current generation of laser designators (STANAG 3733 compliant) will be preferred. Further compatibility with other advantageous lasers designs which may exist in future generations (such as variations of wavelength, pulse width, repetition rate, etc.) is a benefit, but not a key driver. Of tertiary importance is the spectral band(s) of the imaging component. Concepts which include dual-band imaging are of interest, though practical concerns of engineering and funding should be seriously considered in the proposal phase. The imaging spectral band selection should be contextualized within performance and CONOPS considerations. Finally, this topic is open to any particularly novel concepts which may address the fundamental need for dual mode SAL/imaging in a performant and low-CSWaP package, even if previous descriptors may seem not to include such a concept. The topic authors may not be aware of every successful approach, thus we broadly welcome inquiries and proposals which are competitive to the alternatives.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include complete analysis and design of dual mode seeker sub-system components for development and testing, conceptual designs including optical and radiometric performance models in relevant CONOPS, and key assumptions or requirements highlighted, with any additional technology required for testing/operating noted.

PHASE II: Produce a system-level design and prototype of Phase I concepts. Prototypes will be tested in both laboratory and field environments. Any analysis and models shall be continuously refined and exercised to reflect improvements or changes from the Phase I. ROM cost estimates will be refined.

PHASE III DUAL USE APPLICATIONS: Development of the dual-mode SAL imager seeker will find ready application in military missile seeker technology, with key partnerships from prime DoD contractors supporting transitions to programs of record. Additionally, multi-use passive imaging and laser sensing devices will be immediately applicable to large commercial industries, such as vehicle advanced driver assistance systems (ADAS).

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: [1] J. Barth, A. Fendt, R. Florian, et al., "Dual-mode seeker with imaging sensor and semi-active laser detector," Proceedings of the SPIE Volume 6542 (2007); [2] J. English, R. White, "Semi-active laser (SAL) last pulse logic infrared imaging seeker," Proceedings of the SPIE Volume 4372 (2001); [3] Patent US 8,164,037, “Co-boresighted dual-mode SAL/IR seeker including a SAL spreader,” Raytheon Company, David D. Jenkins, Byron B. Taylor, David J. Markason, Apr. 24, 2012

KEYWORDS: semi-active laser guidance; human-in-the-loop; autonomous guidance and control; laser designated; dual-mode seeker; automatic target recognition

AF NUMBER: AF222-D004

TITLE: System Level Initiatives for rocket Cargo (SLICk)

TECH FOCUS AREAS: Network Command, Control and Communications; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Electronics; Space Platform; Information Systems

OBJECTIVE: This topic seeks to preform system-of-systems analysis, concept exploration, test and evaluation of capabilities enabled by the emerging commercial rocket market and the ability to quickly transport materials to any point on the globe.

DESCRIPTION: The Department of the Air Force is exploring rocket transportation capability for DoD logistics and the Air Force Research Laboratory (AFRL) is currently assessing emerging rocket capability across the commercial vendor base, and its potential use for quickly transporting DoD materiel to ports across the globe. The U.S. commercial launch market is building the largest rockets ever, at the lowest prices per pound ever, with second-stages that will reenter the atmosphere and be reused. These advances in the U.S. commercial launch market are presenting the need for assessment and maturation of system-of-systems concepts of rocket transportation for DoD (Department of Defense) logistics by the United States Air Force and Space Force (USAF/USSF). A large trade space exists for the potential of rocket cargo for global logistics, to include improvements in delivery cost and speed compared to existing air cargo operations. The goal of this effort is to investigate concepts, and yet to be develop concepts for rock cargo to determine technical feasibility and risk, programmatic costs, and schedule. The information, test and evaluation (T&E) under this effort will be used to influence and guide rocket cargo efforts. While the goal is to enable up to 100 tons of cargo to be delivered anywhere on the planet within tactical timelines, there may be optimization techniques and process with smaller amounts of cargo and transportation modes other than rockets that can provide rapid delivery of materials. An objective of this effort is to grow AFRL’s Rocket Cargo industrial base. This topic is intended to reach companies capable of completing a feasibility study and prototype validated concepts under accelerated Phase I and II type schedules. This topic is aimed at later stage research and development efforts rather than “front-end” or basic research/research and development. The focus is on emerging commercial capabilities to minimize cost and enable agile logistics through the entire span of responsive mission planning, rapid cargo logistics, ground launch operations and coordination with commercial airspace. The main deliverables will be modeling and simulation (M&S), T&E of concepts that advance the viability and utility of using commercial rockets and associated systems for Department of Defense global logistics to expanding capabilities of the USSF for combatant commanders.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include the assessment of emerging commercial rocket capability and the potential to quickly transport DOD materiel to ports across the globe. Phase I-type efforts would include agile global logistic concepts to deliver 1 to 100 tons of DoD cargo anywhere on the planet in less than one hour. The result of Phase 1-type efforts is to assess and demonstrate whether commercial rockets and associated systems can deliver DoD cargo anywhere on the planet in less than one hour.

PHASE II: Eligibility for a Direct to Phase Two (D2P2) is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of rapid logistics concepts that enable quick transport of DoD material to ports across the globe. Prototypes, M&S and experimentation should explore a wide range of integrating commercial rocket capabilities and cargo platforms within the Air and Space Force logistics train. These capabilities should consider areas that are unique to military logistics such as mission planning and execution, transportation of quick reaction forces/humans, munitions, fuel, ground operations, loading and unloading of cargo and transportation of unloaded cargo other remote locations. Phase II efforts shall conduct analysis, M&S and experimentation to address military-unique requirements that may not be otherwise met by commercial space transportation capabilities. No funding will be invested in developing commercial rocket systems.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

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S. Sankar, ” The Supply Chain Revolution: Innovative Sourcing and Logistics for a Fiercely Competitive World”, American Management Association, 2017;

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O. Yakimenko, “Precision Aerial Delivery Systems: Modeling, Dynamics, and Control”, American Institute of Aeronautics and Astronautics, 2015;

WHO, “Qualification of shipping containers, Technical supplement to WHO Technical Report Series, No. 961, 2011”, QAS/14.598 Supplement 13, 2014;

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KEYWORDS: Rocket Cargo; Systems Analysis; Cargo Systems; Commercail Containers; ISO-90; Modeling and Simulation; Delivery Systems; Agile Logistics; Rapid Delivery; Commercail Rockets; Logistics Train; Mission Planning; Ground Operations

AF NUMBER: AF222-D005

TITLE: Rocket cargo Applications and adaptations of Commercial (K)containers (RACK)

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Electronics; Space Platform; Air Platform

OBJECTIVE: This topic seeks to preform concept exploration, Modeling and Simulation (M&S), prototype development, test and evaluation of lower-cost, lighter and multi-domain cargo containers with additional features needed for space transport.

DESCRIPTION: The Department of the Air Force (DAF) has a 70-year history of launching exquisite, fragile payloads to space and doing so in a highly mass-optimized fashion. US Transportation Command (USTRANSCOM) also have a long history of deploying inter-modal containers to allow cargo to withstand the environments of transport by air, sea, rail, and land, and rapidly switch between the transport modes without repackaging. Inter-modal container development has not addressed the emerging market of transport by space. Merging these two expertise will be necessary for rocket transportation of Department of Defense (DoD) materials. Innovative options for intermodal containers that are reasonable mass-optimized for space launch are needed. Whereas in the past the DoD optimized rocket payloads solely for mass, understanding the trade-space between mass-optimization and end-to-end speed of the logistics chain is desired. Relaxing the mass optimization for containers presents a vast array of concepts to greatly accelerate the speed at which crews can load and unload a rocket. Novel designs in mass optimized, inter-model containers for space could allow crews to move the cargo to other transport modes without having to repack materials in separate and distinct containers. The goal of this effort is to investigate and develop concepts for low-cost and inter-modal containers that are suited for space transport of cargo. Different type of cargo classes should be considered, such as sensitive material requiring vibration isolation (i.e. medical equipment/supplies), liquid fuel and even human transport needs. The information, test and evaluation (T&E) under this effort will be used to influence and guide container development that is suitable for rocket cargo efforts. An objective of this effort is to enable the commercial market to develop and manufacture inter-modal shipping container that meet the needs of the DoD for rocket transportation. This topic is intended to reach companies capable of completing a feasibility study and prototype validated concepts under accelerated Phase I and II type schedules. This topic is aimed at later stage research and development efforts rather than “front-end” or basic research/research and development. The focus is on emerging commercial capabilities of cargo containers to minimize cost and enable agile logistics through the entire span of responsive mission planning, rapid cargo logistics, ground launch operations and coordination with commercial airspace. 463L interfaces/materials handling system should be taken into consideration as that is cargo system used for military aircraft and a standard form factor to be considered is the ISU-90. Civil systems use, to a greater extent containers of the size 88" or 96" X 125" civil pallets and may need to be accommodated as part of the Rocket Cargo container trade space. The main deliverables will be modeling and simulation (M&S), T&E of concepts that advance the viability and utility of using commercial inter-modal container systems for rocket transport capabilities of the United States Space Force (USSF) for combatant commanders.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include the assessment of emerging commercial inter-modal container systems that enable rapid transport of DOD materiel to ports across the globe. Phase I-type efforts would include the addition of “space” as a new domain for inter-modal systems. In addition, Phase I-type efforts would include assessment of containers that can withstand high-g ejection and thermal loading in the case of air launched delivery. Novel methods for disassembly and/or prepping containers to re-enter the logistics chain should have also been addressed. The result of Phase I- type efforts is to assess and demonstrate whether commercial container systems can support the DoD's goal of delivering cargo anywhere on the planet in less than one hour.

PHASE II: Eligibility for a Direct to Phase Two (D2P2) is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of commercial shipping containers that enable quick transport of DoD material to ports across the globe. Prototypes, M&S and experimentation should explore a wide range of inter-modal systems that can be used for cargo transport on commercial rocket capabilities. The container systems should consider areas that are unique to military logistics such as mission planning and execution, transportation of quick reaction forces/humans, munitions, fuel, ground operations, loading and unloading of cargo and transportation of unloaded cargo other remote locations. Phase II efforts shall conduct analysis, M&S and experimentation to address military-unique requirements that may not be otherwise met by commercial container systems used during space transport. No funding will be invested in developing commercial rocket systems.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES: V. Reis, R. Macario, "Intermodal Freight Transportation", Elsevier, 2019;

R. Konings, H. Priemus, P. Nijkamp, "Future of Intermodal Freight Transport: Operations, Design and Policy", Elgar Publishing, 2008;

C. Moore, S. Yildirim, S. Baur, "Educational Adaptation of Cargo Container Design Features", ASEE Zone III Conference, 2015;

K. Giriunas, H. Sezen, R. B. Dupaix, "Evaluation, modeling, and analysis of shipping container building structures", Engineering Structures, vol. 43, 2012;

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Defense Transportation Regulation part VI, Management and Control of Intermodal Containers and System 463L Equipment, https://www.ustranscom.mil/dtr/dtrp6.cfm, 2021;

Defense Transportation Regulation References, https://www.ustranscom.mil/dtr/dtr_references.pdf;

KEYWORDS: Multi-Domain Cargo Containers; Multi-Modal Cargo Containers; Mass Optimization; Shock and Vibration Isolation; Low-Cost Shipping Containers; Agile Logistics; Rapid Cargo Logistics; Ground Launch Operations; Mission Planning and Management; 463L Interfaces and Material Handling; ISU-90

AF NUMBER: AF222-D006

TITLE: Rapidly applied Applications to Initiate Launch (RAIL)

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Electronics; Space Platform; Air Platform

OBJECTIVE: This topic seeks to preform analysis, concept exploration, application development, test and evaluation, and prototype integration to enable rapid launch of commercial rocket capabilities and support the US Space Force (USSF) goal to quickly transport materials to any point on the globe.

DESCRIPTION: Emerging commercial rocket capabilities present a unique opportunity for the USSF to quickly transport materials (and people) to any point on the earth and fundamentally change how the Department of Defense (DoD) preforms logistical operations. While it has been demonstrated that these rockets can quickly get to any point on the earth, the amount of time necessary to prep a rocket for launch and obtain regulatory approvals for launch is still undesirable. This topic seeks to address head-on, the historical processes and procedures that can take months to enable a rocket to launch. The diametrically opposed state of “months of planning with rapid launch” needs to be congruent – “rapid planning with rapid launch”. Efforts under RAAILL can be broken down into three areas: 1. Ground, launch and landing operations, 2. Mission Planning, and 3. Logistics and Readiness. Ground, launch and landing operations should include both pre-flight and post flight aspects. Mission planning should include areas such as mission design, range control, airspace de-confliction and weather prediction and mitigation. Logistics and readiness should include areas such as command and control (C2) scheduling, launch schedule de-confliction, materiel distribution and maintenance and training and exercises. There are various scenarios where insertion of rapid techniques and process may differ. First, there is the capability for responsive 1-way rocket cargo delivery to austere sites. These austere sites have no on-site rocket capability to unload or have a booster needed to return the rocket to a different port. Responsive 1-way scenarios may be in response to disaster or humanitarian relief efforts and response times could be on the order of less than 60 minutes flight and within 48 hours of executive orders. Second is the capability for routine 2-way logistics between CONUS and OCONUS launch sites. These launch sites are, in-general already established and have ground operations for loading and unloading with existing commercial logistics processes. A third area is airdrop. This a totally new area where cargo is ejected from a rocket cargo platform and is delivered specific locations. Airdrop may include subsonic or supersonic payload deployment of small or large payloads. Supersonic payload deployment may include egress burn to land safely downrange and subsonic may be expendable. Rocket cargo platforms may need modification to accommodate DoD unique cargo interfaces. The goal of this effort is to develop, demonstrate and integrate rapid logistic processes, tools, and applications specific to USSF needs. These efforts could be new or modification of existing systems and processes. An objective of this effort is to grow AFRL’s Rocket Cargo industrial base. This topic is intended to reach companies capable of completing a feasibility study and prototype validated concepts under accelerated Phase I and II type schedules. This topic is aimed at later stage research and development efforts rather than “front-end” or basic research/research and development. The focus is on emerging commercial capabilities to minimize cost and enable rapid logistics through the entire span of responsive mission planning, cargo logistics, ground launch operations and coordination with commercial airspace. The main deliverables will be modeling and simulation, software applications, process development, Test and Evaluation of concepts that advance the ability to rapidly launch rocket cargo platforms.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, software application development, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include the assessment of existing systems and processes required for launch of rocket platforms. Phase I efforts would include the modification of existing software applications and tools demonstrating techniques to reduced time to plan and execute missions – whether specific to commercial or the DoD. Phase 1 type efforts would also include the understanding of current regulatory process and organizations required for launch of rocket systems to space with proposed ways-forward to reduce bureaucratic oversight and regulatory burden.

PHASE II: Eligibility for a Direct to Phase Two (D2P2) is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, software application and tool development, experimentation and evaluation of rapid concepts that enable quick transport of DoD material to ports across the globe. Prototypes, applications, Modeling and Simulation and experimentation should explore a wide range of rapid concepts that can be used for cargo transport on commercial rocket capabilities. Cargo could include the need to transport personnel which might require separate and distinct systems and process for rapid launch. Systems, processes and applications for quick and responsive ground operations, flight de-confliction, regulatory department notification and coordination, and all-weather launch are just some of the areas to be considered under RAAILL. Rapid concepts should consider areas that are unique to military logistics such as mission planning and execution, transportation of quick reaction forces/humans, munitions, fuel, ground operations, loading and unloading of cargo and transportation of unloaded cargo other remote locations. Phase II efforts shall conduct analysis, Modeling and Simulation and experimentation to address military-unique requirements that may not be otherwise met by commercial systems used during space transport. No funding will be invested in developing commercial rocket systems.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, Modeling and Simulation, applications and tools, Test and Evaluation results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES: Office of Commercial Space Transport, “www.faa.gov/about/office_org/headquarters_offices/ast/”; J. Bresina, P. Morris, “Mixed-Initiative Planning in Space Mission Operations”, Bresina, 2007;

J. Wertz, W. Larson, “Space Mission Analysis and Design”, 3rd Edition, Space Technology Library, 1999;

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H. Pasquier, C. Cruzen, M. Schmidhuber, Y.H. Lee, “Space Operations: Inspiring Humankind's Future”, Springer International Publishing, 2010;

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KEYWORDS: Ground Launch Operations; Landing Operations; Mission Planning; Command and Control; Logistics; Air-Space Deconfliction; Weather Prediction; Rapid Logistics; Loading and Un-Loading Cargo;

AF NUMBER: AF222-D007

TITLE: Experiments in Joint (Commercial/DoD) Ejection Concepts, Technology and Operations for Rocket cargo (EJECTOR)

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Electronics; Space Platform; Air Platform

OBJECTIVE: This topic seeks to preform high speed separation analysis, concept exploration, test and evaluation using sub-scale experiments to enable air-drop of cargo ejected from a rocket that is capable of transporting up to 100 tons of cargo.

DESCRIPTION: The Department of the Air Force is exploring rocket transportation capability for DoD logistics and the Air Force Research Laboratory (AFRL) is currently assessing emerging rocket capability across the commercial vendor base, and its potential use for quickly transporting DoD materiel to ports across the globe. The U.S. commercial launch market is building the largest rockets ever, at the lowest prices per pound ever, with second-stages that will reenter the atmosphere and be reused. These advances in the U.S. commercial launch market are presenting the need for assessment and maturation of air-drop cargo concepts where cargo is ejected from the rocket and delivered to a specific destination. Air-drop of cargo is desirable when a rocket cannot land and be unloaded, such as on the ocean or in austere environments where landing on a surface impossible. Air-drop of cargo may be required in an area just after a natural disaster or to remote Forces when landing a rocket is not desired. The goal of this effort is to support the analysis in determining if air-drop of large payloads is feasible and at what speeds. Various concepts of operations (CONOPS) need to be analyzed that include slow drop speeds (< 0.5 Mach) when the rocket is preforming a slow-down maneuver all the way up to fast drop conditions where the rocket is traveling at speeds up to Mach 5. An objective of this effort is to explore multiple CONOPS and preform modeling and simulation using techniques as Computational Fluid Dynamics (CFD) and 6 Degrees of Freed (6DoF) models of the rocket cargo platform. Sub-scale experiments of the ejection mechanisms with the cargo containers is desired in order to get a better understanding of the trade space. Part of the focus of this topic should be on what are the package/container sizes and how many may be needed to make the air-drop mission relevant? What is the range of viable high-speed separation conditions? (Rocket orientation, speed, altitude, ejection technique). What trajectories allow egress of the rocket after air-drop? What are the remaining capabilities of the rocket after air-drop delivery of the intended cargo? Quantification of the parent response to child separation and ejection velocity required for safe separation are part of the analysis on this topic. The main deliverables will be modeling and simulation (M&S) and sub-scale experiments examining the feasibility of air-dropping cargo from a rocket.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, commercial container design or use, ejection systems, parachute delivery systems, concept development, concept demonstration and concept evaluation and sub-scale laboratory experimentation. Phase I-type efforts include modeling and simulation using CFD techniques, the ability to create 6DoF models of various rocket designs, concepts and/or prototypes of ejection systems, drogue chute and/or Inflatable Aerodynamic Decelerator (IAD) familiarity, trade-space analysis tools and applications and sub-scale experimentation expertise. The result of Phase I-type efforts is to assess and demonstrate whether commercial rockets and associated systems can air-drop cargo.

PHASE II: Eligibility for a Direct to Phase Two (D2P2) is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, sub-scale experimentation, cost benefit analysis, system-of-systems studies, software application and tool development of concepts that enable air-drop of DoD material to any point across the globe. Prototypes, applications, M&S and sub-scale experimentation should explore a wide range of concepts that can be used for air-drop of cargo from commercial rocket capabilities. Concepts should consider areas that are unique to military logistics such as the air-drop of Humanitarian relief supplies, medical equipment and supplies, munitions, fuel and electronic systems. Phase II efforts shall conduct analysis, M&S and sub-scale experimentation to address military-unique requirements that may not be otherwise met by commercial systems used during air-drop type missions. No funding will be invested in developing commercial rocket systems.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, applications, tools and sub-scale experimentation and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES: R. Johnson, “Ejection Seat Mechanism in Civil Aircraft”, International Journal of Scientific & Engineering Research, Volume 3, Issue 10, October-2012; F. Liu, “Review on Ejector Efficiencies in Various Ejector Systems”, International Refrigeration and Air Conditioning, 2014; K. Dutt, “Analytical Description Of Pneumatic System”, International Journal of Scientific & Engineering Research, Volume 4, Issue 9, September-2013; C. Hohmann, B., Tipton, Jr., M. Dutton, “Propellant for the NASA Standard Initiator, October 2000, NASA/TP-2000-210186; M. Falbo, R. Robinson, “Apollo Experience Report - Spacecraft Pyrotechnic Systems”, March 1973, NASA TN D-7141; D. Waye, “Design and performance of a parachute for the recovery of a 760-lb payload”, Apr 1991, SAND-90-2158C; CONF-9104171-3, ON: DE91007509; J. Hagen, M. Burlone, K. Rojdev, “Major Design Choices and Challenges that Enabled the Success of the Ejectable Data Recorder System”, March 2020, IEEE Aerospace Conference in March 2020;

KEYWORDS: High Speed Ejection Systems; Commercial Cargo Containers; Shock and Vibration Isolation; Computational Fluid Dynamics (CFD); 6 Degrees of Freed (6DoF) models; Modeling and Simulation; Sub-Scale Experimentation; Concept of Operations (CONOPS); High-Speed Seperation Systems; Safe Seperation; Pneumatic systems;

AF NUMBER: AF222-D008

TITLE: Analytical Toolkit for SATCOM Analysis in Contested Environments

TECH FOCUS AREAS: Network Command, Control and Communications

TECHNOLOGY AREAS: Space Platform; Air Platform; Battlespace

OBJECTIVE: Deliver a modular, portable, analytical toolbox to enable dynamic workflows to assess probability of mission success for assets dependent on satellite communications in a contested environment.

DESCRIPTION: Satellite communications (SATCOM) is a critical service that is relied upon in order to operate assets in land, air, and sea. As the nature of global conflicts transition away from de-centralized non-nation state actors to near-peer adversaries, the potential threats to SATCOM services also changes. There is a need to increase the sophistication in how the U.S. will acquire, plan, and utilize SATCOM to guarantee mission success while operating in a wide variety of contested environments. While some of this change will reside strictly within policy, a new class of users will require access to software tools to enable in depth modeling and analysis to provide timely and accurate results for decision making. A common code base and architecture is needed to support simulated situations for planning, as well as the ability to take in data feeds to evaluate real-world, real-time events. The approach should be modular to allow for users to customize workflows to meet their specific needs whether that be for the combatant command, centers like the Persistent Attack and Reconnaissance Operations Center (PAROC), or an individual unit with SATCOM dependent assets. The approach should be compatible for deployment on systems at all levels of classification. Respondents must include a description of what data sources they will be utilizing and how those will be acquired without government action. Respondents must describe their software development process and expect to provide monthly updates and potential redirection from the TPOC.

PHASE I-TYPE EFFORT: Award of a D2P2 will require documented feasibility study that substantiates that the offerors proposed technology meets the following criteria - Offeror must demonstrate a robust framework that allows use of qualitative and quantitative metrics from multi-source information, to assess a contested environment and provide ranked options to ensure SATCOM services for mission success. An evaluation of the algorithms, including the accuracy and precision in the parameters utilized, shall be supplied. The study must show an example simulated scenario(s) that require at least two different workflows to provide solutions to support various types of potential end users. Stated letters of support from an operations community are encouraged. GFE is not anticipated.

PHASE II: Offeror will leverage documented framework, algorithms and scenarios. After consultation with the Air Force customer, offeror will expand upon the initial algorithms to achieve both new workflows and desired accuracy and timeliness. The scenario(s) will need to be expanded to demonstrate utility for a land, air, and sea asset. The potential threats must be expanded in the scenario to include a space-based threat. The system should demonstrate how results can be ingested and displayed by an existing, operational tool to reach real-world users without costly refactoring or licensing for a new tool. GFE is not anticipated.

PHASE III DUAL USE APPLICATIONS: After consultation with the Air Force customer, expand upon Phase II to demonstrate a real-time analysis workflow and include at least one operational input. If a facility is made available with adequate resources, deliver, install, and demonstrate at least one prototype copy of the software suite at an Air Force-operated facility. Provide training so that at least one subject matter expert could run the toolkit on a computer without contractor aid.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force

SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Network survivability oriented Markov games (NSOMG) in wideband satellite communications D Shen, G Chen, G Wang, K Pham, E Blasch, Z Tian https//ieeexplore.ieee.org/xpl/conhome/6950783/proceeding DOD COMMAND, CONTROL, AND COMMUNICATIONS (C3) MODERNIZATION STRATEGY September 2020 SATELLITE COMMUNICATIONS: DOD Should Develop a Plan for Implementing Its Recommendations on a Future Wideband Architecture, GAO-20-80, GAO Report to Congressional Committees, Dec 2019

KEYWORDS: SATCOM; EMI; modeling & amp; simulation

AF NUMBER: SF222-D009

TITLE: Non-Standard Space Domain Information

TECH FOCUS AREAS: Network Command, Control and Communications; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Space Platform; Battlespace

OBJECTIVE: Design, develop, and demonstrate information generation techniques to observe and deter hostile actions from non-standard threat vectors in the space domain.

DESCRIPTION: As one of the 5 core competencies identified in US Space Force (USSF) Spacepower Doctrine, Space Domain Awareness of non-standard threat vectors (NSTVs) is essential to secure the ultimate high ground above the Earth to project military space power for deterrent and coercive objectives. The complex gravitational topology of the expanded Area of Regard (AOR), including the expansive domain beyond GEO, enables low-cost options for spacecraft to rapidly alter course and unexpectedly threaten terrestrial and space-based assets. Over the next 10 years the space domain will become more crowded and possibly contested. For example, currently, there are 39 funded missions planned for launch before 2030 that will reach Lunar distances originating from at least fourteen countries by means of non-standard trajectories. The United States (US) does not currently possess the capability to adequately monitor the space domain for all NSTVs. As a result, adversaries can unexpectedly threaten both terrestrial and space-based assets without attribution. The USSF needs new information generation techniques to establish a path forward to projecting Spacepower into the expanded AOR through Space Domain Awareness. This will enable Space Security through Deterrence and Combat power projection by alerting/supporting defensive operations and targeting/performing battle damage assessments on offensive operations.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, commercial container design or use, ejection systems, parachute delivery systems, concept development, concept demonstration and concept evaluation and sub-scale laboratory experimentation. Phase I-type efforts include: developing simulation capabilities to model non-standard threat vectors and the expanded space domain AOR, simulating a comprehensive and diverse set of NSTV models to evaluate different architecture concepts, developing and evaluating an operations architecture and Concept of Operations (CONOPs) for generating actionable information on NSTVs, developing conceptual approaches for incremental deployment of the architecture, and developing information processing techniques to generate actionable information on the NSTV threats.

PHASE II: Perform additional modeling and simulation of the necessary systems and subsystems to quantify the Technology Readiness Levels (TRLs) of all Key Enabling Technologies (KET). Develop a strategy with execution plan to mature each capability for a prototype system demonstration. Execute development necessary to rapidly mature each KET in the architecture. Through simulation or deployment to a relevant environment, demonstrate the ability to generate actionable information on NSTV threats on relevant timelines. GFE is not anticipated.

PHASE III DUAL USE APPLICATIONS: Develop a strategy to transition prototype residual capabilities and incremental proliferation based on operational requirements. Develop and support an information dissemination strategy to ensure operator accessibility. Generate the necessary documentation to train operators to effectively and efficiently utilize the new information at operations centers. Support activities to ensure adequate operator training and sustainment of the information systems. Assist the government in quantifying the operational impact of additional technology proliferation and additional information.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation

(ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: United States Space Force, "Spacepower," Space Capstone Publication, Headquarters United States Space Force, June 2020. M. Bolden, T. Craychee and E. Griggs, "An Evaluation of Observing Constellation Orbit Stability, Low Signal-to-Noise, and the Too-Short-Arc Challenges in the Cislunar Domain," Advanced Maui Optical and Space Surveillance Technologies Conference, Maui, Hawaii, 2020. Trusted Space, Inc., "Constellation to Observe and Deter Adversaries in the Cislunar Environment (CODACE) Final Report," Space Development Agency, 2020. J. J. P. T. W. W. a. C. R. M. D. J. Dichmann, "TRAJECTORY DESIGN FOR THE TRANSITING EXOPLANET SURVEY," 2014.

KEYWORDS: information architecture design; spacepower; deterrence; indications & warning; object tracking; real-time data processing; data dissemination; space domain; information exploitation; space domain awareness

AF NUMBER: AF222-D010

TITLE: Energy Needs for Expeditionary forces supplied by Rocket cargo Generated deliverY (ENERGY)

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Nuclear; Electronics; Space Platform

OBJECTIVE: Energy-enabled DoD expeditionary operations require capabilities that increase flexibility and agility in force posture and employment. Expeditionary and contingency operations must be conducted in remote areas, austere environments, or locations otherwise experiencing degraded infrastructure, logistical support, and deficiencies in basic power, water, food, shelter, security, and medical care. To support these mobile and forward operating locations, transformational technologies in the areas of deployable energy generation, storage, and transmission are needed to provide resilient power to command and control nodes, crewed stations, and operational equipment. Concepts are being explored where all the necessary supplies (food, water, shelter, etc.) will be delivered via rocket where up to 100 tons of cargo can be delivered rapidly to any point on earth. Along with the creation and development of the power systems, this topic seeks to further investigate the specific requirements for the transportation of the power systems using containers such as the ISU-90 and 20 foot CONEX boxes. That is, what are the unique requirements of the container system (shock, vibration) needed to house and subsequently deliver the power system. The rocket delivery is anticipated to be a “fee for service” and development of a rocket to support deliver is not part of this Topic. This topic seeks to preform system-of-systems analysis, concept exploration, test and evaluation of capabilities of expeditionary power systems and their ability to be delivered by the emerging commercial rocket market and the ability to quickly transport these systems to any point on the globe.

DESCRIPTION: The National Defense Strategy identifies threats across Asia and beyond as a principal priority for the Department. To confront this reality, the U.S. must project combat power across the globe via its expeditionary forces. These forces emphasize rapid mobility and agility and require fuel and power generation to move, fight, and to sustain. As the DoD seeks the capability to employ highly mobile forces able to get to any point on the earth via rocket and move from one location to another within theater complicating adversary targeting solutions, the traditional energy supply must also become mobile, lighter and be delivered via cargo container on a rocket capable of up to 100 tons of cargo. It is anticipated that the power generation requirements are between five kilo-watts (5kw) and fifty kilo-watts (50kw). As the adversary adapts to this operational concept, traditional diesel/JP8-powered electrical generators need to be supplemented to improve expeditionary energy resiliency/diversity to power the fight. Improving the efficiency of existing technologies with the addition of new renewable power generation, storage and distribution technologies will provide a light and mobile power generation capability to enable the capability to execute a highly mobile conflict. The main deliverables will be modeling and simulation (M&S), Test and Evaluation of concepts and sub-scale experiments in expeditionary power systems and the ability to deliver these systems via rocket.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Relevant areas of demonstrated experience and success include: M&S, cost benefit analysis, risk analysis, concept development, concept demonstration and concept evaluation, laboratory experimentation and field testing. Phase I-type efforts include the assessment of emerging light weight, portable and rapidly deployable power systems including generations, storage and distribution. Phase I-type efforts would include concepts, sub-systems, components and laboratory experimentation of expeditionary power generation and the ability to rapidly deploy these systems.

PHASE II: Eligibility for a Direct to Phase Two (D2P2) is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR/STTR Programs. These efforts will include M&S, simulation of prototype concepts, cost benefit analysis, system-of-systems studies, experimentation and evaluation of expeditionary power systems and rapid logistics concepts that enable quick transport of these systems to ports across the globe. Prototypes, M&S and experimentation should explore a wide range of small, light-weight and transportable power generation, storage and distribution systems leveraging commercial processes and systems to the maximum extent possible. These capabilities should consider areas that are unique to expeditionary forces and military logistics for power generation up to 50 kw. Delivery of these systems should consider ISU-90 and 20 foot standard commercial cargo containers. Phase II efforts shall conduct analysis, M&S, experimentation and sub-scale experiments to address military-unique requirements in power generation and transportation that may not be otherwise met by commercial space transportation capabilities. No funding will be invested in developing commercial rocket systems.

PHASE III DUAL USE APPLICATIONS: Phase III shall include upgrades to the analysis, M&S, T&E results and provide mature prototypes of system concepts. Phase III shall provide a business plan and address the ability to transition technology and system concepts to commercial applications. The adapted non-Defense commercial solutions shall provide expanded mission capability for a broad range of potential Governmental and civilian users and alternate mission applications. Integration and other technical support to operational users may be required.

REFERENCES: L. Grigsby, Electric Power Generation, Transmission and Distribution, Third Edition, CRC Press, 2012; Mitsubish Power, Hydrogen Power Generation Handbook, Second Edition, June 2021; Small Nuclear Power Reactors, World Nuclear Association, November 2021, https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx; T. Hamacher, A.M. Bradshaw, Fusion as a Future Power Source: Recent Achievements and Prospects, 18th World Energy Congress, 2001; A. Gupta, R. Sengupta, Analytical Study of the Development of Nuclear Fusion Reactors as Potential Source of Energy In the Future, 2019; Academia, Power Generation, Recent Papers in Power Generation, https://www.academia.edu/Documents/in/Power_Generation; B. Jasim, P. Taheri, An Origami-Based Portable Solar Panel System, 2018 IEEE 9th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)

KEYWORDS: Power Generation; Power Storage; Power Distribution; Portable Power Systems; Light-Weight and Transportable Power Generation; Cargo Containers for Power Systems; Shock and Vibration Isolation

AF NUMBER: SF222-D011

TITLE: Technology Enablers for Just In Time Multimission Airmen/Warfighters (JIT MMA/W)

TECH FOCUS AREAS: Network Command, Control and Communications; Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Bio Medical; Air Platform

OBJECTIVE: Create an integrated capability to support deployed personnel performing a wider variety of mission tasks across traditional AFSC and expertise boundaries.

DESCRIPTION: Deploying large numbers of personnel will not be feasible at forward austere locations in future fights. Multi-capable airmen must have point-of-need support for performance and resilience. The goal is to leverage maturing technologies in key areas of focus under this topic to provide seamless, adaptive and resilient airman performance across a range of mission types and tasks especially focused on multi-mission performance in deployed, austere locations. Technology areas of interest include but are not limited to Training and aiding content management ; Augmentation strategies and technology; Sensing, sensors and fusion methods; Intelligent and naturalistic user interfaces; Software models for agents (SME and Wingman); Data on/data off and augmented analytics; and tools for persistent, secure, covert networks and data movement. This topic seeks relevant technologies in areas of relevance to achieve the objective. While eventual integration will be accomplished the goal here is to solicit viable candidates in the areas and work to mature and apply those to meet the stated objective.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Phase II involves the identification and selection of technology alternatives in two or more of the areas of relevance to support the objectives. Several distinct Phase II efforts are envisioned to both mature specific technology options and capabilities in and of themselves but to also to tailor and focus them on the objectives for JIT MMA/W specifically. A number of the products from the Phase II efforts are expected to mature as stand alone capabilities, but will also mature with a goal of integration into an overall set of technology capabilities to meet the objectives for the topic.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES: Majumder, S., Mondal, T., Deen, M.J. Wearable sensors for remote health monitoring (2017) Sensors (Switzerland), 17 (1), art. no. 130, . Cited 444 times; Pandya, B., Pourabdollah, A., Lotfi, A. A cloud-based pervasive application for monitoring oxygen saturation and heart rate using fuzzy-as-a-service (2021) ACM International Conference Proceeding Series, pp. 69-75.; Mahmood, A.S., Jafer, E., Hussain, S., Fernando, X. Wireless body area network development for remote patient health observing (2017) IHTC 2017 - IEEE Canada International Humanitarian Technology Conference 2017, art. no. 8058193, pp. 26-31.Cited 6 times.; Fouse, A., Weiss, C., Mullins, R., Hanna, C., Nargi, B., & Keefe, D. F. (2018, June). Multimodal Interactions In Multi-Display Semi-Immersive Environments. In 2018 IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA) (pp. 36-41). IEEE.; Rebensky, S., Carroll, M., Bennett, W., & Hu, X. (2021). Impact of Heads-up Displays on Small Unmanned Aircraft System Operator Situation Awareness and Performance: A Simulated Study. International Journal of Human–Computer Interaction, 1-13.; Oviatt, S. (2007). Multimodal interfaces. In The human-computer interaction handbook (pp.

439-458). CRC press.; Jones, G., Berthouze, N., Bielski, R., & Julier, S. (2010, May). Towards a situated, multimodal interface for multiple UAV control. In 2010 IEEE International Conference on Robotics and Automation (pp. 1739-1744). IEEE.; Böhme, H. J., Wilhelm, T., Key, J., Schauer, C., Schröter, C., Groß, H. M., & Hempel, T. (2003). An approach to multi-modal human–machine interaction for intelligent service robots. Robotics and Autonomous Systems, 44(1), 83-96.; Lemmelä, S., Vetek, A., Mäkelä, K., & Trendafilov, D. (2008, October). Designing and evaluating multimodal interaction for mobile contexts. In Proceedings of the 10th international conference on Multimodal interfaces (pp. 265-272).; Cummings, M. L. (2015). Operator interaction with centralized versus decentralized UAV architectures. Handbook of Unmanned Aerial Vehicles, 977-992.

KEYWORDS: Augmented, virtual and extended reality technology; Flexible/Wearable Sensors; Cognitive state assessment; Physiological state assessment (e.g., Vital Signs); Task/activity performance monitoring and assistance; Environmental monitoring (e.g., CBRNE; DE); Data analytics and dashboards; Performance assessment and prediction; Multimodal communication and interaction technologies; Collaboration Tools; Haptics; Advanced visualization tools; Holographic displays; Brain Machine Interface (BMI) technologies; Telemedicine and telemaintenance tools; Wearable computer systems; Animated troubleshooting/procedures; Software models and agents; agent-based instruction and real-time aiding; distributable content for training and task-aiding; Scenario creation; AI/ML accelerators and analytics; Gaming technologies; digital engineering; Secure persistent data/content access; multi-capable tasks and airmen

AF NUMBER: AF222-D012

TITLE: POINT: Processes for Optical Imaging Next generation Technologies

TECH FOCUS AREAS: Directed Energy

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Materials; Air Platform

OBJECTIVE: Develop advanced concepts and an improved capability to hybridize heterogeneous, large format semiconductor materials, at the die and wafer level, for next-generation DoD Visible (VIS) and Infrared (IR) focal plane arrays (FPAs). In the near term, there is interest in affordable means to electrically and thermally connect wafer level semiconductors having interconnects down to 6 μm on center with yields greater than 0.99999 across array sizes approaching 10k x 10k. Of interest is affordable, low volume production rate capability with the means of processing 10's to 100's of wafers per year. Interconnect quality should withstand the standard levels of environmental characterization typical of air and space domain qualifications (e.g. shock, vibration, temperature, humidity, radiation, etc.).

DESCRIPTION: There is a demonstrated need across the electronics community for means of electrically and thermally connecting semiconductor materials for the use in various stacked applications. This need has been solved utilizing oxide bond technologies that rely on Van der Waals forces to adhere two wafers together when placed in close proximity. This stacking technology is being utilized for several medium to high volume applications but is cost prohibitive for small volume R&D and production lots of interest to USG. The Air Force seeks to solve this manufacturing shortfall through this program. Establishing realistic entrance criteria for incoming wafers in terms of surface flatness, Total Thickness Variation (TTV), along with contamination requirements is envisioned for this project. Other means of forming high density, high interconnect yield electrical/thermal bonding besides oxide bonds will be considered. Current state-of-the-art, HgCdTe 2k x 2k IR FPAs with 10 micron pixel pitch require a full 4 cm2 of both the IR detector material and "defect-free" silicon for the CMOS read-out integrated circuit (ROIC). With future FPAs approaching 10k x 10k at 10 micron pitch that will be on the order of 100 cm2 of area. This square area being larger than available 8" wafers will likely require future FPAs to be assembled from smaller scale chiplets 3D-integrated on an interposer employing Thru Silicon Vias (TSVs). Added to this will be FPA cooling requirements of these larger chips, and simultaneously providing tolerance against both radiation and human-made threats. Mid-wave IR imagers operating in the 3-5 μm band performing a major role in missile-warning applications are typically cooled down to the 100 – 130 K range. These large format FPAs have a substantial cooling power requirement (~ watts) and a significant need to mitigate the effects of unmatched coefficients of thermal expansion (CTEs). Rad-tolerance of these hetero-integration techniques will allow the emerging FPAs to be used in the space domain, where upcoming satellite constellations are increasing production demands. Finally, future FPAs tolerant to man-made threats, such as lasers, are also likely to benefit from heterogeneous-integration techniques extrinsic protection technologies to be packaged directly on the detector chiplets. Employing next-generation hetero-integration approaches is what will guarantee USG next-generation FPAs and is the focus of this topic. It is envisioned that multiple USG programs being executed in parallel to this activity will provide CMOS wafers that will need to be hybridized. These external programs very likely will be able to provide interconnect yield statistics that offerors can leverage and the USG can use to gauge formal success of the program. The company/ companies that provide the CMOS wafers for hybridization can / should be viewed as future customers for this boutique low volume manufacturing capability that the USG is seeking to establish through this program.

PHASE I: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the USSF customer. The feasibility study should have; -Identified the prime potential USSF end user(s) for the non-Defense commercial offering to solve the USSF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: https://www.spiedigitallibrary.org/conference-proceedings-of-spie/7082/1/Silicon-p-i-n-focal-plane-arrays-at-Raytheon/10.1117/12.798580.short ; https://www.spiedigitallibrary.org/conference-proceedings-of-spie/9219/921906/Advancements-in-SiPIN-hybrid-focal-plane-technology/10.1117/12.2072720.short

KEYWORDS: Focal Plane Array; Resiliency; Stacking; CMOS; semiconductor;

AF NUMBER: SF222-D013

TITLE: Metamaterial Applications for Space-Based Active Phased Arrays

TECH FOCUS AREAS: Network Command, Control and Communications; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Materials

OBJECTIVE: Develop metamaterial solutions for space-based active phased array applications to provide enhance capabilities for L-band, S-band, and C-band. The research and development must address enhancements in non-mechanical beam steering and pointing, and reduced aperture volume and mass. In addition, integration and system characterization should be considered in conjunction with manufacturing challenges.

DESCRIPTION: Future concepts for space-based communications and sensing hinge upon the use of novel functionalities and increased capabilities in smaller platforms with low SWaP. One area that has shown promise is the use of metamaterials for antenna applications. One of the greatest challenges to overcome for space-based phase arrays is the large size and mass of the aperture, in addition to beam pointing/steering. Investigation and application of metamaterials in conjunction with software-defined phase arrays seeks to enhance active phased array performance in L-band, S-band, and C-band. Metamaterial based apertures have demonstrated acceptable single band performance in small form factor and low cost systems for commercial markets. Flexibility to define the aperture properties can be explored through new metamaterial design coupled with active components - the focus of this effort should be on the metamaterial application and not on the feed network design or software-defined radio design. Metamaterials considered should be appropriate and feasible for operation in the space environment. The system performance should be characterized in comparison to traditional phased arrays. Some metrics may include pointing stability, overall steering FOV/FOR, access area, etc.

PHASE I: This topic is intended for a D2P2, therefore a Phase I award is not required. This topic is intended for technology proven ready to move directly into a Phase II. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study and any reports/documentation the support moving D2P2. This includes determining the scientific and technical merit and feasibility of ideas appearing to have potential. It must have validated the product-market fit between the proposed solution and a potential USSF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the USSF customer. The feasibility study should have; -Identified how this technology is enhancing state-of-the-art and current fielded solutions -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. A Phase III award may include a technology/prototype demonstration, with feasibility in both air and space applications.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: T. Itoh, "Metamaterials for RF applications," 2008 33rd International Conference on Infrared, Millimeter and Terahertz Waves, 2008, pp. 1-3, doi: 10.1109/ICIMW.2008.4665715; ; E. Brookner, "Advances and breakthroughs in radars and phased-arrays," 2016 CIE International Conference on Radar (RADAR), 2016, pp. 1-9, doi: 10.1109/RADAR.2016.8059284.

KEYWORDS: Active Phased Arrays; Metamaterials; Ka-band; Multiple band antenna; Space-based communications; Non-mechanical beamsteering; Software Defined Radio

AF NUMBER: SF222-D014

TITLE: Advanced Materials for Satellite Propulsion Components that use ASCENT (Advanced Spacecraft Energetic Non-Toxic) propellant

TECH FOCUS AREAS: Quantum Sciences; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Space Platform; Materials

OBJECTIVE: The AF and NASA have recently shown via flight experiments that the ASCENT (Advanced Spacecraft Energetic Non-Toxic) propellant can be used for high-thrust chemical propulsion needed for orbit transfer and debris avoidance. Additionally, ground testing has shown it can also be used for station-keeping using low-thrust electrical propulsion systems. As a dual-use, single source fuel, ASCENT enables the elimination of one of the two satellite fuel delivery and storage systems used on today's satellite systems; saving cost, weight, and space. Moreover, ASCENT burns 30% hotter than SOA hydrazine propellant, increasing propulsive efficiency with a demonstrated 50% increase in time-on-station. Not only do these factors reduce the associated cost, weight, and complexity of current systems, they also streamline the logistical footprint to service such vehicles—a consideration that is amplified by the fact that ASCENT is a green propellant with far less toxicity and handling issues than SOA hydrazine. In short, ASCENT has the ability to transform in-space propulsion and logistics. A key challenge in realizing the benefits of the ASCENT propellant is the aggressive combustion environment that it creates and how harsh it is on available SOA materials. Current hydrazine propulsion systems require a catalyst bed, bedplate, and thruster nozzle all of which are made out of costly iridium metal (Ir). These components are subject to efficiency and life limiting issues due to the much hotter ASCENT propellant. The higher heat loads cause morphological changes in the Iridium microstructure via sintering of the catalyst bed particles and gain growth within the catalyst particles as well as the bedplate and nozzle. Sintering in the catalyst bed results in localized propellant pooling, uneven ignition and leads to charring of the propellant which then blocks the local area for future combustion. This reduces performance and causes non-uniform pressures and heat loads within the bed. Whereas grain growth reduces material strength and fracture toughness. Both of these phenomena results in component failure due to both cyclic thermal shock and fatigue. The goal of this project is to identify (by modeling) and test new ultra higher temperature materials for the catalysis bed material to minimize sintering and grain growth. Additionally, improve the catalysis architecture to minimize uneven distribution of pore volume that causes pressure and thermal gradients. These two task will help to improve catalysis bed life as well as the other components life by a factor up to 20X.

DESCRIPTION: This topic is focused on filling a capability gap in emerging space propulsion technology. It will first use new material modeling methods for assessing catalysis bed materials (chemistry, architecture and degradation) for increase lifetime in the ASCENT propellant. Promising chemistries and designs will be fabricated and sent to AFRL/RQR for lifetime testing. Post tested beds will be characterize by the contractor and the results used to improve the modeling. Lifetimes improvements of 20X will be the goal.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. Phase I proposals will not be evaluated and will be rejected as nonresponsive. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: 1.) "AF-M315E Propulsion System Advances & Improvements" R. Masse, M. Allen, E. Driscoll, R. Spores, L. Arrington, S. Schneider & T. Vasek https://ntrs.nasa.gov/api/citations/20170001286/downloads/20170001286.pdf

KEYWORDS: Combustion; In-Space Propulsion; ASCENT propellant; new catalysts and bed plate materials; increased lifetime; Material Modeling; Quantum Mechanics; Artificial Intelligence/Machine Learning; Structural Analysis

AF NUMBER: SF222-D015

TITLE: Wear-protection Coatings for 5th/6th Generation Systems

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Materials

OBJECTIVE: The end state of this project is to have a fully developed wear-protection coating that meets or exceeds 5th/6th generation system requirements. The coatings wear-protection performance shall be demonstrated in an approved laboratory test rig and shall provide an increased life expectancy of 1.5 over than the legacy material system. The final product will be considered for future Program Office funding to qualify and transition the material system.

DESCRIPTION: Performance requirements for 5th and 6th generation systems contain a myriad of wear-prone seals with high performance requirements. The demanding operational environment results in increased wear and lower lifetime expectancy for wear components, which increases stress on the supply chain to meet fleet demand for component replacement. In addition, these wear components are infrequently accessed by maintainers, leading to extensive damages that are visually concealed by other structures and are undiagnosed for long periods of time. Increasing inspection intervals to detect such damages is not an option due to the additional maintenance burden from lengthy and labor-intensive OML restoration processes when the components are reinstalled. Undiagnosed wear has caused significant performance degradation on these systems and is currently a top maintenance driver. Although there are a variety of market solutions for wear-strips and protective liners, many of these are too thick for these applications and require the flight control surfaces to be periodically removed from the structure to facilitate the reapplication process. The goal of this SBIR topic is to develop a wear-protection coating system that provides improved performance over the legacy coating system qualified by Lockheed Martin. The wear-protection coating must meet all LM requirements (fluid resistance, thickness, cure time/temp envelope,…etc.,) and shall not require major changes to current application processes or significantly increase maintenance time.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. Therefore, a Phase I award is not required. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and potential AF stakeholders. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the DAF customer. The feasibility study should have; -Identified the prime potential DAF end user(s) for the non-Defense commercial offering to solve the DAF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers. A material solution addressing this topic request shall provide a minimum of 1.5x improvement in wear protection over similar commercially available systems (e.g., Teflon-loaded paints, composite wear strips, plastic wear liners etc.,) in conditions representative of typical aircraft environments (i.e., inclusion of dust/debris and fluids typically found on aircraft) . Additionally, the proposed product must have the following capabilities: -ability to tailor thickness to approximately 8-12 mils; -ability to produce layer with uniform thickness (i.e., free of runs, sags, waviness) upon application; -processability in a wide range of temperature and humidity conditions typical in field-level maintenance (i.e., approximately 60-90°F/5-95%RH); -resistance to typical aircraft fluids (e.g., jet fuel, deicer fluid, hydraulic fluid, engine oil, etc.,); -cure time less than 5 hours; -minimal specialized tools for required for installation.

PHASE II: The Phase II effort should modify the candidate wear-protection coating to meet or exceed 5th/6th generation system material requirements. The SBIR offeror shall coordinate with Lockheed Martin to develop/define material requirements and establish acceptable test methods to characterize material performance and compare to the legacy material system. After requirements and test methods have been defined, the offeror shall characterize their material and modify the system appropriately. The project team will assess the results and provide guidance as necessary. In order to achieve cost savings and provide a sustainment benefit to the programs, any developmental materials shall provide at least a 1.5x increase in life expectancy over the legacy material systems. The final formulation shall be fully characterized at the end of the program and cost and supply estimates shall be determined. Final demonstrations of the material life expectancy shall be performed using a wear test rig approved by the project team.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. Phase III funding will be considered by the appropriate System Program Office. The intent of a Phase III effort will be to perform a flight test evaluation and to contract LM for material qualification and approval.

REFERENCES: Bhushan, B, and Gupta, B K. Handbook of Tribology: Materials, coatings, and surface treatments. United States: N. p., 1991. Web.

KEYWORDS: Wear-protection; coatings; 5th Generation; abrasion; wear; OML

AF NUMBER: AF222-D016

TITLE: GNSS-Denied Positioning Solution for Unmanned Aerial Systems Using Existing Camera Turrets

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Develop and demonstrate a solution for opportunistic position updates from an existing onboard camera turret mounted on group 2 or group 3 unmanned aerial systems (UAS) to enable operation in Global Positioning System (GPS) and Global Navigation Satellite System (GNSS) denied operating environments. Ideally, the solution should be accurate to within 50m and does not require installation of additional sensors.

DESCRIPTION: Accuracy, availability, and integrity of Positioning, Navigation, and Timing (PNT) information from GPS and other GNSS is under constant threat from denial and deception techniques. The concern of overreliance on GPS/GNSS systems has spurred a surge in alternative Positioning, Navigation, and Timing (Alt-PNT) research. Many of these tools and techniques are restricted to certain missions or environments to operate effectively. Providing resilient PNT for small UAS (sUAS) is particularly difficult due to significant size, weight, and power (SWAP) constraints. Any additional PNT payload added to sUAS will force the platform to trade off primary mission payload, reducing both capability and loiter time. This effort will leverage existing sensors for any positioning information that can be provided when GPS/GNSS based navigation is denied. Such vision-based systems currently on sUASs rely on similar requirements as vision based navigation systems. They require minimal cloud cover and visible terrain containing features, therefore these conditions can be assumed for a majority of the mission. It is also assumed that the camera turret settings will not always be ideal for image based navigation so the navigation algorithm should notify the operator when the navigation solution is degraded, meaning the camera settings and aim need to be adjusted to provide an image useful for solving for a position.

PHASE I-TYPE EFFORT: This topic is meant to be awarded directly into a Phase II as the technology has been proven out. This topic incorporates existing gimbaled cameras with image navigation to produce an image based position estimate for navigation in GPS denied or degraded environments. Gimbaled cameras have been proven out on a variety of active inventory unmanned aerial systems (UAS) used in today’s conflicts including those on the MQ-1, MQ-9, and a variety of smaller UASs used by SOCOM. This topic is geared towards small UASs that are both in development and operationally deployed. Image navigation has been proven in both the civilian academic world and within the DoD and defense contractors. There has been developments in using gimbaled sensors to produce position updates on the US LITENING Advanced Targeting Pod and the F-35 electro-optical distributed aperture system. Both of these systems have processing power and technological capabilities beyond what is found on smaller UASs. This topic will use existing gimbaled optical sensors on small UASs combined with image navigation techniques to produce navigation updates by adding no or very minimal hardware.

PHASE II: By using only the existing gimbaled optical sensor and onboard mission computer on a small UAS a position update accuracy within 50 meters should be achieved and provided to the UAS navigation system. Current commercial off the shelf (COTS) systems require the addition of external cameras and processing computers which will not fit on existing operational small UASs. This topic will leverage existing hardware on small UASs currently in development or operationally deployed. The 645th Aeronautical Systems Group (Big Safari), who support SOCOM, has expressed great interest in the added navigation capability without having to modify the hardware on their small UASs. With little to no modifications required to current class 2 and 3 UASs this topic will easily transition to the warfighter through the 645th and various remotely piloted aircraft (RPA) system program offices (SPO). For the proposal the following vignette depicts the robustness and performance that is required:
A group 2 UAS with an Intelligence, Surveillance, and Reconnaissance (ISR) mission is launched; in a GPS/GNSS denied environment. The UAS must approach a target of interest tens of kilometers away expecting a total mission duration of 3 or more hours. The operation may occur in daylight or darkness. It is assumed an initial position and time are either entered by hand or transferred from a host platform. En route the camera turret operator will be able to point the camera turret to look for interesting features based on feedback from the navigation algorithm. While performing the primary ISR mission the sensor operator is

notified when position accuracy is degraded and the camera turret should be used to obtain an additional position estimate. The aircraft will maintain a reliable command and control (C2) link to the operator throughout the mission. The following features must be considered for a proposal The onboard camera turret will be the primary sensor used to perform a position update during a GPS/GNSS outage. Images, pointing angles, and settings metadata can be read off the camera turret. The navigation algorithm should work without direct control of the sensor turret. The algorithm can encourage the operator to re-point but it is not guaranteed. It is understood that a position solution from the camera turret will only be available intermittently depending on what the camera is currently seeing. The desire is a software only solution. Additional payload should be zero or minimal, although it is understood that installation of a dedicated processor may be necessary. Any additional hardware must fit within a typical group 2 UAS payload bay. The algorithm must be compatible with operational group 2 and group 3 UAS camera turrets. GPS/GNSS may be unavailable at takeoff. At a minimum, a rough manual position and time estimate will be available. Both traditional and machine learning approaches may be considered. However the underlying uncertainty metrics of all measurements/estimates must be fully understood and accurately represented. System must provide both a position solution and associated raw measurements. The algorithm should output its solution in the All Source Positioning and Navigation (ASPN) format. The solution should be built as a module that can be integrated into a government-owned open architecture PNT filter. No government furnished equipment (GFE) will be provided. Availability of required reference data must be taken into consideration.

PHASE III DUAL USE APPLICATIONS: If a successful Phase II solution is developed, a Phase III will quickly transition the developed technology to meet any specific needs of the individual customers within the DoD, other government agencies, or the civilian world. The technology could also be expanded to manned aircraft with camera turrets to aid in navigation in a contested, degraded and operationally limited (CDO) environment. The commercial sector could us this technology as an alternate to GPS during outage periods or when traversing hostile areas. The image matching algorithms could be used for time based surveying to track farming, animal, and land management trends. The development of this topic could be incorporated into the USAF Vanguards via a gimbaled sensor on a Golden Horde munition or Skyborg aircraft with no hardware changes.

REFERENCES:

G. Conte and P. Doherty, “An integrated UAV navigation system based on aerial image matching," in IEEE Aerospace Conference Proceedings, 2008.;

T. Machin, “Real-time implementation of vision-aided monocular navigation for Small fixed-wing unmanned aerial systems, quot;

Masters thesis, Air Force Institute of Technology, 2016.; B. W. Randal and T. W. McLain, Small Unmanned Aircraft Theory and Practice.;

Keskin, Ali.; Fixed Wing UAV Target Geolocation Estimation From Camera Images. 2021.

KEYWORDS: Navigation; Position; UAS; UAV; SUAS; Position Update; CDO; Alternative Navigation; Gimbaled Camera; Image Matching

AF NUMBER: AF222-D017

TITLE: Cross Security Domain Linking of Partitioned Human Performance and Training Data Sets

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: Link and aggregate human performance data collected during pilot training across security and privacy boundaries without exposing protected/sensitive data to unauthorized parties. Support predictive and prescriptive analytics of individual, team, and force proficiencies and training needs.

DESCRIPTION: USAF pilot training produces human performance data with varying levels of privacy and security protection requirements. This creates disconnected partitions (silos) of data limiting the USAF's ability to predict current and future pilot proficiency, predict impacts of proposed training, and make optimal training decisions. This effort explores and demonstrates: 1. Methods for identifying, linking, navigating, and querying data across partitions while preventing exposure of data to unauthorized users 2. Methods for characterizing limitations or uncertainties of analyses given the subset of partitions accessible 3. Methods for recommending partition changes and merges to maximize actionable insights from the data 4. Recommendations for analytic techniques and proficiency prediction suited to incomplete partitioned data sets

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR Programs. The goal of phase II is to prototype, demonstrate, and evaluate one or more methods for cross security domain linking of USAF provided partitioned human performance and training data sets. Demonstrate meaningful analytics combining data from multiple partitions with estimates of uncertainty. Document lessons learned, needs for further research, and strengths/limitations of the considered approaches. Consider applications to related to security and privacy challenges such as healthcare.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: U.S. Department of Defense. (2018). DoD Cloud Strategy. https://media.defense.gov/2019/Feb/04/2002085866/-1/-1/1/DOD-CLOUD-STRATEGY.PDF.; Kaissis, G.A., Makowski, M.R., Rückert, D. et al. Secure, privacy-preserving and federated machine learning in medical imaging. Nat Mach Intell 2, 305–311 (2020).; https://doi.org/10.1038/s42256-020-0186-1 U.S. Department of Defense. (2017). Cross Domain

Policy. DoDI 8540.01.; https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/854001p.pdf

KEYWORDS: pilot training; cross domain; security; privacy; data management; cybersecurity; federated learning; differential privacy; homomorphic encryption; multiparty computation

AF NUMBER: AF222-D018

TITLE: Generalized Enrichment of Pilot Training Data Through Automated Classification of Pilot training Objectives, Scenarios, and Performance

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: Adapt and apply classification algorithms to pilot training data to identify training scenarios with similar objectives and similar levels of pilot proficiency in achieving those objectives

DESCRIPTION: USAF pilot training produces volumes of system-based and observer-based human performance data. It is difficult to meaningfully organize these data sets, and this effort to applies machine learning and classification techniques to enrich the data sets and to enhance rapid retrieval of relevant data. This effort explores and demonstrates: 1.Classification of data sets exhibiting similar training objectives preferably mapped to mission types, Mission Essential Competencies™ (MECs), and/or Ready Aircrew Program (RAP) requirements 2.Automated observation of training providing scores of scenario applicability to different objectives and constructs 3.Classification of individual pilot, team, and team-of-team proficiency exhibited during training 4.Classification of scenario complexity; perceived versus actual difficulty

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. The goal of phase II is to prototype, demonstrate, and evaluate classification techniques applied to at least three of the areas identified in the problem description with representative data sets. Document lessons learned, needs for further research, and strengths/limitations of the considered approaches.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Kabudi, T., Pappas, I., Olsen D. H. (2021). AI-enabled adaptive learning systems: A systematic mapping of the literature. Computers and Education: Artificial Intelligence, vol 2. (2021).; Monllao Olive, D. (2019). Automatic classification of students in online courses using machine learning technqiues. [Master's Thesis, University of Western Australia].; Watz, E., Neubauer, P., Kegley, J., Bennett, W. (2018). Managing Learning and Tracking Performance across Multiple Mission Sets. Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC).

KEYWORDS: pilot training; proficiency; classification; data management; scenario complexity; scenario

applicability; competencies; machine learning

AF NUMBER: AF222-D019

TITLE: Efficient Processing of Printed Resistive Film Coatings

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Materials; Air Platform

OBJECTIVE: Develop resistive film coatings and their respective manufacturing processes that uniformly and cost efficiently produce stable products with low variability and consistent quality.

DESCRIPTION: Industry capabilities are emerging to utilize ink jet printing to deposit capacitive and resistive coatings onto traditional substrates. The government is interested in adapting this technology to create resistive films for use in multiple applications. Additionally, mature manufacturing processes must be developed and demonstrated to uniformly and cost efficiently produce stable printed resistive coatings with low variability. Areas of interest are, but certainly not limited to, low thermal mass processes that enable lower costs, environmentally stable products, lower temperature substrates, and polymer substrates for resistive film manufacture.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: http://www.iscst.com/wp-content/uploads/2015/06/Lopez.pdf;

KEYWORDS: printed; honeycomb; core; r-card

AF NUMBER: AF222-D020

TITLE: Generation of Synthetic Exemplar Data with Relevant Tactics

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: Propose algorithms and methods for synthesizing multi-modal pilot training data to expedite development of novel analytics.

DESCRIPTION: Security requirements for pilot training and readiness data sets hamper development and validation of analytics. Performers are often unable to access sufficient data, or they find the access controls inefficient and time consuming. This effort seeks: 1.Algorithms or techniques for synthesizing data sets including representative data formats, modalities, and behaviors suitable for developing and validating PBT-focused analytics 2.Characterization of the quality, scope, and limitations of the synthetic data sets; i.e., what types of analytics and stages of development/validation are suitable for the synthetic data set versus real data sets Consider applying scoring methods from the “Generalized enrichment of pilot training data through automated classification of pilot training objectives, scenarios, and performance” area to rate synthetic behavior

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. The goal of phase II is to develop, demonstrate, and validate software tools for generating synthetic data on-demand meeting varying requirements for suitability to analytics development and validation. Conduct a study characterizing limitations of synthetic data sets and make recommendations on which problems are well-suited to synthetic data. Document lessons learned, needs for further research, and strengths/limitations of the considered approaches.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

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REFERENCES: Patki, N. (2016).The Synthetic Data Vault: Generative Modeling for Relational Databases. [Master's Thesis, Massachusetts Institute of Technology]; Anderson, J., Kennedy, K.E., Ngo, L., Luckow, A., Apon, A. (2014). Synthetic data generation for the internet of things. IEEE Conference on Big Data.

KEYWORDS: pilot training; synthetic data; privacy; security; verification; validation

AF NUMBER: AF222-D021

TITLE: Detecting and Tracking Trends in Large-Force Performance Over Time

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Air Platform

OBJECTIVE: Detect, track, predict, and report trends in individual, team, and large force human performance over time. Develop and demonstrate novel algorithmic approaches for the identification, detection, and tracking of causal events.

DESCRIPTION: The DoD routinely conducts large force team of teams exercises, (e.g. Red Flag) which train multiple teams at once. This topic focuses on developing novel approaches for detecting key events or conditions in large force exercises that impact mission success. Successful approaches will be tested against training data that includes single teams and multiple teams. This area considers: 1. Evaluation of dynamic multi-team performance and adjustments in performance assessments based on available opportunities and on contingent performance of team members and/or other teams 2. Identification of root causes for training outcomes and for accomplishing mission objectives 3. Prediction of mission outcomes given detection of key events

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR Programs. The goal of Phase II is to develop, demonstrate, and validate selected methods using USAF provided data from pilot training events. Store results in an existing knowledge management system to support training and learning. Document lessons learned, needs for further research, and strengths/limitations of the considered approaches.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Arthur, W., Jr., Glaze, R.M., Bhupatkar, A., Villado, A.J., Bennett, W., Jr., and Rowe, L.J. (2012). Team task analysis: Differentiating between tasks using team relatedness and team workflow as metrics of team task interdependence. Human Factors, 54(2), 277-295 Kabudi, T., Pappas, I., Olsen D. H. (2021). AI-enabled adaptive learning systems: A systematic mapping of the literature. Computers and Education: Artificial Intelligence, vol 2. (2021).; Monllao Olive, D. (2019). Automatic classification of students in online courses using machine learning technqiues. [Master's Thesis, University of Western Australia].; Watz, E., Neubauer, P., Kegley, J., Bennett, W. (2018). Managing Learning and Tracking Performance across Multiple Mission Sets. Interservice/Industry Training, Simulation, and Education

Conference (I/ITSEC).

KEYWORDS: teams; large force exercises; performance assessment; prediction; machine learning

AF NUMBER: AF222-D022

TITLE: Manufacturing Process Informatics for Composite Curing (M-PICC)

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Electronics; Materials; Air Platform

OBJECTIVE: State-of-the-art large structural composite manufacturing includes the use of thermocouples to monitor temperature ramp rates and steady state temperature profiles to ensure correct cure cycles. These data streams are expected to become more prolific and denser as current research and development is addressing wireless, in-the-bag thermocouple technologies that will make temperature data collection more convenient and affordable. Yet despite the wealth of data available, it is rarely used for anything more than to ensure temperature profiles are within tolerance; it is then archived (typically on a hard drive somewhere) and forgotten unless there is an investigation related to a future component failure. The objective of this project is to maximize the value of this data by using it to accomplish some or all of the following: optimize manufacturing processes; optimize workpiece properties; enable model-based quality definition and/or serial-number-specific part certification; enhance agility; and enable rapid spin-up of production capacity for aerospace components.

DESCRIPTION: Research and develop a general and reusable technology stack (methods, algorithms, tools, software, etc.) for collecting, managing, curating, and using thermocouple data collected in composites curing processes. Develop data pipelines that facilitate the integration of temperature data collection systems, digital models, and product lifecycle management tools, preferably based on current standards. Develop technology that utilizes thermocouple data to enable adaptive process control to optimize manufacturing processes. Process optimization includes classical metrics like yield, cycle time, tolerances, and process capability, but can also include optimization of the process to maximize material property objectives. Tools that optimize or facilitate agile decision making for upstream and/or downstream manufacturing processes, possibly across links in the supply chain, are also encouraged. Develop technology leverages temperature data to enable model-based inspection and serial-number-specific workpiece quality inspection and certification. Develop technology that enables supply chain agility by allowing aerospace manufacturers to quickly and confidently spin up production of novel components. Solutions that facilitate rapid adaptation of non-aerospace to emergency aerospace production is also encouraged. Cloud-based solutions are encouraged, but the Department of Defense’s cybersecurity needs must be adequately addressed. Proposals that include technology demonstrations and/or pilot systems in production at aerospace manufacturers are highly encouraged.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research and development, or direct procurement of products and services developed in coordination with the program.

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Patra, Dibyayan; Kundu, Chitresh; Patra, Prabal, “Wireless Dip Temperature Lance for provisioning hot metal analytics of blast furnaces”, Ironmaking and Steelmaking, v 48, n 5, p 619-627,2021; ISSN: 03019233, E-ISSN: 17432812; DOI: 10.1080/03019233.2020.1833677; Publisher: Taylor andFrancis Ltd.;

KEYWORDS: thermocouple; hub; reciever; temperature; cure; composite; out of autoclave; composite aircraft; manufacture; defect; repair; damage; porosity; delamination

AF NUMBER: AF222-D023

TITLE: Liquid Crystalline Devices for Non-mechanical Beam Steering for Air and Space Applications

TECH FOCUS AREAS: Network Command, Control and Communications; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Materials; Air Platform

OBJECTIVE: The application of liquid crystalline devices for optical sensors and communications has cross-domain and cross armed service branch impacts. The objective of this research and development is to assess and improve the manufacturing processes and quality assurance processes for LCDs for air and space applications. This includes maturing the design and integration strategies that directly affect manufacturability. A desirable end state would be a thorough assessment of technology and manufacturing readiness and demonstrations of air and space worthiness for extreme environments. These are some of the final barriers to entry for this technology.

DESCRIPTION: Ultrathin, planar, non-mechanical optical beam steering devices using liquid crystal materials and manufacturing has been researched and developed by AFRL and partners over the past ten years for air and space defense applications. Not only do LC's present enhanced functional capabilities in addition to beam steering (e.g. spectral filtering and variable focusing), they also drastically reduce the system mass, power, and mechanical complexity (i.e. SWaP) relative to conventional optics and opto-mechanics. The technology is at a point where it would greatly benefit from ManTech investment to investigate: - MRL assessment and baseline - Quality and uniformity within manufacturing process - Air an d space worthiness considerations within manufacturing process and possible in-line article testing - Integration and interface considerations within design and manufacturing process - Analysis of cost-drivers and manufacturing challenges - Implementation of process improvements to address above

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study and any reports/documentation the support moving D2P2. This includes determining the scientific and technical merit and feasibility of ideas appearing to have potential. The company must have an existing manufacturing process in place. It must have validated the product-market fit between the proposed solution and a potential DAF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the DAF customer. The feasibility study should have: -Identified how this technology is enhancing state-of-the-art and current fielded solutions and manufacturing processes -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicted on the offeror having performed a "Phase-I-like" effort, predominantly separate from the SBIR programs. Under the Phase II effort, the offeror shall sufficiently develop the technical approach and process in order to conduct a small number of enhanced manufacturing demonstrations. Identification of manufacturing/production issues and/or business model modifications required to further improve product or process relevance to improved costs, availability, or safety, should be documented. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies and processes developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program. A Phase III award may include a technology/prototype demonstration, with feasibility in both air and space applications.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Tabiryan, N. V., Roberts, D. E., Liao, Z., Hwang, J.-Y., Moran, M., Ouskova, O., Pshenichnyi, A., Sigley, J., Tabirian, A., Vergara, R., De, L., Kimball, B. R., Steeves, D. M., Slagle, J., McConney, M. E., Bunning, T. J., Advances in Transparent Planar Optics: Enabling Large Aperture, Ultrathin Lenses. Adv. Optical Mater. 2021, 9, 2001692. https://doi.org/10.1002/adom.202001692

KEYWORDS: Liquid Crystalline Devices; Non-mechanical Beam Steering; Ultrathin; Planar; Optical; Optics; Gimbal-less;

AF NUMBER: AF222-D024

TITLE: High Temperature Paste Adhesives and Sealants

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Materials; Air Platform

OBJECTIVE: Develop fill/fair and potting materials for both BMI and polyimide parts and assemblies. Through this work methods and procedures to repair damaged structures including laminates and sandwich structures will also be developed. Process development would evaluate both autoclave and oven based solutions as well as out of facility processes that might include techniques like heating blankets or heating boxes.

DESCRIPTION: Conduct an industry survey of commercial-off-the-shelf (COTS) materials and processes that might be capable of meeting the objective while also conducting technical journal literature reviews of constituent materials that might be combined in a novel way to also meet the objective. Based on the COTS and technical literature reviews down select up to five material systems for evaluations for fill/fair and potting on polyimide and BMI composite material systems as well as repairing damaged polyimide and BMI structures. The structures will be a honeycomb core sandwich structure. Setup a design-of-experiments to evaluate the down selected candidates on their physical and mechanical properties on both fill/fair/potting and repair. Based on experimental results further down select to optimize the formulations for both fill/fair/potting and repair. This may result in two different optimized formulations of multiple systems. Conduct trials/demonstrations of the optimized material systems for both fill/fair/potting and repair. Based on the optimized material systems experimental results down select to no more than two systems for further optimization development, if needed, and conduct final physical and mechanical property evaluations. Finally demonstrate the final formulations for fill/fair/potting and repair on polyimide and BMI composite material systems. Concurrently while evaluating the repair objectives of the work of the optimized fill/fair and potting materials, identify heating technologies and processes for out of autoclave structural repairs.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

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Galati University Press, 2012; Organic Polymer Materials in the Space Environment; Chen, Ding, Li and Wang; Progress in Aerospace Sciences, 83 (2016) 37-56.; Characterization and Properties of High-Temperature Resistant Structure Adhesive Based on Novel Toughened Bismaleimide Resins; Wang, Xiong, Ren, Ma, Han and Chen; High Performance Polymers, Vol 33(5) 488-496, 2021; A Review of the Releationship Between Design Factors and Environmental Agents Regarding Adhesive Bonded Joints; Gualberto, do Carmo Amorim, Meneses Costa; Brazilian Society of Mechanical Sciences and Engineering (2021) 43:389;

KEYWORDS: high temperature composite repairs; high temperature composite fill and fair materials and processes; BMI repairs; polyimide repairs; out of autoclave high temperature materials; high temperature adhesives; high temperature sealants

AF NUMBER: AF222-D025

TITLE: Advanced Signal Processing Library

TECH FOCUS AREAS: Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems; Air Platform

OBJECTIVE: Develop a library of signal processing modules that can integrate into existing frameworks such as CFE. Develop techniques to port from a homogenous X86 architecture to a heterogeneous architecture with best of breed GPP, GPU, and FPGA processing.

DESCRIPTION: There are numerous Collaborative Framework Environment (CFE) deployments in both ground and airborne environments. In many of these deployments, the signal environment is continuously changing. Rapid deployment of flexible and reconfigurable signal-processing capabilities to address these changes in complicated signal environments is required to provide timely support to current mission requirements. Software-processing modules that will assist with preparation of the signal environment to identify and mitigate interfering signals and to support detection, identification, and collection of target Signals is of Interest are required. In congested signal environments, performing preprocessing of the environment, filtering of interfering signals and noise, will increase the probability of successfully performing the collection and processing of weak, Low Probability of Intercept (LPI), and Low Probability of Detection (LPD) signals. Software modules will be utilized by machine learning algorithms to adapt to changing signal environments while maintaining mission capabilities. The Collaborative Framework Environment (CFE) is a Cross-Service open system architecture that operates on a number of hardware environments. CFE is a fully containerized application that uses micro-services to provide a customizable and extensible solution for hosting complex RF signal processing applications. CFE uses a common SDR-based DSP architecture including GNU radio, and X-Midas building blocks and includes functionality to support a wide array of ISR capabilities to include SIGINT, machine-to-machine communication signals, and real-time ELINT processing. CFE is designed for rapid integration of third-party capabilities and strives for hardware agnostic capabilities, enabling CFE to run on a variety of hosting hardware. The system currently has a dependency on X-86 architectures and there is a need to deploy signal-processing solutions into embedded processors. Often embedded processors that include ARM, GPU, and FPGA resources are available that can be used to meet mission requirements. Today’s signal processing environment requires the most effective use of the hardware that is available to perform signal processing. In order to expedite the deployment of signal processing capabilities, the development of signal environment processing tools and a process to optimize the transition of functionality from X86 architectures to embedded processors and FPGA and GPU resources is required.

PHASE I-TYPE EFFORT: This is a Direct to Phase 2 (D2P2) topic. Phase 1-like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Develop advanced signal processing modules and demonstrate the transition from a homogenous X86 architecture to a more heterogeneous architecture leveraging best of breed GPP, GPU, and FPGA processing. i. Develop and demonstrate a number of signal processing module containers in CFE. ii. Examine and quantify the impacts and resources to implementations in alternative environments such as ARM architectures that include GPP, GPU (CUDA), and FPGA when available in heterogeneous environments. iii. Develop a resource management module to manage available GPP, GPU, and FPGA heterogeneous hardware. iv. Develop matrix of engineering tradeoffs between architectures for implementers. v. Generate Interface Control Document (ICD) and overview descriptions in parallel with the system. Complete the design of the sensor, demonstrate performance of a prototype system through laboratory testing, and deliver the prototype for subsequent evaluation by the government.

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to existing CFE implementations and in support of new complex requirements. Additionally, applications of the technology to support commercial communications and signal processing applications are possible. Furthermore, technologies for lightweight, high performance airborne sensors with integrated processing have other commercial mission applications.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

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1.Yang Qu, Zhiqiang Wu, Ruolin Zhou, Yan Su, "Hierarchical Mixed Signal Detection and Modulation Classification", Circuits and Systems (MWSCAS) 2020 IEEE 63rd International Midwest Symposium on, pp. 213-216, 2020.;

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3.K. Umebayashi, R. Takagi, N. Ioroi, Y. Suzuki and J. J. Lehtomäki, "Duty cycle and noise floor estimation with welch FFT for spectrum usage measurements," 2014 9th International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM), 2014, pp. 73-78, doi: 10.4108/icst.crowncom.2014.255311.;

4.Detecting and Classifying Low Probability of Intercept Radar, 2nd Edition" a book by Phillip E. Pace, Artech House, 2009.;

KEYWORDS: adaptive filter; signal interference mitigation; signal environment characterization; FPGA; GPU; airborne signal processing; statistical signal processing; low probability of intercept; low probability of detection

AF NUMBER: AF222-D026

TITLE: Navigation Warfare on Autonomous Threats (NWAT)

TECH FOCUS AREAS: Microelectronics; Autonomy

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems

OBJECTIVE: Design and develop an affordable, adaptable and responsible Counter Position Navigation and Timing (C-PNT) system that balances employment challenges and large scale needs of C-PNT technology for anti-terrorism efforts globally.

DESCRIPTION: The United States Department of Defense (DoD), Joint Counter UAS Office (JCO) and the Department of the Air Force (DAF) are responsible for securing nearly 2000 installations around the world from autonomous maritime, ground and air threats. These threats are fueled by a vibrant industry base developing autonomous vehicles in all domains for a variety of peaceful uses. The nefarious employment of these autonomous products or the integration of these commercial products into foreign government systems is creating an ever growing gap between the ability of a low cost autonomous threat to complete its mission and our ability to protect US interests. This topic focuses on responsibly reducing the autonomy of threats through PNT interference. The exact approach in doing this must be precise, low power, support future proofing and have general adaptability. The need for responsible, affordable and approvable technologies that can maximize effect on threats and minimize its effect on friendly assets is urgently needed. There are many fixed and handheld C-PNT systems that exist today but costs, approvals and flawed employment approaches are stunting their adoption. New innovative approaches are needed in this space before wide spread employment of these technology will be possible. This topic is seeking optimized solutions that can be rapidly employed in ground and air environments. Proposals should consider a proper balance of size, weight, power, cost and adaptability to maximize capability in non-permissive environments. Solutions will likely be additions to existing installation security systems and should be easily integrated and proven to be interoperable with other components of these systems Acceptable proposals may consider new or efficient methods for constraining interference effects to areas where threat drones are and friendly are not. Adaptability of RF emissions, antennas types or sizes and ease of integration would be of interest. How other sensors in a system of system could make a NWAT subsystem more effective would help highlight the benefit of the approach. Lastly, proposals should consider how the system could be employed with minimal user interaction while still protecting against unnecessary or ineffective spectrum use.

PHASE I-TYPE EFFORT: This is a Direct to Phase 2 (D2P2) topic. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Based on current performance and effectiveness data this effort would provide a new offering in industry to fill this warfighter need. Proposals must define expected final performance data and evidence to support it. The proposal must address design features in terms of at least: i. Employment strategy for both airborne and ground systems ii. Specifications and features of the system that would reduce collateral RF effects iii. Cost and scalability up to thousands of units iv. Compatibility with US and allies policy on C-PNT technologies v. Open architecture approach to support adaptability and integration with other systems

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to an operational capability in support of many MAJCOM and COCOMs across the DoD.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation

(ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

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1.Mark Harris, “FAA Files Reveal a Surprising Threat to Airline Safey: The U.S. Military’s GPS Tests”, https://spectrum.ieee.org/faa-files-reveal-a-surprising-threat-to-airline-safety-the-us-militarys-gps-tests;

2.Aerospace Corporation, “A New Tool To Fight GPS Jammers”, https://aerospace.org/article/new-tool-fight-gps-jammers;

3.GPS.gov “Information about GPS Jamming” https://www.gps.gov/spectrum/jamming/ ;

4.John Keller, “U.S. Military Committed to Electronic Warfare Jammers to Counter Enemy GPS and Drone Signals.” https://www.militaryaerospace.com/rf-analog/article/14039289/electronic-warfare-ew-portable-jammers ;

KEYWORDS: GPS Jammer; Drones; Autonomous Vehicles; Autopilots; FAA; DoD Authorities; Counter PNT technology; directional antennas; interference

AF NUMBER: AF222-D027

TITLE: Detect-and-Avoid on Long-Endurance Platform

TECH FOCUS AREAS: Autonomy; Artificial Intelligence/Machine Learning

TECHNOLOGY AREAS: Sensors; Electronics; Information Systems; Air Platform

OBJECTIVE: Integrate mature detect and avoid capability on an existing long-endurance, Group V UAS platform for increased aircraft and pilot-in-the-loop operational awareness that leverages new and evolving C-SWaP sensors and sensor fusion software.

DESCRIPTION: Detect and Avoid (DAA) systems provide unmanned aircraft systems (UAS) with an “equivalent level of safety, comparable to see-and-avoid requirements for manned aircraft” (FAA). While progress in this area has focused on future civil and commercial airspace navigation, military applications support the safe transit of military UAS’s through the National Airspace (NAS) and over international waters without concern of collision with other aircraft. While the solution can be platform agnostic, the scope of this topic is to examine integration of DAA on a specific UAS platform. The platform is a Group V, fixed-wing UAS designed for long endurance with a pilot-in-the-loop. Operational environment for the platform with DAA is Visual Flight Rules (VFR) only. The UAS has performance limitations between 10-25 kft of altitude and 65-110 kts. The solution’s advisory should be compatible with the platform’s performance limitations and not require/suggest aggressive climb or descent rates (i.e. the UAS requires climb/descent rates limited to 500 fpm or less). While a pilot-in-the-loop (PIL) system will be employed for the UAS, the onboard DAA system should provide improved airspace situational awareness otherwise not known to the pilot without the system. The solution should have limited latency (threshold of less than two seconds) to the ground control station (GCS) for potential operational use. The solution will interact with the GCS so that the PIL has situational awareness from the onboard DAA. The GCS software and interface will be available for potential add-in integration, though the solution can also use a separate system. The solution should provide easily interpretable graphics to the user to promote rapid response, as required, to avoid potential collisions with due regard including outside the National Airspace System (NAS). The solution should include a fully autonomous DAA mode without a PIL intervention for lost communications scenarios. The DAA system will be used for cooperative and non-cooperative intruders. The solution’s scope includes both DAA sensors and sensor fusion, with access to the platform’s transponder. At a minimum, input will be ADS-B in signals and radar cross-sections from surrounding airborne aircraft. Avoidance will be limited to other aircraft (i.e. does not require terrain and/or obstacle avoidance). DAA will only be required during transit operations (Class A and Class E airspaces and due regard). Solutions with existing ICAO/FAA certifications are desired (reference RTCA DO-365), and airworthiness for CONUS flight testing will be required by end of program. When combined with a low-cost goal, a long endurance platform accomplishes its mission by reducing the cost, size, weight, and power (C-SWaP) of onboard components. Therefore, the solution should prioritize C-SWaP performance. The size of the DAA system is important for any outside mounted sensors (i.e. radar) that could potential affect the planar area or wing performance and lead to increased drag, thus lowering the effectiveness of the long endurance platform. Internal space in the UAS is available for a DAA system, though external pod mounted sensors will be considered but are not preferred due to their increased drag on lower effectiveness of long endurance platform performance.

PHASE I-TYPE EFFORT: This is a Direct to Phase 2 (D2P2) topic. Phase 1 like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Integrate mature detect and avoid capability on an existing long-endurance, Group V UAS platform, and demonstrate the utility in several Air Force need areas for missions that are at different stages of conceptual maturity, including where conceptual development has not yet begun. Provide intermediate products to be assessed by planning teams, summarizing information that captures sensitivity of mission-level outcomes, including schedule, cost and risk, to key architecture and implementation decisions. Carry at least one flight test assessment of complete system integrated on UAS against manned aircraft intruder.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the technologies developed in Phase II for potential government and commercial applications. Government applications include rapid concept development and maturation for emerging military space missions. There are potential commercial applications to space system design, and evaluation and assessment of new business ventures.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: 1.McCalmont, John, Utt, James, Deschenes, Michael, and Taylor, Michael (2005) Sense and Avoid, Phase I (Man-in-the-Loop) Advanced Technology Demonstration. AIAA Infotech@Aerospace, https://doi-org.wrs.idm.oclc.org/10.2514/6.2005-7176;

2.Truitt, Todd, Zingale, Carolina, and Konkel, Alex, (2016) Human-in-the-Loop Simulation to Assess How UAS Integration in Class C Airspace Will Affect Air Traffic Control Specialists. FAA Technical Report, https://hf.tc.faa.gov/publications/2016-01-uas-operational-assessment-visual-compliance/full_text.pdf;

KEYWORDS: Detect and avoid; autonomous; sense and avoid; DAA; SAA; UAS; airborne

AF NUMBER: SF222-D028

TITLE: Cislunar Space Domain Awareness Sensor

TECH FOCUS AREAS: Microelectronics; Autonomy

TECHNOLOGY AREAS: Sensors; Space Platform

OBJECTIVE: Develop lightweight, high performance space-based optical imager capable of collecting metric observations of objects in the vast cislunar region.

DESCRIPTION: The United States Space Force (USSF) is tasked with protecting and defending US interests in space. Until now, the limits of that mission have been in near Earth, out to roughly geostationary (GEO) range (approximately 36,000 km). With new US public and private sector operations extending into cislunar space, the reach of USSF's sphere of interest will extend to 450,000 km and beyond – more than a tenfold increase in range and 1,000-fold expansion in service volume. USSF now has an even greater surveillance task for space domain awareness in that region, but its current capabilities and architecture are limited by technologies and an architecture designed for the legacy mission. Existing ground and near earth sensors are not only stressed by the increased range and volume, but also by background from lunar albedo for objects near the moon, obstruction from the moon itself, and the chaotic nature of orbits acted on by the gravity of both Moon and Earth which causes trajectory estimation to become more complicated. Additionally, there are a large range of orbits, trajectories and timelines for objects traversing or operating in this regime, where some orbits take hours to complete and some take weeks. To address the challenges posed to the current architecture, the USSF is exploring space-based sensors operating in lunar or cislunar orbits, not only to provide access to the large volume to be surveilled, but also to address gaps of current coverage posed by the bright lunar background or the moon itself. Several alternative architectures are being considered, including proliferation of sensors in various lunar and Earth-Moon periodic orbits, or a few sensors in Earth-Moon Lagrange points. The former would benefit from low cost optical sensors for economy in scale, and the latter with high sensitivity for detection at long ranges with fewer sensors. Both would benefit from a compact and lightweight sensor, and the capability for wide area search and discovery of objects in unknown or complex orbits. The focus of this topic is development of an optical sensor with application to these architectures.

PHASE I-TYPE EFFORT: This is a Direct to Phase 2 (D2P2) topic. Phase 1-like proposals will not be evaluated and will be rejected as nonresponsive. For this D2P2 topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort via some other means (e.g. IRAD, or other funded work). It must have developed a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective above. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility or nascent capability to meet the capabilities of the stated objective. Proposal may provide example cases of this new capability on a specific application. The documentation provided must substantiate that the proposer has developed a preliminary understanding of the technology to be applied in their Phase II proposal to meet the objectives of this topic. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results.

PHASE II: Based on emerging space domain awareness architectures for the cislunar regime, develop a design for an optical sensor for detection and tracking of cislunar objects. Define the performance capabilities and design features in terms of at least: i. Detectability of objects (goal of apparent visual magnitude of 16 and brighter) ii. Tracking accuracy (goal of better than 5 arc seconds) iii. Number of observations / day (goal of 500 or more) iv. Mission life (goal of 3 years or more) v. Utilizes commonly available industry standard data and mechanical interfaces between payload and bus, for example using standard fastener sizes, RS-422, Ethernet, etc. vi. Compliance with General Environmental Verification Standard (GEVS) for environmental durability Complete the design of the sensor, demonstrate performance of a prototype system through laboratory testing, and deliver the prototype for subsequent evaluation by the government

PHASE III DUAL USE APPLICATIONS: The Government has an interest in transition of the demonstrated concept to an operational capability in support of cislunar space situational awareness operations. Additionally, applications of the technology to support commercial satellite operators in this regime are envisioned for orbit tracking, collision avoidance, and anomaly resolution. Furthermore, technologies for lightweight, high performance space sensors have other commercial mission applications.

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1.Buehler, D., Felt, E., Finley, C., Garretson, P., Stearns, J., Williams, A., “Posturing Space Forces for Operations Beyond GEO”, Space Flight Journal, 31 January 2021, https://spaceforcejournal.org/posturing-space-forces-for-operations-beyond-geo/;

2.Kaplan, S., ” Eyes on the Prize - The Strategic Implications of Cislunar Space and the Moon”, Center for Strategic and International Studies, 13 July 2020, https://aerospace.csis.org/eyes-on-the-prize/;

3.Holzinger, M.J., Chow, C.C., Garretson, P., “A Primer on Cislunar Space”, 3 May 2021, https://www.afrl.af.mil/Portals/90/Documents/RV/A%20Primer%20on%20Cislunar%20Space_Dist%20A_PA2021-1271.pdf ;

4.Werner, D., “Updated intelligence report calls for improved monitoring of cislunar space”, Space News, 24 August 2021, https://spacenews.com/dia-report-2021-cislunar-monitoring/ ;

5.Goddard Spaceflight Center, General Environmental Verification Standard (GEVS), GSFC-STD-7000B, 28 April 2021, https://standards.nasa.gov/standard/gsfc/gsfc-std-7000 ;

KEYWORDS: space situational awareness; space domain awareness; space surveillance; space catalog; cislunar; small space-based telescope; space sensor; image processing

AF NUMBER: AF222-D029

TITLE: Dynamic Materials for Customizable Impact Protection

TECH FOCUS AREAS: General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Space Platform; Materials; Battlespace

OBJECTIVE: To develop novel reconfigurable thermoset composite panels with excellent impact resistance. The materials will preferably be able to be reshaped to demonstrate the ability to protect structures such as aircraft underbodies, vehicle doors & undercarriage and Airmen. Additionally, composites should be able to demonstrate on-site panel welding and repair after impact while also meeting current state of the art ballistic needs.

DESCRIPTION: The goal of this SBIR is mature and demonstrate a transformational concept that fundamentally shifts the defense economy from a static “single component” to a dynamic “continuous fabrication” mentality to meet 21st century defense needs. This concept would lead to significant cost savings as well as unprecedented agility. While traditional materials are often shipped to locations in end use shapes & configurations, and act as single use components, this project will focus on emergent materials that enable reconfigurable components. Specifically, concepts stemming from materials including (but not limited to), reprocessable thermosets, covalent adaptable networks, and self-healing polymers may offer reconfigurability while maintaining durability. Reprocessable thermoset composites exhibit excellent material strength & resilience but offer significant advantages over conventional thermoplastic & thermosets including the new ability for polymer bonding, reshaping & repair. These materials, or composites, should focus on: 1) Exhibiting excellent mechanical properties while being chemically “active”, to facilitate on-site material reprocessing. 2) Illustrating the ability to ship flat components (or other easily shipped shapes) and then reshape, or weld, materials into the desired configuration for on-site use as lightweight ballistic protection for aircraft, vehicles, or personnel. 3) Make significant effort to minimize complex tooling/processing to reshape the materials so on-site protocols can be performed in a straightforward manner. This concept would facilitate comprehensive on-site repair of damaged components and provides inherent advantages for expeditionary forces to sustain operations in austere locations and expeditionary bases.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II.. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

REFERENCES: Taynton, P.; Ni, H.; Zhu, C.; Yu, K.; Loob, S.; Jin, Y.; Qi, J.; Zhang, W. "Repairable Woven Carbon Fiber Composites with Full Recyclability Enabled by Malleable Polyimine Networks" Adv. Mater. 2016, 28, 2904–2909

KEYWORDS: Agile; repair; reconfigurable components; self-healing; adaptable networks; composites; polymer welding.

AF NUMBER: AF222-D030

TITLE: Reconfigurable free-space metasurfaces for infrared photonics

TECH FOCUS AREAS: Directed Energy; Network Command, Control and Communications; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Electronics; Space Platform; Materials; Air Platform

OBJECTIVE: The objective of this SBIR investment is to mature the manufacturing of optical free-space reconfigurable metasurface technologies. Large area (larger than a few millimeters square) free-space meta-optics have only recently been demonstrated. Furthermore, development of thermal switching in metasurfaces fabricated from phase change media has also been demonstrated on the scale of integrated optics community. The combination of these complimentary R&D thrusts have yet to be matured. The end state would be a demonstration of those two capabilities into a single functional architecture with a well-defined manufacturing strategy utilizing mature foundry best practices to ease further transition.

DESCRIPTION: In order to realize reconfigurable, free-space optical metasurfaces, design and optimization of integrated circuitry will be required. Electrical requirements for thermal switching of large phase change metasurfaces must be considered for practical solutions. Following the conceptual design, this the electrically driving switching circuitry can then be manufactured using mature silicon foundry processes. Following this step or in parallel, design and optimization of the phase change metasurface must be completed utilizing computation electromagnetism (CEM) and machine learning (ML) algorithms for two state reflective or transmissive geometries. For example, key performance parameters may include high reflectivity in one state and high absorption or transmission in the other. Other embodiments may be considered. Once the metasurface design is identified, maturation of the metasurface patterning in phase change media will be pursued. This will employ large, free space optical scale lithography followed by chemical etch formulation and optimization. Other nanofabrication techniques may be considered such as nanoimprint lithography. Finally, the prototype devices will be tested at the laboratory breadboard scale.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation

(ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: Zhang, Y., Chou, J.B., Li, J. et al. Broadband transparent optical phase change materials for high-performance nonvolatile photonics. Nat Commun 10, 4279 (2019). https://doi-org.wrs.idm.oclc.org/10.1038/s41467-019-12196-4;J. R. Thompson, J. A. Burrow, P. J. Shah, J. Slagle, E. S. Harper, A. Van Rynbach, I. Agha, and M. S. Mills, "Artificial neural network discovery of a switchable metasurface reflector," Opt. Express 28, 24629-24656 (2020)

KEYWORDS: Phase Change Materials; Metasurfaces; Planar Optics; Non-mechanical Beam Steering; Field of view steering;

AF NUMBER: AF222-D031

TITLE: Bulk Optical Materials Supplier for the Infrared - BOMSIr

TECH FOCUS AREAS: Directed Energy; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Materials

OBJECTIVE: Program objective is manufacturing process improvement to increase yield of optically clear, bulk, semiconductor materials for use as refractive elements in electro-optical infrared systems operating at wavelengths greater than 2 µm. This requires large clear apertures (> 75 mm) and thicknesses (> 1 mm) to enable mechanical robustness such that the final elements can be cut/shaped, polished to optical quality specifications. Focus of the effort would be on improving the bulk uniformity to meet spectral and optical requirements for current and future EO/IR systems of interest to the DoD. Materials to investigate should include binary and ternary semiconductor materials having minimal linear absorption in the optical transparency window while at relevant temperature.

DESCRIPTION: The government envisions a design of experiments (DOE) type of approach to optimize yield of optically clear, bulk, semiconductor materials for use as refractive elements in electro-optical infrared systems. These systems typically operate at wavelengths greater than 2 µm and are cryogenically cooled. It is anticipated that one binary and one or two ternary compounds be chosen for the DOE. Proposals should discuss a path towards increasing clear apertures starting from 50 or 75 mm diameter to greater than 120 mm. Wafer-like parts should have consistent spectral performance, such as transmission and bandgap/cut-on wavelength, across the clear aperture and throughout the bulk. As grown material should be as close to intrinsic as possible and exhibit minimal linear absorption due to unwanted dopants. Bulk material should be >1 mm thick and increase to provide clearer aperture. Similarly, the parts should also have consistent optical performance across the clear aperture and bulk, demonstrated through minimization of scatter from point and macroscopic defects and inhomogeneity's. Parts should be optically isotropic and not exhibit birefringence. They should be mechanically robust to allow cutting, shaping and polishing to meet typical optical quality surface specifications such as flatness, parallelism and scratch-dig. There is also interest in metrology development for evaluating the bulk semiconductor material either during growth or immediately post growth, but prior to initial cutting or rough polish. For example, ensuring the desired optical bandgap has been grown prior to additional processing steps is of interest. Similarly, evaluation of material properties, such as dopant concentration, carrier lifetimes, mobility's, etc., as functions of the DOE process is also of relevance. The impact of post growth treatment, such as high temperature annealing, could also be a component of the DOE.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a "Phase I-type" effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES:

https://www.sciencedirect.com/science/article/abs/pii/S0030401813004033?via%3Dihub

KEYWORDS: infrared; optics; optical materials; nonlinear optics; semiconductors

AF NUMBER: SF222-D032

TITLE: Infrared Coating Process Improvements for Detectors

TECH FOCUS AREAS: Directed Energy; General Warfighting Requirements (GWR)

TECHNOLOGY AREAS: Sensors; Materials

OBJECTIVE: Program objective is manufacturing processes improvement for high performance thin film coatings for infrared (> 2 μm) electro-optical imaging applications. These multi-layer coatings require tight manufacturing tolerances in order to meet current and future infrared detector performance specifications. The focus would be on improving the uniformity of the infrared coatings to meet the requirements for both spectral (e.g. pass-band transmission or blocking band rejection) and imaging (e.g. scatter, point defects within the coating, scratch/dig specifications on outer layer) performance for DoD applications.

DESCRIPTION: A variety of thin film materials are used in multi-layer infrared optical coatings. One of the most challenging thin film coatings to deposit is Germanium. This material can be a large yield detractor when it comes to the building of optical elements for infrared detectors. This program would investigate different deposition processes for Germanium, as well as other candidate materials, on infrared optical materials to improve the overall yield. The government envisions a design of experiments (DOE) type of approach with 2-3 different deposition techniques. Some of the DOE parameters would investigate deposition rate, coating thickness, as well as process induced stress. The different deposition techniques would also take into account the compatibility with other infrared thin film coating materials. There is also interest in metrology development for evaluating the as-deposited thin film coatings on individual optical elements prior to integration and assembly. A secondary focus would be an investigation of different metrology methods to verify coating (spectral and optical quality) performance prior to inserting it into an optical assembly.

PHASE I-TYPE EFFORT: This topic is intended for technology proven ready to move directly into a Phase II. Phase 1-like proposals will not be evaluated and will be rejected as nonresponsive. The offeror is required to provide detail and documentation in the Direct to Phase II proposal which demonstrates accomplishment of a “Phase I-type” effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-market fit between the proposed solution and a potential AF stakeholder. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. The feasibility study should have; -Identified the prime potential AF end user(s) for the non-Defense commercial offering to solve the AF need, i.e., how it has been modified; -Described integration cost and feasibility with current mission-specific products; -Described if/how the demonstration can be used by other DoD or Governmental customers.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-type” effort predominantly separate from the SBIR Programs. Under the phase II effort, the offeror shall sufficiently develop the technical approach, product, or process in order to conduct a small number of advanced manufacturing and/or sustainment relevant demonstrations. Identification of manufacturing/production issues and or business model modifications required to further improve product or process relevance to improved sustainment costs, availability, or safety, should be documented. Air Force sustainment stakeholder engagement is paramount to successful validation of the technical approach. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution.

PHASE III DUAL USE APPLICATIONS: The contractor will pursue commercialization of the various technologies developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications. Direct access with end users and government customers will be provided with opportunities to receive Phase III awards for providing the government additional research & development, or direct procurement of products and services developed in coordination with the program.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

REFERENCES: https://link.springer.com/article/10.1007%2Fs10854-007-9562-4

KEYWORDS: infrared; optics; optical materials; optical coatings; manufacturing processes

AF NUMBER: AF222-D033

TITLE: SiGeSn LADAR Receiver

TECH FOCUS AREAS: Microelectronics

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Design and fabricate a LADAR Receiver based on SiGeSn avalanche photodiodes and operating at 2.0-2.2 um.

DESCRIPTION: LADAR receivers are routinely used for target identification purposes and require expensive, cooled detector materials such as HgCdTe. Meanwhile, military sensor costs must be commensurate with platform costs, preventing widespread implementation of LADAR. A low cost APD material would enable the next generation of extended SWIR LADAR across a multitude of platforms. SiGeSn has been identified as a low-cost sensing material. Lasers, detectors, and avalanche photodiodes have already been demonstrated. However, no one has assembled a full LADAR receiver, or array, that avoids hybridization and creates gain. The goal of this D2P2 program is (a) to leverage extensive work on SiGeSn devices to create a LADAR receiver, (b) design a receiver that can be implemented as a backend of line CMOS process, and (c) create a full system demonstration at wavelengths beyond 2 um. The requirements for meeting these goals are: the operating temperature should be greater than 200 K; the pixel pitch should be less than 100 um; the EQE-gain product should be greater than 500%; and the pixels should have a bandwidth greater than 100 MHz. No use of government materials, equipment data, or facilities is anticipated.

PHASE I-TYPE EFFORT: Provide documentation of Phase I-type feasibility; for example: i) publication or presentation in a scientific or technical journal or conference reporting growth and/or device fabrication in the SiGeSn system; ii) APD device design including the SiGeSn epitaxial stack for an array to be developed in the Phase II effort iii) Demonstrate device modeling results for SiGeSn APDs iv) Demonstrate prior APD fabrication experience in another material system (not SiGeSn) and confirmed supplier for SiGeSn epitaxial source material

PHASE II: Demonstrate a 16 x 16 LADAR receiver operating at 2.0-2.2 um using SiGeSn APDs without hybridization. The EQE-gain product shall be greater than 500% and the pixel pitch shall be less than 100 um.

PHASE III DUAL USE APPLICATIONS: Demonstrate a 128 x 128 single photon LADAR receiver operating at 2.0-2.2 um using SiGeSn APDs without hybridization. The EQE-gain product shall be greater than 500% and the pixel pitch shall be less than 100 um.

NOTES: The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the proposed tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct questions to the Air Force SBIR/STTR HelpDesk: usaf.team@afsbirsttr.us

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1. Zhou, Yiyin, Huong Tran, Wei Du, Jifeng Liu, Greg Sun, Richard Soref, Joe Margetis et al. "Mid-Infrared GeSn/SiGeSn Lasers and Photodetectors Monolithically Integrated on Silicon." In CLEO: Science and Innovations, pp. JM2E-1. Optical Society of America, 2020.;

2. Conley, Benjamin Ryan. "GeSn Devices for Short-Wave Infrared Optoelectronics." (2014).;

3. Chen, Qimiao, Shaoteng Wu, Lin Zhang, Weijun Fan, and Chuan Seng Tan. "Simulation of high-efficiency resonant-cavity-enhanced GeSn single-photon avalanche photodiodes for sensing and optical quantum applications." IEEE Sensors Journal (2021).

KEYWORDS: LiDAR; LADAR; SiGeSn; GeSiSn; Hybridization; avalanche photodiode

CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM
FY22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The approved FY22.2 topic included in the Chemical and Biological Defense (CBD) Small Business Innovation Research (SBIR) Program is provided in this document. Offerors responding to this Announcement must follow all general instructions provided in the Department of Defense (DoD) Program Announcement. Specific CBD SBIR requirements that add to or deviate from the DoD Program Announcement instructions are provided below.

Please read the entire DoD Announcement and these CBD SBIR instructions carefully prior to submitting your proposal. Also go to https://www.sbir.gov/about/about-sbir#sbir-policy-directive to read the SBIR/STTR Policy Directive issued by the U. S. Small Business Administration (SBA).

INTRODUCTION

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) requires the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) Program into a single office – Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs. The Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), located at the Defense Threat Reduction Agency (DTRA), provides the management for the Science and Technology component of the Chemical and Biological Defense Program. Technologies developed under the Small Business Technology Transfer (STTR) Program have the potential to transition to the Joint Program Executive Office for Chemical Biological Radiological and Nuclear Defense (JPEO-CBRND) if the appropriate level of technology maturity is demonstrated. The JSTO-CBD Science & Technology programs and initiatives improve defensive capabilities against Chemical and Biological Weapons of Mass Destruction. The SBIR portion of the CBD Program is managed by the JSTO-CBD.

The mission of the Chemical and Biological Defense Program is to ensure that the U.S. Military has the capability to operate effectively and decisively in the face of chemical or biological warfare threats at home or abroad. Numerous factors continually influence the program and its technology development priorities. Improved defensive capabilities are essential in order to mitigate the overall impact of chemical and biological threats. The U.S. military requires the finest state-of-the-art equipment and instrumentation available to permit our warfighters to 'detect to warn' and avoid contamination, if possible – and to be able to sustain operations in a potentially contaminated environment. Further information is available at the Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs homepage at https://www.acq.osd.mil/ncbdp/cbd/

The overall objective of the CBD SBIR Program is to improve the transition or transfer of innovative Chem-Bio technologies to the end user – the warfighter – in addition to commercializing technologies within the private sector for mutual benefit. The CBD SBIR

Program targets those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection for both point and stand-off capabilities; individual and collective protection; hazard mitigation (decontamination); medical pre-treatments (e.g., vaccine development and delivery); medical therapeutics (chemical countermeasures and biological countermeasures); medical diagnostics; Digital Battlespace Management (aka information systems technology) to include but not limited to modeling and simulation (e.g., meteorological dispersion), disease surveillance, data fusion, and health & human effects to include wearable technologies.

Proposals not conforming to the terms of this Announcement will not be considered. CBD SBIR reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by CBD SBIR will be funded. CBD SBIR reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, or other related issues).

Use of Foreign Nationals (also known as Foreign Persons), Green Card Holders, and Dual Citizens

See the "Foreign Nationals" section of the DoD SBIR Program Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on the project. You may be asked to provide additional information during contract negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. The Chemical and Biological Defense SBIR Program requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the Chemical and Biological Defense SBIR Program and these proposal preparation instructions should be directed to: Mr. Larry Pollack, Chemical and Biological Defense SBIR Program Manager, JSTO-CBD, at lawrence.p.pollack2.civ@mail.mil or dtra.belvoir.rd.mbx.jsto-cbd-chem-bio-defense-sbir@mail.mil

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 20-pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. No other information included in the other proposal volumes counts against the 20-page Proposal Technical Volume page limit. Pages provided in excess of this length will not be evaluated or considered for review. The proposal must not contain any type smaller than 10-point font size (except as legend on reduced drawings, but not tables).

Your entire proposal submission must be submitted electronically through the Defense SBIR/STTR Innovation Portal (DSIP) located at: https://www.dodsbirsttr.mil

A hardcopy is NOT required and will not be accepted by the Chemical and Biological Defense SBIR Program. Hand or electronic signature on the proposal is NOT required.

Any questions pertaining to the DoD SBIR/STTR submission system should be directed to DSIP Support: DoDSBIRSupport@reisystems.com

NEW: The maximum dollar amount for a Phase I proof-of-concept/feasibility study is $183,000 for a period of performance of up to six (6) months. **The CBD SBIR Program will not accept Phase I proposals which exceed $183,000 for the Phase I effort**. The total SBIR funding amount available for Phase II activities from a resulting Phase II contract is not to exceed $1,200,000.

Selection of Phase I proposals will be based upon the three evaluation criteria discussed in this Program Announcement. The CBD SBIR Program reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality in the judgment of the technical evaluation team will be funded. All SBIR contract awards, both Phase I and Phase II, are subject to availability of funding.

Companies should plan carefully for any research involving animal or human subjects, chemical agents, biological agents, etc. The brief Period of Performance available for a Phase I project precludes plans that include these elements, as all DoD requirements and necessary approvals associated with animal and/or human use must be strictly adhered to, and require considerable coordination and significant time for final protocol approvals. See below for further information regarding all research that will include research involving human subjects and/or animal use.

Proposals not conforming to the terms of this Announcement, and any unsolicited proposals, will not be considered. All awards are subject to the availability of funding and successful completion of contract negotiations. The Chemical and Biological Defense Program is not responsible for any funds expended by the proposer prior to contract award.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed $183,000. Total Base cost for Phase I must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by the Chemical and Biological Defense Program during proposal evaluations.

Supporting Documents (Volume 5)

Offerors are welcome to provide Supporting Documents in this section, but these documents will not be considered by the Chemical and Biological Defense Program during proposal evaluations.

DIRECT TO PHASE II PROPOSAL GUIDELINES

The Chemical and Biological Defense SBIR Program is not currently participating in any Direct to Phase II topics.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees.

Phase II is the demonstration of the technology that was found feasible in Phase I. Phase I awardees may submit a Phase II proposal without invitation; however, it is strongly encouraged that a Phase II proposal not be submitted until sufficient Phase I progress can be evaluated and assessed based on results of the Phase I proof-of-concept/feasibility study. Therefore, it is suggested that a Phase II proposal be submitted no sooner than five months from date of Phase I contract award. **All Phase II proposal submissions must be submitted electronically through the Defense SBIR/STTR Innovation Portal system at: https://www.dodsbirsttr.mil**

At the proposal submission website, Phase II proposals MUST be submitted to '**CBD** SBIR' regardless of which DoD contracting office negotiated and awarded the Phase I contract. Additional instructions regarding the Phase II proposal submission process including submission key dates will be provided to Phase I awardees after the Phase I contract is awarded; additional information may also be found at http://www.cbdsbir.net to include Phase II proposal submission cycle deadlines established by the CBD SBIR/STTR Program Manager.

The Phase II proposal must include a concise summary of the Phase I project including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I project, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology. Due to limited funding, the CBD SBIR program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

All proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing and manufacturing the developed technology. Proposers are required to submit a budget for the entire 24-month Phase II Period of Performance. During contract negotiation, the Contracting Officer may require a Cost Volume for a base year and an option year; thus, proposers are advised to be aware of this possibility. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD SBIR/STTR submission site). The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. At the Contracting Officer's discretion, Phase II projects may be evaluated for technical progress prior to the end of the base year, prior to extending funding for the option (second) year.

The CBD SBIR Program is committed to minimizing the funding gap between Phase I and Phase II activities. The CBD SBIR Program typically funds a cost plus fixed fee Phase II award, but may award a firm fixed price contract at the discretion of the Contracting Officer.

It is recommended that Phase II awardees have a Defense Contract Audit Agency (DCAA) approved accounting system. If you do not have a DCAA approved accounting system, this could delay/prevent a Phase II contract award. Visit https://www.dcaa.mil/Customers/Small-Business for more information on DCAA approved accounting systems.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
At this time, the CBD SBIR Program is not participating in the Technical and Business Assistance (TABA) Program.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. Notification will be provided via e-mail to the small business offeror – specifically to the Corporate Official (Business Point of Contact) and the Principal Investigator, as listed on the Cover Page (Volume I) of the proposal.

Upon written request via e-mail sent to dtra.belvoir.rd.mbx.jsto-cbd-chem-bio-defense-sbir@mail.mil and within 30-days of non-selection, debriefing statements will be provided by the CBD SBIR Program Office. The debriefing statement will be provided only via reply e-mail to the Corporate Official and the Principal Investigator, as listed on the Cover Page (Volume I) of the proposal.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Mr. Larry Pollack, Chemical and Biological Defense (CBD) SBIR Program Manager, Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), lawrence.p.pollack2.civ@mail.mil

ADDITIONAL INFORMATION

Fraud, Waste and Abuse

All offerors must complete the fraud, waste, and abuse training (Volume 6) that is located on the Defense SBIR/STTR Innovation Portal (DSIP) (https://www.dodsbirsttr.mil). Please follow guidance provided on DSIP to complete the required training prior to submitting proposals.

To Report Fraud, Waste, or Abuse, Please Contact:
DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: (800) 424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this Announcement.

CBD SBIR Projects Requiring Animal and Human Subjects

Companies should plan carefully for any research involving human subjects and/or animal use in addition to the use of any chemical or biological warfare agents, and use of any agents associated with "Dual Use Research of Concern (DURC)". The brief Phase I Period of Performance precludes plans requiring the use of many of these materials as well as animal and/or human subjects prior to obtaining all necessary DoD approvals.

Animal Use: If the proposed research involves the use of animal, the research cannot begin until the U.S. Army Medical Research and Development Command, Office of Research Protections (USAMRDC ORP), Animal Care and Use Review Office (ACURO) provides written authorization that the research may proceed. Offerors are required to: a) justify and b) include detailed information on the use of animals, and c) include the location(s) of where the animal work is to be performed.

The DTRA Research Oversight Board (ROB), in coordination with the appropriate CBD SBIR POC, will provide ongoing oversight throughout the duration of the effort to ensure proper approvals are in place.

The DTRA ROB and USAMRDC ACURO conduct site visits as part of its responsibility for compliance oversight. Offerors and subcontractors must comply with all applicable research involving animal use protections requirements. Accurate and complete study records must be maintained and made available to representatives of the DTRA ROB and USAMRDC ORP ACURO. Non-compliance with these terms and conditions may result in withholding of funds and/or the termination of the award. Further information may be required if the proposal is successful. Modifications to the already approved protocols require approval by the ACURO prior to implementation.

Protection of Human Subjects: Research under CBD SBIR awards involving the use of human subjects, to include the use of human biospecimens (human anatomical substances)* and/or human data, shall not be proposed for any Phase I Period of Performance.

If the research proposed during the Phase II Period of Performance includes research involving human subjects, to include the use of human anatomical substances and/or human data, the research cannot begin until the USAMRDC Human Research Protection Office (HRPO) provides written authorization that the research may proceed. HRPO authorization is required for any offeror and subcontractors that will use funds from this award to conduct research involving human subjects, human anatomical substances, and/or human data. Offerors are required to: a) justify and b) outline the use, and c) include the source of the human subjects, human biospecimens and/or human data involved in the research.

The DTRA Research Oversight Board (ROB), in coordination with the appropriate CBD SBIR POC, will provide ongoing oversight throughout the duration of the effort to ensure proper approvals are in place.

*This prohibition does not apply to research under this award that solely uses only one or both of the following types of human biospecimens to accomplish its aims: (1) established/exiting *commercially* available human cell lines; (2) established/existing patient-derived xenograft (PDX) models.

The DTRA ROB and USAMRDC ORP HRPO conduct site visits as part of its responsibility for compliance oversight. Prime and subcontractors must comply with all applicable human research protections requirements. Accurate and complete study records must be maintained and made available to representatives of the DTRA ROB and USAMRDC ORP HRPO. Non-compliance with these terms and conditions may result in withholding of funds and/or the termination of the award. Further information may be required if the proposal is successful.

CBD SBIR FY22.2 Phase I Topic Index

TOPIC NUMBER: CBD222-001

TITLE: Non-Perfluoroalkyl and Non-Polyfluoroalkyl Substances (PFAS) Elastomeric Chemical Barrier Materials

RT&L FOCUS AREA(S): Warfighting Requirements (GWR)
TECHNOLOGY AREA(S): Chemical/Bio Defense, Materials/Processes

OBJECTIVE: Design and develop a non-PFAS elastomeric barrier that provides permeation resistance to CBRN agents.

DESCRIPTION: The primary requirements for Chemical, Biological, Radioactive, and Nuclear (CBRN) protective items such as garments, gloves, boots, and masks are that they (i) ensure barrier function against various chemical challenges, (ii) provide flexibility and stretch for ease of movement and comfort for the wearer, (iii) possess adequate mechanical strength as required for the application, and (iv) do not compromise the barrier and mechanical properties when subjected to environmental and operational stressors. Desired properties for protective items are described in the National Fire Protection Association (NFPA) 1994 Class 1 standard [1].

Typical CBRN elastomer materials are either thermally cross-linked compounds or melt-processed thermoplastic polymers. Cross-linked materials are generally less susceptible to chemical permeation due a more restricted swelling in these systems. Often, a reinforcing filler (i.e., carbon black) is incorporated for mechanical property enhancement. While the increased filler content will reduce permeation, it also causes increased system stiffness and hardness. No commercially available elastomer can provide the range of resistance required to protect from the entire range of potential chemical challenges including chemical warfare agents (CWAs), toxic industrial chemicals (TICs), fuels, lubricants, solvents, vapors, and acids and bases, while retaining sufficient stretch.

Fluoropolymers or copolymers or coatings involving them have been added to elastomeric materials in order to impart or enhance barrier properties. The unique combination of properties of fluorine-containing polymers such as excellent chemical resistance, permittivity, flame resistance, hydro- and oleophobicity, weak adhesion and low cohesion have led to their applicability as membrane constituents or as coatings or fillers in chemical barrier materials. However, environmental concerns are beginning to require the reduced use and eventual elimination of fluorine containing systems [2, 3] and have stimulated the search for alternatives [4].

This topic calls for the design of novel, non-PFAS* elastomeric barrier systems that can provide improved permeation resistance. Approaches include but are not limited to: tailoring polymers using known approaches such as multilayers, interpenetrating polymers, coatings, or fillers; and rational design of novel polymer molecular structures [5]. The barrier materials should offer protection against vapor and liquid TICs and chemical agent challenges. The threshold level of permeation resistance should be cumulative permeation mass of less than 6 micrograms/cm^2 for industrial chemicals, 1.25 micrograms/cm^2 for Soman and 4.0 micrograms/cm^2 for distilled mustard when challenged with 20 grams per meter squared (g/m^2) of liquid chemical agent or

1% agent in gas phase. The permeation is to be tested after subjecting the material to 100 cycles of flexing per ASTM F392 and 10 cycles of abrasion with 600 grit paper as per ASTM D4157. The objective level of permeation is the same cumulative permeation mass limits assessed after 6 hours. Testing permeation resistance can be performed with appropriate simulants using standard test protocols specified in the reference document [1]. The detailed conditions for testing must be approved by the Government Technical POC.

*For the purposes of this SBIR topic, non-PFAS items are defined as those not containing fluorine. Perfluoroalkyl and polyfluoroalkyl substances (PFASs) are synthetic organofluorine chemical compounds that have multiple fluorine atoms attached to an alkyl chain.

PHASE I: Demonstrate a fluorine-free elastomeric barrier material that demonstrates the required barrier properties for one industrial chemical (e.g. tetrachloroethylene) and one chemical weapons agent (CWA) simulant (e.g dimethyl methylphosphonate) while retaining the desired physical properties: flame resistance as defined by ASTM F1358 (after flame time less than or equal to (≤) 2 sec); system should meet the threshold goal of 12% linear strain that is reversible. It is expected that at least one novel barrier candidate is produced in a 3” x 3” swatch for repellency studies. Outline a potential scale-up method and cost assessment for the material.

PHASE II: Optimize, scale and formulate minimally one candidate material for chemical repellency testing against a chemical agent** (e.g. Soman) and additional industrial chemicals (dimethyl sulfate and toluene). Provide a 6” x 6” swatch for independent agent evaluation by the end of Phase II/Month 10. In addition to assessing the physical properties noted in Phase I (flame resistance, reversible linear strain), determine puncture resistance as defined by ASTM 1342/F1342M Method A (puncture force ≥ 36 N). Methods must be developed to bond/integrate the elastomeric barrier material with other functional materials such as Nomex FR fabric, as identified by the Government Technical POC. At the conclusion of Phase II, elastomeric barrier fabric sample, at least 12 inches wide and 5 yards in length, obtained from continuous pilot scale production should be made available for independent evaluation.

** Use of any chemical agent will require the small business to work with an approved chemical surety laboratory

PHASE III: The elastomeric barrier material successfully demonstrated in Phase II will be integrated into CBRN protective ensemble. Materials should be made in full width (40") production, and issues in garment manufacture that may arise, such as seams, will be addressed.

PHASE III DUAL USE APPLICATIONS: An improved elastomeric, chemical barrier material would have a broad range of dual use applications with first responders, anti-terrorism personnel, agrochemical (pesticide) applications personnel and industrial, medical, and laboratory personnel.

REFERENCES:
1. a) NFPA 1990 Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents 2022 Edition, National Fire Protection Association (NFPA), Quincy, MA 02269, USA.

https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1990 . Note that the 2022 Edition of NFPA 1990 is a combination of Standards NFPA 1991, NFPA 1992, and 1994.

b) NFPA 1994 Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents 2001 Edition, National Fire Protection Association (NFPA), Quincy, MA 02269, USA. http://www.disaster-info.net/lideres/english/jamaica/bibliography/ChemicalAccidents/NFPA_1994_StandardonProtectiveEnsemblesforChemicalBiologicalTerrorismIncidents.pdf

2. National Defense Authorization Act for Fiscal Year 2022 https://www.congress.gov/bill/117th-congress/senate-bill/1605/text

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4. G. Glenn, R. Shogren, X. Jin, W. Orts, W. Hart-Cooper, and L. Olson, Per- and polyfluoroalkyl substances and their alternatives in paper food packaging, *Compr. Rev. Food Sci. Food Saf*. 20 (2021) 2596–2625.

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KEYWORDS: chem-bio protection, PFAS, fluorine-free, permeation resistance, elastomer

TOPIC NUMBER: CBD222-002

TITLE: Non-PFAS (Perfluoroalkyl or Polyfluoroalkyl Substances) Liquid Repellant Coatings

RT&L FOCUS AREA(S): Warfighting Requirements (GWR)
TECHNOLOGY AREA(S): Chemical/Biological Defense; Materials/Processes

OBJECTIVE: Develop and scale textile coatings that repel both hydrophobic and hydrophilic liquids without the use of perfluoroalkyl or polyfluoroalkyl substances (PFAS)

DESCRIPTION: Protective textiles for high-risk applications, such as Chemical/Biological Defense (CBD), first response, and healthcare must impart a high level of protection for the user. These textiles protect against a range of threats that can include toxic industrial chemicals (TICs), pharmaceuticals, blood, fuels, biological pathogens, and chemical warfare agents [1,2]. Per- and polyfluoroalkyl substances (PFAS) encompass a variety of compounds with C_n-F_{2n+1} bonds and are commonly used in repellent textile coatings. Long chains with carbon-fluorine bonds impart a high level of surface repellency against both water and oils by reducing surface energy [3].

Because of their repellent properties, uses for PFAS range from cookware to Chem-Bio (CB) protective clothing. However, increasing environmental and health concerns have led industry to remove PFAS from their processes. PFAS are known to persist in the environment, are challenging to remediate, and contribute to a variety of human health issues [4]. There are ongoing efforts to modify textile coatings, such as durable water repellent coatings (DWR) used on rain jackets and outdoor equipment [5,6], but the U.S. Department of Defense (DoD) is making efforts to remove all PFAS from military shoes and clothing/garments [6].

With the removal of PFAS as a component of repellent coatings, new textile coating technologies are needed that offer a high level of protection against both hydrophilic and hydrophobic compounds. Sprays, nanoparticles, other functionalized textile surfaces have been used to impart omniphobicity and “lotus leaf” properties with high contact angles against a variety of liquids, but more research is needed to develop and scale non-PFAS coatings that repel such a range of liquids [7-11]. There is a critical need to find coating technologies that can meet requirements without utilizing a carbon-fluorine bond.

In order to replace or compete with PFAS textile coatings, new technologies must be:

- Omniphobic: Able to repel both hydrophilic and hydrophobic liquids, including water, oils, and toxic chemicals
- Scaleable: Able to scale coating manufacture to treat full textile rolls or garments
- Aqueous based solvent system: Textile manufacturers have strict limitations on flammable solvent use
- Material independent: Able to function on multiple textile types such as mixtures of natural, synthetic, stretch, and non-stretch fibers
- Durable: Coatings must have resistance to UV light, temperature cycling and the same if not better resistance to laundering and abrasion as currently used DWR technologies

This SBIR topic solicits the following innovative technology requirements:

	T	O
oil rating (AATCC 118)	6A	8A
after 1 laundering	6A	8A
after 3 launderings	4A	8A
spray rating (AATCC 22)	100	100
after 1 laundering	90	100
after 3 launderings	70	100
% change in textile		
air permeability (ASTM D737)	10	0
stretch (ASTM D2594)	10	0
weight (ASTM D 3770)	10	0
stiffness (ASTM D747)	10	0
burst strength (ASTM D 3787)	10	0
Tear strength (ASTM D 1424)	10	0
Flame resistance (ASTM F 1358)	0	0
Wicking	10	0

T = Target; O = Objective

PHASE I: Phase I must demonstrate that a fluorine-free repellent coating can be applied to a fabric with no significant change to fabric properties. The table above details standard evaluations to assess performance, but other appropriate tests may be used as needed. For Phase I, the focus of material evaluation should be on repellency properties (oil rating, spray rating), weight changes, and loading of the active compound before and after coating. Phase II will address further textile properties, including laundering, but earlier material evaluations during Phase I are encouraged. An assessment of scaling capability for the repellent technology will be made, with special consideration for industry standard practices and limitations (i.e. solvent choice). Upon completion of Phase I, coated and uncoated textile swatches will be made available for independent evaluation. Two different types of coated textiles are required for Phase I (natural, synthetic, or a blend).

PHASE II: Phase II will optimize and scale the repellent coating for both natural and synthetic textiles and blends thereof, including at least one fabric that has stretch. The objective is to scale the repellent coating so it may be used to treat 60” width fabric rolls. The coating must demonstrate no significant change to fabric properties, including flame resistance, stretch, burst and tear strength, drape and stiffness, wicking, air permeability, and color. The table above details standard evaluations to assess performance, but other appropriate tests may be used as needed. Phase II testing should also include durability assessments (stretch, burst, tear) before and after abrasion and laundering. Evaluations of omniphobicity must be performed along the length and width of the production to demonstrate uniformity. An assessment for manufacturing and commercializing the repellent technology will be made, including a complete cost assessment for the repellent coating production and application. Upon completion of Phase II, coated and uncoated textile rolls will be made available for independent evaluation.

PHASE III: The coated textiles successfully demonstrated in Phase II will be integrated into Chemical/Biological/Radiological/Nuclear (CBRN) protective ensembles, Army Combat Uniforms (ACUs) and Flame Resistant Army Combat Uniforms (FRACUs). Textiles should be made in full width production; issues in garment manufacture that may arise should be addressed.

PHASE III DUAL USE APPLICATIONS: Omniphobic coatings have wide applications to protect materials from corrosion and liquid. They are used in outerwear, sportswear, camping gear, civilian Personal Protective Equipment (PPE), construction, shipyards, etc.

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2. a) NFPA 1990 Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents 2022 Edition, National Fire Protection Association (NFPA), Quincy, MA 02269, USA. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1990 . Note that the 2022 Edition of NFPA 1990 is a combination of Standards NFPA 1991, NFPA 1992, and 1994.

b) NFPA 1994 Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents 2001 Edition, National Fire Protection Association (NFPA), Quincy, MA 02269, USA. http://www.disaster-info.net/lideres/english/jamaica/bibliography/ChemicalAccidents/NFPA_1994_StandardonProtectiveEnsemblesforChemicalBiologicalTerrorismIncidents.pdf

3. Gluge, J., et al. (2020). "An overview of the uses of per- and polyfluoroalkyl substances (PFAS)." Environ Sci Process Impacts **22**(12): 2345-2373.Schellenberger, S., et al. (2019). "Highly fluorinated chemicals in functional textiles can be replaced by re-evaluating liquid repellency and end-user requirements." Journal of Cleaner Production **217**: 134-143. 10.1016/j.jclepro.2019.01.160. 10.1039/d0em00291g

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KEYWORDS: PFAS, Non-PFAS, liquid repellency, fabric coatings, textile, Individual Protection

TOPIC NUMBER: CBD222-003

TITLE: Collapsible and Protective Portable Canine Shelter

RT&L FOCUS AREA(S): Warfighting Requirements (GWR)
TECHNOLOGY AREA(S): Chemical/Biological Defense

OBJECTIVE: Develop a collapsible, one person-portable, chemical and biological protective kennel with air filtration for rapid deployment to protect Military Working Dogs.

DESCRIPTION: Military Working Dogs (MWDs) have proven to be a vital component in the execution of warfighter missions. From supporting warfighter security to being a force multiplier, MWDs and their handlers are often the first to enter and assess situations where Chemical/Biological (CB) or other threat materials are present. If an area is contaminated or otherwise unsafe due to an imminent CB threat or is operational mobility limited, immediate exfiltration can be delayed. Handlers have access to a wide array of personal protective equipment (PPE), developed, improved and deployed for decades; however, there are very few PPE options for MWDs. Most, if not all, currently fielded protection systems, like the Joint Expeditionary Collective Protection (JECP) Shelters require a significant logistical footprint including electrical access and complex active filtration. For certain critical missions demanding a high degree of maneuverability and general readiness, it is highly desirable to have innovative MWD shelters with much lower logistical requirements and convenience elements such as portability, air filtration and expansion for future requirements. The goal of this SBIR topic is to develop a one person-portable canine shelter addressing the following requirements:

- Deployment: the shelter should be able to be set up in the same time that the handler would be donning an individual CB protective suit.
- Total System Weight: 22 lbs (threshold); 12 lbs (objective). Total system weight includes all components and required elements, exclusive of batteries (if any).
- Deployed Shelter Volume: must be capable of comfortably housing canines up to 75 lbs (threshold) with a range of 60 to 120 lbs (objective).
- Stowed Shelter Volume: 4000 in3 (threshold); 1800 in3 (objective). Shelter volume is independent of any external components.
- Total System Volume (stowed; all components): 5000 in3 (threshold); 2200 in3 (objective).
- Filtration: shelter should be capable of filtering particulates and adsorbing a wide range of chemical warfare agents such as (but not limited too): nerve agents—tabun (GA), sarin (GB), soman (GD), VX; mustard agents—H, HD, L; tear agents— CN, CS, CR, OC; blood agents—hydrogen cyanide (AC), cyanogen chloride (CK), arsine (SA); chlorine, phosgene, chloropicrin (PS), and diphenylchloroarsine (DA). Any required filter elements should be user-exchangeable and commercially available.
- Airflow: shelter shall provide adequate, filtered air to canines both at rest and under exertion, minimum 1.1 cfm/sf (threshold); shelter shall also allow for one-way exhaust of air back into the atmosphere.
- Other Environmental: all components shall be independently operational between 32 and 105 degrees Fahrenheit (threshold) with a wider rage desired; interior of shelter must maintain temperature and humidity within CFR specifications for dog transport (45 – 85 degrees

Fahrenheit and 30-70% relative humidity for no more than 4 hours); shelter materials shall be CB resistant/protective.

- Health/Safety: safe to the touch for canine and handler (e.g., no sharp edges, exposed moving parts, and potentially hazardous protruding parts); safe for the sheltered canine (e.g., resistant to scratching/biting, no toxic components, no risk of physiological harm/stress); a system to notify handler of any unexpected risks to the canine are of interest.
- Power: power requirements should be carefully considered to ensure portability; battery operation, DC operation, and hybrid approaches are of interest.
- Backpack transportable by one individual.
- Additional Elements: also of interest, but not required, include systems which provide temperature control/regulation, broader temperature and environmental operational parameters (e.g., radioactivity detection), consideration of health concerns related to animal waste, lighting and multiple stowage/transport options.

Research conducted under this topic must comply with Federal and Department of Defense Regulations, and Public Law (in particular, Animal Welfare Act 4 and amendments) regarding the treatment of dogs.

PHASE I: Design an appropriate Canine Shelter Technology that will meet the requirements outlined above. Threshold and objective quantitative health requirements including physiological, anatomical and behavioral will be defined after consulting with both military and commercial sources. Provide a detailed description of the operation of the system and mechanism of air filtration for canine safety. Identify components and/or develop technical specifications for components that, when integrated, will meet the performance goals. Conduct necessary calculations on the design and performance of the components to demonstrate the feasibility and practicality of the proposed Canine Protective Shelter for maximum efficiency, including mitigation of risks associated with factors limiting system performance and operating in extreme environments in theatre. Demonstrate a prototype system or primary components of a prototype system at TRL 3+.

PHASE II: Optimize and construct working prototypes at TRL 4-5 as designed and configured in Phase I to meet or exceed stated objectives. Conduct laboratory tests to validate all specifications. Conduct field tests if appropriate. Develop final product specification documents that include a list of all system components and their requirements and instructions for field deployment and stowage. In addition, an investigation of potential alternative applications should be conducted in conjunction with a market assessment.

PHASE III: Materials and technology developed under this project could also be integrated into military individual protection equipment and collective protection equipment for the Warfighter. The system would provide real-time chemical protection in a hazardous environment, enabling the Warfighter and canine to have necessary protection.

PHASE III: DUAL USE APPLICATIONS: The system could be introduced into the civilian marketplace along with current civilian CB barrier technologies. The shelter could be incorporated for use in other applications for civilian response in a hazardous chemical environment for both domestic and working animals. The shelter would also be applicable to federal, state and local law enforcement. The temperature and ventilation systems employed in the system could separately be marketed for government and commercial uses.

REFERENCES:

1. Joint Expeditionary Collective Protection (JECP) Family of Systems (FoS). Joint Committee on Tactical Shelters. 6th Bi-Annual DOD JOCOTAS Meeting with Rigid & Soft Wall Shelter Industry & Indoor & Outdoor Exhibition, 2-4 Nov 2009, Panama City Beach, FL.

2. Military Working Dogs: An Overview of Veterinary Care of These Formidable Assets, Veterinary Clinics of North America: Small Animal Practice, Volume 51, Issue 4, July 2021, Pages 933-944

3. Andrew L. McGraw DVM, MS, Todd M. Thomas DVM, MSpVMBerglund, Larry & Yokota, Miyo & Santee, William & Endrusick, Thomas & Potter, Adam & Goldman, Scott & Hoyt, Reed. (2011). Predicted Thermal Responses of Military Working Dog (MWD) to Chemical, Biological, Radiological, Nuclear (CBRN) Protective Kennel Enclosure.

KEYWORDS: Military Working Dog, Canine Protection, Canine Physiology, Canine Kennel, Chemical and Biological Protection

TOPIC #: CBD222-004

TITLE: Development and Testing of Contact-Free Methods for Classifying the Morphological Properties of Aerosols

RT&L FOCUS AREA(S): Warfighting Requirements (GWR)
TECHNOLOGY AREA(S): Chemical/Biological Defense

OBJECTIVE: Develop capabilities for contact-free, imaging of aerosol particles from environmental matrices with simultaneous assessment and discrimination of particle morphology. The developed instrumentation must be capable of processing chemical and biological aerosols via point detection at the location of the instrument in real time. The instrumentation should be deployable on an unmanned platform such as unmanned aerial vehicles (UAVs) or unmanned ground vehicle (UGVs).

DESCRIPTION: The detection and characterization of airborne aerosol particles is paramount to rapidly sense chemical and biological threats. This is especially true for urban and/or battlespace settings where the aerosol composition can include inorganic, organic, and biological particles with complex morphologies across orders of magnitude in size (1−100 microns (μm)) [1]. Because aerosols contain a large majority of innocuous particles, the detection of possible threat materials is limited by their small concentration within a complex ambient matrix containing materials of non-interest as well as interfering compounds. Moreover, aerosol properties can evolve in time through chemical aging processes (environmental degradation) and mechanical forces. While sensor technology has improved over the last 20 years, threat detection still remains a challenge in operational environments at mission-speed due to the complex and dynamic nature of the surrounding environmental media.

An essential aspect of useful methods to investigate such aerosols is to do so in a contact-free manner, which has motivated legacy methods such as elastic light scattering. However, the wide diversity of irregularly shaped aerosol particles presents significant challenges for existing methods often because the measured data cannot be mapped onto particle properties without strong assumptions about a particle’s size, shape, and source. These limitations underscore the need for technologies with the ability to directly provide particle images, allowing individual particle morphology and orientation to achieve increased detection and characterization confidence. Current capabilities for this purpose that do not involve particle collection or trapping are highly limited.

New methods have been developed to image free-flowing aerosol particles on the single and multi-particle level via optical light scattering and holographic imaging [2−4]. Recent efforts have also introduced machine-learning techniques capable of differentiating particle morphology [4]. Leveraging these and similar recent developments in determining morphological properties has the potential to generate a capability that could augment the Department of Defense’s current and/or future aerosol particle detection systems by providing a layered approach to distinguish background particles from potential threat agents. But to do so will require the development of sensing instrumentation capable of rapidly imaging particles and characterizing their material composition both autonomously and rapidly. The imaging capability should overlap with the inhalable particle-size range and rely on methods that are contactless and free from conventional assumptions such as particle levitation or flow-through technologies. Analysis of the image data should, at a minimum, enable classification of the particles based upon both size and morphology with the intent that it could queue subsequent non-imaging particle diagnostics. Particle material composition should consist of, at a minimum, the ability to differentiate between absorbing and non-absorbing components present, and be able to discriminate biological from non-biological particles or components within particles.

PHASE I: Phase I entails the design of a concept for a rapid, contact-free comprehensive system for aerosol particles. The study should lead to a proof-of-concept or demonstration that outlines an unmanned aerial or ground vehicle-based system consisting of all the elements of a contact-free method to image inhalable-sized aerosol particles. The Phase I project should focus on the discrimination of at least one biological and one non-biological species in the 1–100 μm (micron) size-fraction (i.e., with improved detection performance over current methods). The accompanying architecture required to integrate machine learning techniques for particle differentiation should also be considered. The Phase I project should also define a clear path forward for designing a prototype with low size, weight, and power (SWaP) to enable deployment on unmanned vehicles. Chemical and biological threats of all classes are of interest for sensing and identification. Examples include biological spores, such as anthrax or simulants thereof (that can be accessed by the small business offeror), and allergens like pollens.

The Phase I final report must explain in detail the contact-free detection method selected, software concepts, hardware requirements, and identify potential use cases and limitations.

PHASE II: Mature the concept into a pre-production portable instrument prototype integrating the capabilities outlined in the concept developed during Phase I.

The key deliverable of Phase II will be the demonstration of the system in a relevant environmental setting where the prototype is capable of sampling upwards of 100 particles per second and classifying chemical and biological simulants to within 90% accuracy. Evaluation of the machine-learning particle-detection algorithms will be extended to multiple threat vectors. The system will be benchmarked against standard techniques of aerosol identification. An initial analysis of the commercial applications of the system will be conducted, focusing on the baseline cost of the system and the market space addressed by the technology development.

PHASE III: The small business will pursue commercialization of the technologies developed in Phase II for potential government and commercial applications. Government applications include rapid detection of chemical and biological threat aerosols.

PHASE III DUAL USE APPLICATIONS: Contact-free aerosol imaging and identification has the potential to be integrated into ongoing Department of Defense programs including the Nuclear, Biological and Chemical Reconnaissance Vehicle Sensor Suite Upgrade (NBCRV SSU) program and the Joint Biological Tactical Detection System (JBTDS) program. The system could similarly be installed on UAVs and UGVs used by other agencies responsible for chemical and biological threat surveillance such as the Department of Homeland Security (DHS). The successful product can also fulfill air quality environmental applications such as assessing pollutants, dust loading, smoke and pollen for commercial applications and for use by government agencies including the U.S. Environmental Protection Agency (EPA).

REFERENCES:
1. P. Kulkarni, P. A. Baron, K. Willeke (eds.) *Aerosol Measurement: Principles, Techniques, and Applications*, 3rd ed., (Wiley, 2011).

2. M. J. Berg, G. Videen, "Digital holographic imaging of aerosol particles in flight," *J. Quant. Spectrosc. Radiat. Transfer* **112**, p. 1776-1783 (2011).

3. O Kemppinen, JC Laning, RD Mersmann, G Videen, MJ Berg, "Imaging atmospheric aerosol particles from a UAV with digital holography," Nature Scientific Reports 10 (1) 1-12 (2020).

4. P Piedra, A Kalume, E Zubko, D Mackowski, YL Pan, G Videen, "Particle-shape classification using light scattering: An exercise in deep learning," Journal of Quantitative Spectroscopy and Radiative Transfer 231, 140-156 (2019).

KEYWORDS: Chemical/Biological Threat Detection, sensors, aerosols, environmental sampling; environmental surveillance

TOPIC NUMBER: CBD 212-005

TITLE: Artificial Intelligence (AI)-based Real-time Automatic 3D Reconstruction and 3D Model Generation from Multiple Image Sources for Situational Awareness and Transport and Dispersion Modeling

RT&L FOCUS AREA(S): Artificial Intelligence/Machine Learning
TECHNOLOGY AREA(S): Chemical/Biological Defense; Information Systems Technology; Battlespace Environments; Sensors

OBJECTIVE: Develop a tool capable of automatically generating 3D models by the fusion of images from various sources, such as but not limited to LIDAR, x-ray, photos, satellites, and blueprints. These 3D models will be used for projection via augmented reality (AR), inserted into virtual reality (VR) platforms, and serve as terrain for transport and dispersion (T&D) modeling.

DESCRIPTION: Visual representation of chem/bio hazards is one of the various types of information of interest to allow Warfighters to gain situational awareness prior to operations and responses. Recent efforts managed by the Digital Battlespace Management Division at the Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD) have looked into leveraging extended reality (XR) technologies to provide modern, advanced, and realistic representations of chem/bio hazards. Active projects are also looking into merging modeling and simulation (M&S) capabilities with XR tools. Nevertheless, there is a gap in the ability to rapidly, automatically, and accurately generate 3D models. The ability to generate 3D models of items (e.g. devices, threat-filled weapons), buildings, and terrain based on multiple image sources to support visualization, mission rehearsal, and Chemical-Biological (CB) hazard T&D modeling is desired.

In this development, the Chemical and Biological Defense Program and the JSTO-CBD look to work with small business firms to develop a software capability that can merge and fuse imagery data from sources such as LIDAR, x-ray, night-vision thermal/IR images, visible light camera photos, satellite images, open source maps, mobile phone images/sensors, and/or blueprints (in format of plan PDF or computer assisted drawing, CAD, electronic files). This capability should rapidly and automatically output photorealistic 3D models that can be georeferenced with topographical accuracy allowing varying degrees of fidelity to support different needs on hardware systems with different computational power and/or rendering capacity. The software capability should be able to generate 3D models based on one to all of the image sources mentioned above; it is understood that model fidelity can vary when data sources are limited.

In addition to exterior representations, the ability to generate the interior layouts of buildings based on exterior images is of interest. The interior layouts may be generated based on inference model(s) to be developed under this effort, yet should be true-to-drawings when building blueprints are available. If image data for building interiors are available, the ability to merge these data and/or correct inference model(s) for 3D reconstruction is also desired. Considerations should be taken when HVAC information is available as the building airflow plays a key role in hazard T&D in buildings. The ability to output parameters necessary for CONTAM multi-zone models based on blueprints is desired. The tool should also be capable of extracting necessary information to be utilized for generating JSTO-CBD developed box models.

The application of artificial intelligence (AI)/machine learning (ML) algorithms may be necessary at any one or various points of the 3D model generation workflow; proposals should identify if and how AI/ML will be utilized. The capability to be developed under this topic should allow flexible outputs in commercial standard formats, which can further be utilized in other commercial platforms, computational fluid dynamics (CFD) modeling, and/or support DoD tools. This software solution must be able to operate in both connected and disconnected environments.

Proposals must provide innovative solutions that are forward compatible as well as demonstrate knowledge and expertise working with state-of-art technologies relating to 3D reconstruction/3D model generation/rendering and understanding of intricacy of T&D modeling. Successful developments should adapt modular designs and agile software development processes.

PHASE I: Design and develop a process for automatic 3D reconstruction and 3D model generation using the fusion of image data types listed above. Identify methods and approaches to develop an interior inference model and any AI/ML algorithms necessary that are to be developed in Phase II and Phase III. Develop an early prototype to demonstrate the ability to automatically generate 3D models compatible with all modern game engines based on the fusion of two of the above mentioned image sources for items and terrains as well as that based on fusion of two of the above mentioned image sources to include blueprints/CAD files for buildings. The ability to generate parameter files necessary for CONTAM models based on CAD files should also be demonstrated.

PHASE II: Refine the design and the prototype to allow automatic 3D reconstruction and 3D model generation that can be georeferenced with topographical accuracy based on one to all image data sources listed above. Develop interior inference model and AI/ML algorithms as needed. Develop the capability to parameter files necessary for CONTAM models based on blueprints (in format of plan PDF or computer assisted drawing, CAD, electronic files) or based on interior inference model that can be associated with the 3D models. Assumptions on airflow when using interior inference model should be scientifically supported. The 3D models generated should also be flexible to accept association with other CONTAM or CFD models of choice of the user.

PHASE III: Refine the software capability to allow for options on multiple commercial standard output formats of 3D models with options for varying degrees of fidelity to support various applications and needs since the 3D models generated may be utilized in other commercial platforms, support CFD modeling, and support DoD tools. Demonstrate the ability of the tool to generate 3D models that can be utilized in programs on hardware with wide range of computation power and/or rendering efficiency. Refine interior inference model and AI/ML algorithms. Refine the process to generate parameter files necessary for CONTAM models and/or extracting information necessary to generate box models to be associated with the 3D model.

PHASE III DUAL USE APPLICATIONS: This technology can support civilian and military operations, planning, and situational awareness. The ability to generate 3D models based on fusion of image sources can support industries focusing on graphics or XR technologies. Applications in civil engineering, forensic site reconstruction, digital twin generation, medical image fusion, and the construction industry are also realized.

REFERENCES:
1. W.S. Dols, et al., 2009, Development and Demonstration of a Method to Evaluate Bio-Sampling Strategies using Building Simulation and Sample Planning Software. NIST Technical Note 1636.

2. Ham, H. et al., 2019, Computer vision based 3D reconstruction: a review. International Journal of Electrical and Computer Engineering (IJECE), 9(4), pp. 2394-2402. DOI: 10.11591/ijece.v9i4.pp2394-2402

3. Remondino, F. et al., 2006, Image-based 3D Modeling: a review. The Photogrammetric Record 21(115): pp. 269–291. DOI:10.1111/j.1477-9730.2006.00383.x

4. Suveg, I. et al., 2002, Automatic 3D Building Reconstruction. Proc. SPIE 4661, Three-Dimensional Image Capture and Applications V, (8 March 2002); DOI: 10.1117/12.460181

5. Xue, J. et al., 2021, Review of Image-Based 3D Reconstruction of Building for Automated Construction Progress Monitoring. Applied Sciences, 11(17), pp. 7840. DOI: 10.3390/app11177840

6.Wang, Q. et al., 2019, Applications of 3D point cloud data in the construction 1 industry: A fifteen-year review from 2004 to 2018. Advanced Engineering Informatics, 39, pp.306-2 319. DOI:10.1016/j.aei.2019.02.007

7. Yang M-D. et al., 2018, Fusion of Infrared Thermal Image and Visible Image for 3D Thermal Model Reconstruction Using Smartphone Sensors. Sensors, 18(7). DOI:10.3390/s18072003

8. Sentenac T. et al., 2018, Automated thermal 3D reconstruction based on a robot equipped with uncalibrated infrared stereovision cameras. Advanced Engineering Informatics, 38, pp: 203–215. DOI: 10.1016/j.aei.2018.06.008

9. https://www.nist.gov/services-resources/software/contam

KEYWORDS: 3D reconstruction, 3D model, augmented reality (AR), virtual reality (VR), extended reality (XR), photogrammetry, terrain, building, transport and dispersion (T&D), modeling and simulation (M&S)

DHA 2022.2 Small Business Innovation Research (SBIR)

Proposal Submission Instructions

INTRODUCTION

The Defense Health Agency (DHA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

Broad Agency Announcement (BAA), topic, and general questions regarding the SBIR Program should be addressed according to the DoD SBIR Program BAA. For technical questions about a topic during the pre-release period, contact the Topic Author(s) listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit https://www.dodsbirsttr.mil/submissions/login.

The DHA Program participates in up to three DoD SBIR BAAs each year. Proposals not conforming to the terms of this BAA will not be considered. Only Government personnel will evaluate proposals with the exception of technical personnel from Odyssey Systems who will provide technical analysis in the evaluation of proposals submitted against DHA topic number:

- DHA222-002 - To Demonstrate a Technology for Early Detection and Monitoring of Wound Infections.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DHA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the DHA SBIR Program and these proposal preparation instructions should be directed to:

DHA SBIR Program Management Office (PMO)
Email - usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@mail.mil
Phone - (301) 619-7296

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed **20 pages** and must follow the formatting requirements provided in the DoD SBIR Program BAA. Do not duplicate the electronically-generated Cover Sheet or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically-generated Cover Sheet and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be reviewed only to the last word on the 20th page. Information beyond the 20th page will not be reviewed or considered in evaluating the offeror’s proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

Content of the Technical Volume
The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Refer to the instructions provided in the DoD SBIR Program BAA for full details on content of the technical volume.

Cost Volume (Volume 3)
The Phase I Base amount must not exceed **$250,000**. Costs for the Base must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR **will** be considered by DHA during proposal evaluations.

Supporting Documents (Volume 5)
DHA SBIR will accept a Volume Five (Supporting Documents) as required under the DoD SBIR Program BAA.

Fraud, Waste and Abuse Training Certification (Volume 6)
DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. All DHA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO. Submission instructions are typically sent toward the end of month five of the Phase I contract. The awardees will receive a Phase II window notification via email with details on when, how and where to submit their Phase II proposal.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/login). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, the Technical Volume, Supporting Documents, and Fraud, Waste, and Abuse certificate.

The DHA SBIR Program will evaluate and select Phase II proposals using the evaluation criteria in the DoD SBIR Program BAA. Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Small businesses submitting a proposal are required to develop and submit a Commercialization Strategy describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. This plan should be included in the Technical Volume.

The Cost Volume must contain a budget for the entire 24-month Phase II period not to exceed the maximum dollar amount of $1,100,000. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and should be presented side-by-side on a single Cost Volume Sheet.

DHA SBIR Phase II Proposals have six Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse. The Technical Volume has a **40-page** limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically-generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40th page. Information beyond the 40th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DHA SBIR Program **does not** participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program has a Technical Assistance Advocate (TAA) who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified via email to the Corporate Official of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:

Ms. Samantha Connors
SBIR/STTR Chief, Contracts Branch 8
Contracting Officer
U.S. Army Medical Research Acquisition Activity
Phone: (301)-619-6979
Email: Samantha.l.connors.civ@mail.mil

AWARD AND CONTRACT INFORMATION

Phase I awards will total up to $250,000 for a 6 month effort. Phase I contract awards will be awarded as Purchase Orders indicating the Technical Point of Contact. Phase II awards will be a Firm Fixed contract with the Contracting Officer Representative and other contracting staff identified.

ADDITIONAL INFORMATION

RESEARCH INVOLVING HUMAN SUBJECTS, HUMAN SPECIMENS/DATA, OR ANIMAL RESEARCH

The DHA SBIR Program highly discourages offerors from proposing to conduct Human Subjects, Human Specimens/Data, or Animal Research during Phase I due to the significant lead time required to prepare regulatory documentation and secure approval, which could substantially delay the performance of the Phase I award. While technical evaluations will not be negatively impacted, Phase I projects requiring Institutional Review Board approval may delay the start time of the Phase I award. If necessary regulatory approvals are not obtained within two months of notification of selection, the decision to award may be terminated.

Offerors are expressly forbidden to use, or subcontract for the use of, laboratory animals in any manner without the express written approval of the US Army Medical Research and Development Command (USAMRDC) Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRDC ACURO to the recipient. Modifications to previously approved protocols require re-approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRDC's Office of Research Protections (ORP) provides formal authorization. Written approval to begin a research protocol will be issued from the USAMRDC ORP, under separate notification to the recipient. Written approval from the USAMRDC ORP is required for any sub-recipient using funds from this award to conduct research involving human subjects. If the Offeror intends to submit research funded by this award to the US Food and Drug Administration, Offerors should propose a regulatory strategy for review.

Non-compliance with any provision may result in withholding of funds and or termination of the award.

WAIVERS

In rare situations, the DHA SBIR Program allows for a waiver to be incorporated allowing federal facility usage for testing/evaluation. A waiver will only be permitted when it has been determined that no applicable U.S. facility has the ability or expertise to perform the specified work. The DHA SBIR Program has the right of refusal. If approved, the DHA SBIR Program will assist in establishing the waiver for approval. If approved, the proposer will subcontract directly with the federal facility and not a third party representative.

END

DHA SBIR 22.2 Phase I Topic Index

DHA222-001 TITLE: Developing a Hardened Portable EEG System for Aircrew Physiological Monitoring in Flight

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Bio Medical

OBJECTIVE: Design, build, and demonstrate a portable, dry EEG system that is integrated into the HGU-68/P flight helmet and capable of producing reliable and interpretable data in the flight environment which presents considerable sources of noise such as electronic noise, vibration from mechanical components, acceleration forces, changes in temperature and pressure, and non- neurological signals (e.g., muscle activity).

DESCRIPTION: To understand the conditions under which pilots are experiencing Physiological Events, the DoD is seeking technological solutions to measure pilot physiological activity in the cockpit using electroencephalography (EEG). Naval aviation is inherently dangerous, especially in high performance aircraft. Even in the most benign conditions, aviators are loaded with bulky flight gear in cramped cockpits and required to breathe highly concentrated air from a closed-loop system. The flight environment is dynamic and adds additional demands on the aviator through changes in temperature and pressure, exposure to acceleration forces (Gs), and sensory inputs. Repeated exposure to such conditions can result in a Physiological Event (PE). PEs are complex pilot-aircraft interactions that involve two components: 1) a physiological episode (i.e., adverse physiological conditions such as black outs, loss of situational awareness, spatial disorientation, or hypoxia) and 2) an apparent aircraft malfunction. Recent surges in PEs have resulted in the Navy making PEs the number one safety priority in Naval aviation[8]. After examining tens of thousands of samples from onboard oxygen generating systems and revamping the physiology training given to aviators, there was a drastic decrease in the number of PEs reported since 2017[8]. However, PEs have not been eliminated and still present a health risk to aviators in high performance aircraft. Indeed, the POM-23 Aircrew Systems Enabler, Navy Aviation Requirements/Group (ENARG) Executive Steering Committee has stated that PEs continue to be a top health and safety priority for Naval Aircrew.

The etiology of PEs is not well understood. Currently, PEs are assessed through a system of trial and error. Utilizing a reactive, rather than proactive method, aviators report physiological episodes after flight and experts on the ground try to diagnose the cause of the PE. This self-report system is a barrier to understanding why a PE occurred and how it affected the aviator because aviators rely on their subjective memory to attempt to assemble a timeline of events during the flight. Since PEs inherently contain a physiological component, relying on aviator memory to establish a timeline and diagnose an issue is problematic. Even without adverse physiological conditions, human memory is often unreliable[3]. Conversely, a proactive approach gathering physiological data from the aviator in real time affords the opportunity to understand why and when a PE occurs and can inform the design of systems to react accordingly.

Research has shown EEG can be used to detect sensory and cognitive deficits that result from PEs. For example, disruption in attentional focus after a novel auditory stimulus is presented can be measured when individuals experience acute hypoxia[6]. In a similar vein, a reduction in the ability to process visual sensory information can be measured under hypoxic conditions[1]. Prior research has also shown that objective markers for vection, or the powerful illusion of self-motion in spatial disorientation, can be determined using EEG[5]. Finally, numerous studies have shown that physiological measures such as EEG can be used to measure mental workload[7]. Therefore, if EEG can be used to gather physiological data from aviators in real time, we can begin to understand why PEs are occurring, refine training for aviators to detect the early signs of a PE, and inform the design of aircraft systems that can potentially take corrective actions if the aviator is unable to so.

An important consideration for real time recording is that brain dynamics in the laboratory differ from those in real-world environments[2,4]. In the laboratory, recordings can be made under controlled conditions and represent ideal physiological data. However, the flight environment presents considerable sources of noise such as electronic noise, vibration from mechanical components, acceleration forces, changes in temperature and pressure, and non-neurological signals (e.g., muscle activity) that require substantial filtering to interpret, and in some cases, completely prevent the interpretation of physiological data. Thus, an EEG system in a flight environment must able to endure these sources of external noise while capturing reliable and interpretable data.

To address these roadblocks and understand the conditions under which pilots are experiencing PEs, the DoD is calling for technological solutions to implement use of EEG in aviation settings.
Proposed designs should be a portable, dry EEG system that is integrated into the HGU-68/P flight helmet[9] and capable of producing reliable and interpretable data in the flight environment which presents considerable sources of noise such as electronic noise, vibration from mechanical components, acceleration forces, changes in temperature and pressure, and non-neurological signals (e.g., muscle activity). Additional applications for such a device could be with special operations warfighters performing in extreme environments, long-duration en route care monitoring unconscious patients, or civil aviation search and rescue aircrew.

PHASE I: The Phase I effort should focus on designing and or developing an innovative solution for a portable EEG system that integrates into the HGU-68/P flight helmet[9]. The in-helmet portion shall be as light weight as possible and shall not exceed 1 lb. The system shall capture reliable and interpretable EEG data, transmit the data wirelessly to a receiver located in the cockpit (e.g., electronic kneeboard, tablet, or other receiver in the cockpit), but not in the helmet, and be able to distinguish genuine EEG signals from sources of external noise (e.g., electronic noise, vibration from mechanical components, acceleration forces, changes in temperature and pressure, and non- neurological signals) - this will be a key factor. EEG data output should include a graphical user interface for “real time” monitoring by the user via the electronic kneeboard or tablet, and be exportable for analysis and integration into other injury and/or human performance algorithms. It is intended that this prototype may be one device of many to monitor operator performance.

Integration with other physiological devices will be a key performance parameter. Further, considerations should be made of integration with inflight safety equipment such as vests, night vision systems, and helmet mounted displays. The desired cockpit configurations will be primarily fixed-wing ejection seat aircraft, with secondary considerations for rotary-wing cockpits. Provide detailed Phase I final report that includes a) concepts and plans to develop and test for fixed-wing platforms in stationary and 6DOF simulators and b) development of a pathway to FDA clearance/approval. The Phase I effort will include prototype plans to be developed under Phase II. Provide a plan for practical deployment of the proposed.

PHASE II: Develop a working prototype that captures reliable and interpretable data in a powered- on stationary fixed-wing aircraft, and 6DOF simulator. Be advised that effectively filtering out “noise” in an operational environment will be a key factor. The performer should produce a prototype that meets the requirements listed above as well as begin to validate the use of the prototype using human participants. As part of the validation process, user comfort should be evaluated and prioritized especially during long duration wear/use (e.g., a minimum of 2 hours of wear). Testing should ensure the prototype integrates with aircrew survival and safety equipment (i.e., night vision systems or helmet mounted displays), does not impede aircraft egress (i.e., snag hazards), or diminish the survival characteristics of the HGU-68/P flight helmet (i.e., impact protection, visibility, and buoyancy). Through this testing and evaluation process, the performer should make iterative refinements to the prototype to ensure that it meets all of the requirements listed above. In addition, the performer should begin communication with the FDA to ensure that regulatory clearance can be obtained during Phase III. Required Phase II deliverables will include a working prototype, and a report about the overall project progress including all data that demonstrate the ability to measure reliable and interpretable data in the flight environment, and all data that support its potential to meet any parameters that aren't already met.

PHASE III DUAL USE APPLICATIONS: Using the results and progress made during Phase II, a Phase III effort will complete all required flight worthiness approvals in accordance with the Naval Air Systems Command's (NAVAIR) requirements. This phase will include any remaining work necessary to have the proposed solution meet performance parameters described in this topic, demonstrate its performance in a military-relevant environment, and become production ready.

Unlike the military, PEs are not a common factor that degrades the overall safety of the flight environment. However, there are other prevalent factors, such as physiological states of reduced mental or physical performance that result from sleep loss or extended wakefulness that impair a pilot's ability to safely operate an aircraft. In the civilian market this system will provide an innovative way to use EEG to monitor pilots' performance in the aircraft to detect physiological states of reduced mental or physical performance before the overall safety of the flight is compromised.

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KEYWORDS: EEG, ruggedized, physiological monitoring, physiological episode, aircrew, human performance

DHA222-002 TITLE: To Demonstrate a Technology for Early Detection and Monitoring of Wound Infections

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Bio Medical

OBJECTIVE: Develop and validate a technology solution for the early detection and monitoring of wound infections in a prolonged care setting. The technology must improve upon the current ability to identify a wound infection. The end goal is to detect infections early and inform wound infection treatment as early as possible in order to ensure the most positive patient outcome.

DESCRIPTION: The future conflicts anticipates division-on-division combat operations with causality volumes and medical intervention times that mirror what was observed in WWI and WWII. When Soldiers suffer from polytraumatic wounds commonly associated with blast injury include, severe blood loss, polymicrobial infections, a number of physiological, neurological and metabolic changes that are poorly understood or tracked. Moreover, these changes significantly increase susceptibility to infection and alter how the body metabolizes antibiotics, resulting in less than optimal treatments. Another compounding problem is that multiple microorganisms (ESKAPEE & other bacteria, fungi) involved in these combat wound infections exhibit complex pathogenesis and are becoming more and more resistant to multiple, sometimes all, antibiotics through various mechanisms. This scenario becomes more complex in these conflicts, where the deployment of anti-access and area denial (A2AD) technologies will not only limit evacuation to degrade the Golden Hour timeline for medical support but also constrain medical resupply, leaving wounded Warfighters and first line medical support providers stranded in prolonged care (PC) scenarios for unknown durations. Furthermore, repeated mass casualty events will create greater dependency on PC (limited resources while being mobile) increasing the number of deaths from wounds as infection rate rise within 72hrs among wounded Warfighters. PC leads to the perfect storm involving; deranged combat physiology, empiric treatment, increasing resistant of infectious agents, and delayed surgical debridement. An obvious opportunity here is for innovative solutions that are massively scalable and distributive (i.e. affordable and for all combatants) focused on amplifying self/ buddy care (i.e. fire and forget solutions that enables less supply to be carried for longer duration) is the Army’s IFAK (Improved First-Aid Kit) or “rucksack ready” rapid diagnostics tool. This topic explores the development of a device not only as an infection detection tool but also an infection monitoring device capable of identifying clinically relevant aspects of an infection such as Gram status, fungi or bacteria to inform treatment, return to duty, and triage decisions. The ultimate goal of the technology in this request is, but not limited to, to detect a pathogenic organism that could or is currently leading to an infection in or around the wound bed starting at the earliest time possible after injury to include Role 1 care and continue to provide information throughout the continuum of care. In doing so, this convergent technology should detect infection development and inform subsequent treatment choices at various stages of care as well capture transitions in infections, which are leading cause of failed treatment outcomes such as sepsis (i.e. continued treatment of untreatable infection due to the emergent multi-drug resistance). Thus the flexible concept of use is to provide continuous monitoring of wound infections either directly on the injury (on skin, on bandage,..etc.) or within proximity of injury (within uniform, hyperthermia bag, etc.) The aim of this SBIR is to develop a technology with commercial viability that addresses infection detection, but not limited to, sensors, detectors, or emissions (i.e. small molecule-based, photonics, isotopes, chemical reactivity, monoclonal antibodies, and/or bacteriophage) for the purpose of early detection of wound infections. This request will not accept wound dressings in any form.

The technology is not limited to but should consider, the factors below:

1. The technology must include a plan for FDA or equivalent device clearance

2. Detection and monitoring of infection via built-in electrical sensors, VOC sniffers, chemicaldetector, photonics …etc. must be light weight with minimal user training
3. Ease of use technology (simple readout with minimal interpretation) should be operable withlittle training or background with unambiguous primary output (readout may include LED, LCD,colorimetric, digital, or other uncomplicated readout to include wirelessly communicating todevices and telemedicine tools)
4. Contactless and physically applied devices will both be considered provided either approach isdeemed viable and practical (for instance solutions that need skin contact should considersterility of product prior to application and consider packaging requirement)
5. Technology should have the ability at minimum to distinguish between Gram+ and Gram- bacteria as well as fungi as agents of infection
6. Proposal should describe and discuss a miniaturization, ruggedization, re-usability (if any)plan to include minimal logistical support
7. Modular designs with an ability to be incorporated to already existing sets and kits (IFAK,Medic rucksack, CLS components…etc.) are preferred.
8. Designs must have a manual fail-safe backup option if motorized or automated designs areused as an active component
9. Technology should be capable of at least 72 hours of continuous usage without recharge,replacement, or exchange
10. Dimensions should not exceed that of a credit card with less than a 0.25 inch thickness
11. Ease of applications, ability to withstand water, high positive and negative pressures, hot andcold temperatures and minimal storage conditions will be factored in the nomination process
12. Engineering solutions overall should require minimum logistical support and should becompatible with applications in extreme environments including hot and cold temperature)

PHASE I: Given the short duration of Phase I and the high order of technology integration required, Phase I should focus on system design and development of proof-of-concept prototypes that address the detection requirement. Proposals may include early versions detections systems that may combine “classes” of applications into different “sets” of designs. At the end of this phase, fabricated prototypes should demonstrate feasibility, proof-of-concept and establish reasonable qualitative infection signal detection, using relevant testing platforms for the proposed technology. This phase should down-select promising design as well as identify a pre-clinical animal model for use in Phase II. Evaluation of the product’s durability for detecting infection with several select organisms and should include data for the first 6, 24, 48, and 72 hours at a minimum, if not longer. The above time points do not represent system application on subjects but used as a bench mark and quantify efficacy of detection of infection in the wound bed. Parameters used for measurements, such as targets, as well as quantification limits should be adequately described.

PHASE II: During this phase, the lead integrated system should be further refined from proof-of-concept into a viable prototype. Further optimization of the technology for earlier and more robust detection of infection at traumatized wound bed should demonstrated during this phase. Qualitative and quantitative outcomes of product with regards to quantification of CFU/ml, identification of invading organism, and/or characteristics of invading organisms such as gram stain, catalase reactivity, antibiotic resistance…etc in a diverse inoculum, preferably ESKAPEE pathogens and combat relevant fungi . This testing should be controlled and rigorous conditions. Product miniaturization should achieve desirable dimensions and weight. Testing and evaluation of the fieldable prototype shall demonstrate operational effectiveness in simulated environments. Price estimate and comparison analysis for new design relative current fielded equipment and treatment shall be provided to forecast the potential cost of product and commercial viability. The offeror shall articulate the regulatory strategy and provide a clear plan on how FDA clearance will be obtained. Offeror may also consider a pre-pre-submission communication with the FDA as an early communication for guidance.

PHASE III DUAL USE APPLICATIONS: The ultimate goal of this phase is to secure FDA submission by developing partnerships to demonstrate and commercialize a technology enabling the detection of infection in prolonged care situations such as post-surgery wound monitoring in elder care situations with the proper regulatory clearance or authorization for human or Department of Defense use exemption. The global market for elder care services is worth over 900 billion dollars and is expected to grow significantly in the future. Appropriate partnerships to advance the technology above is encouraged. Alternatively, further development, testing and evaluation of monitoring or diagnostic product developed by phase II of this SBIR can be supported by CDMRP, JWMRP, and other DOD opportunities. Accompanying application instructions, simplified procedures, and training materials should be drafted in a multimedia format for use and integration of the product into market. Once developed and demonstrated, the technology can be used both commercially in civilian or military settings to save lives. The selected contractor shall make this product available to potential military and civilian users.

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KEYWORDS: infection detection, wearable, sensors, diagnosis, monitoring, trauma, prolonged care

Defense Logistics Agency (DLA)
22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Logistics Agency's (DLA) mission has three lines of effort the DLA Small Business Innovation Program (SBIP) supports. They include supporting the **NUCLEAR ENTERPRISE** by maintaining nuclear systems readiness, qualifying alternate sources of supply, improving the quality of consumable parts, and increasing materiel availability. **FORCE READINESS & LETHALITY** through Improvements to life cycle performance through technological advancement, innovation, and reengineering, mitigate single points-of-failure that threaten the readiness of weapons systems used by our Warfighters. **SUPPLY CHAIN INNOVATION & ASSURANCE** through improved lead times, reduced lifecycle costs, maintaining a secure and resilient supply chain, providing opportunities for the small business industrial base to enhance supply chain operations with technological innovations. Lastly supply chain assurance securing the microelectronics supply chain, development of a domestic supply chain for rare earth elements, the adoptions of industrial base best practices associated with counterfeit risk reduction.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DLA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the DLA Program and these proposal preparation instructions should be directed to:

Defense Logistics Agency
Small Business Innovation Program (SBIP) Office DLA/J68
Email: DLASBIR2@DLA.mil

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

DLA's objective for the Phase I effort is to determine the merit and technical feasibility of the concept. The technical volume is not to exceed twenty pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages submitted beyond the 20-page limit within the Technical Volume (Volume 2) will not be evaluated. If including a letter(s) of support, they should be included in Volume 5, and they will not count towards the 20-page Volume limit. Any technical data/information that should be in the Volume 2 but is contained in other Volumes will not be considered.

Content of the Technical Volume

Refer to the instructions provided in the DoD Program BAA.

Cost Volume (Volume 3)

A list of topics currently eligible for proposal submission is included in these instructions, followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. Refer to the topic for cost and duration structure. Proposers must utilize the excel cost volume provided during proposal submission on DSIP.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required The Company Commercialization Report (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. SBIR and STTR awardees are required by SBA to update and maintain their organization's CCR on SBIR.gov. Commercialization information is required upon completion of the last deliverable under the funding agreement. Thereafter, SBIR and STTR awardees are requested to voluntarily update the information in the database annually for a minimum period of 5 years.

If the proposing firm has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, regardless of whether the project has any commercialization to date, a PDF of the CCR must be downloaded from SBIR.gov and uploaded to the Firm Forms section of DSIP by the Firm Admin. Firm Forms are completed by the DSIP Firm Admin and are applied across all proposals the firm submits. The DSIP CCR requirement is fulfilled by completing the following:

1. Log into the firm account at https://www.sbir.gov/.
2. Navigate to My Dashboard > My Documents to view or print the information currently contained in the Company Registry Commercialization Report.
3. Create or update the commercialization record, from the company dashboard, by scrolling to the "My Commercialization" section, and clicking the create/update Commercialization tab under "Current Report Version". Please refer to the "Instructions" and "Guide" documents contained in this section of the Dashboard for more detail on completing and updating the CCR. **Ensure the report is certified and submitted.**
4. Click the "Company Commercialization Report" PDF under the My Documents section of the dashboard to download a PDF of the CCR.
5. Upload the PDF of the CCR (downloaded from SBIR.gov in previous step) to the Company Commercialization Report in the Firm Forms section of DSIP. This upload action must be completed by the Firm Admin.

This version of the CCR, uploaded to DSIP from SBIR.gov, is inserted into all proposal submissions as Volume 4. More detailed Instructions are contained the DoD BAA Section 5.3. Phase I proposal Instructions section e. Volume 4.

Supporting Documents (Volume 5)

- Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (required),
- Foreign Ownership or Control Disclosure (Proposers must review Attachment 2 in the DoD SBIR BAA: Foreign Ownership or Control Disclosure to determine applicability),
- Additional Cost information (optional),
- Letters of Support (optional),
- Any other supporting documents (optional),
- A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with DLA, articulating their pull for the technology (i.e., what DLA need(s) the technology supports and why it is important to fund it), and

possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program.
    - Letters of support shall not be contingent upon award of a subcontract.

The standard formal deliverables for a Phase I are the:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking.
- Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing).
- Monthly Status Report. A format will be provided at the PAC.
- The TPOC and PM will determine a meeting schedule at the PAC. Phase I awardees can expect Monthly (or more frequent) Project Reviews.
- Draft Final Report including major accomplishments, business case analysis, commercialization strategy, transition plan with timeline, and proposed path forward for Phase II.
- Final Report including major accomplishments, business case analysis, commercialization strategy and transition plan with timeline, and proposed path forward for Phase II.
- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, high resolution photos or graphics intended for public viewing)
- Applicable Patent documentation
- Other Deliverables as defined in the Phase I Proposal
- Phase II Proposal is optional at the Phase I Awardee's discretion (as Applicable)

DIRECT TO PHASE II PROPOSAL GUIDELINES
15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY allows the Department of Defense to make an award to a Small Business Concern (SBC) under Phase II of the SBIR Program with respect to a project, without regard to whether the small business concern received an award under Phase I of an SBIR Program with respect to such project.

DLA is conducting a "Direct to Phase II" (DP2) implementation of this authority for this SBIR Announcement for topic DLA222-D03 ONLY. This pilot does not guarantee DLA will offer any future Direct to Phase II opportunities.

PROJECT DURATION and COST:

Direct to PHASE II: Phase II – Not to exceed a duration of 24 months and cost of $1,000,000

PERIOD OF PERFORMANCE: The Direct to Phase II period of performance is not to exceed 24 months total.

Direct to Phase II proposals must follow the steps outlined in the following:

1. Offerors must provide documentation that satisfies the Phase I feasibility requirement*.
    - This documentation will comprise the first twenty pages of Volume 2 (Technical Volume) of the Direct to Phase II proposal
2. Offerors must submit a complete Phase II proposal using the DLA Phase II proposal instructions below.

* NOTE: Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility. DLA will not evaluate any Phase II proposal if it determines that the offeror has failed to demonstrate the establishment of technical merit and feasibility.
Proposals must be submitted electronically at https://www.dodsbirsttr.mil/submissions/login.

Complete proposals must include all of the following:

a. Volume 1: DoD Proposal Cover Sheet, Produced in the DSIP System by your company profile.
b. Volume 2: Technical proposal
    Part 1: Phase I Justification (20 Pages Maximum)
    Part 2: Phase II Technical Proposal (40 Pages Maximum)
c. Volume 3: Cost Volume (Excel spreadsheet upload)
d. Volume 4: Company Commercialization Report (Not Required for this BAA)
e. Volume 5: Additional Documents (Optional)
f. Volume 6 FWA Training Certificate is required for proposal submission

Phase II proposals require a comprehensive, detailed submission of the proposed effort. DLA SBIR Direct to Phase II periods of performance are 24 months. Commercial and military potential of the technology under development is extremely important. Successful proposals will emphasize applicability to specific DOD programs of record as well as dual- use applications and commercial exploitation of resulting technologies,

DIRECT TO PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

A. Cover Sheet. This is completed using the DSIP Portal on the Submission Site. This is a compilation of company data as well as specific information regarding the proposed project. Include a brief description of the problem or opportunity, objectives, effort, and anticipated results. Summarize the expected benefits, as well as any government or private sector applications of the proposed research. OSD and SBA will post the Project Summary of selected proposals with unlimited distribution. Therefore, the summary should not contain any classified or proprietary information.

B. Technical Volume (60 pages maximum)

- Phase I Justification (20 Pages Maximum). Offerors are required to provide information demonstrating the establishment of the scientific and technical merit and feasibility.

- Phase II Technical Objectives and Approach (40 Pages Maximum). List the specific technical objectives of the Phase II research and describe the planned technical approaches used to meet these objectives.

- Phase II Work Plan**.** Provide an explicit, detailed description of the Phase II approach. The plan should indicate how and where the firm will conduct the work, a schedule of major events, and the final product to be developed. The Phase II effort should attempt to accomplish the technical feasibility demonstrated in the justification, including potential commercialization results. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process.

- Related Work. Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers must demonstrate an awareness of the state- of-the-art in the technology and associated science.

- Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for a Phase III research or research and development effort.

- Technology Transition and Commercialization Strategy**.** Describe your company's strategy for converting the proposed SBIR research, resulting from your proposed Phase II contract, into a product or non-R&D service with widespread commercial use -- including private sector and/or military markets. Note that the commercialization strategy is separate from the Commercialization Report described in Section 4.L below. The strategy addresses how you propose to commercialize this research, while the Company Commercialization Report covers what you have done to commercialize the results of past Phase II awards. Historically, a well- conceived commercialization strategy is an excellent indicator of ultimate Phase III success. The commercialization strategy must address the following questions:

- What DoD Program and/or private sector requirement does the technology propose to support?
- What customer base will the technology support, and what is the estimated market size?
- What is the estimated cost and timeline to bring the technology to market to include projected funding amount and associated sources?
- What marketing strategy, activities, timeline, and resources will be used to enhance commercialization efforts??
- Who are your competitors, and describe the value proposition and competitive advantage over the competition?

• Key Personnel. Identify key personnel, including the Principal Investigator, who will be involved in the Phase II effort. List directly related education and experience and relevant publications (if any) of key personnel. Include a concise resume of the Principal Investigator(s).

• Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Justify the purchase of any items or equipment (as detailed in the cost proposal) including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during Phase II contract negotiations. State whether or not the proposed work facilities will be performed meet environmental laws and regulations of federal, state (name) and local governments. This includes, but is not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal, and handling and storage of toxic and hazardous materials.

• Consultants**.** Involvement of university, academic institution, or other consultants in the project may be appropriate. If the firm intends to involve these type of consultants, describe these costs in detail in the Cost Volume.

C. Cost Volume. Download, complete, and upload the spreadsheet, located in the Volume 3 section of the proposal submission in DSIP. Some items in the cost volume template may not apply to the proposed project. Provide enough information to allow the DLA evaluators to assess the proposer's plans to use the requested funds if DLA were to award the contract.

- List all key personnel by name as well as number of hours dedicated to the project as direct labor.
- Special Tooling, Test Equipment, and Materials Costs:
- Special tooling, test equipment, and materials costs may be included under Phase II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed; and
- The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate it directly to the specific effort.
- Cost for travel funds must be justified and related to the needs of the project.

D. **Company Commercialization Report (CCR).** Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DLA during proposal evaluations.

METHOD OF SELECTION AND EVALUATION CRITERIA

Evaluation Criteria. DLA will review all proposals for overall merit based on the evaluation criteria published in the DoD SBIR Program BAA.

CONTRACTUAL CONSIDERATIONS

A. Awards. The number of Direct to Phase II awards will depend upon the quality the Phase II proposals and the availability of funds. Each Phase II proposal selected for award under a negotiated contract requires a signature by both parties before work begins. DLA awards Phase II contracts to Small Businesses based on results of the agency priorities, scientific, technical, and commercial merit of the Phase II proposal.

B. Reports**.** For incrementally funded Direct to Phase II projects an interim, midterm written report maybe required (at the discretion of the awarding agency).

C. Payment Schedule. DLA Phase II Awards are Firm Fixed Price / Level of Effort contracts. Base monthly invoices on the labor hours recorded **PLUS** the monthly costs associated with the project.

D. Markings of Proprietary Information. In accordance with DoD SBIR Program BAA, section 5.3. DLA does not accept classified proposals. All Final Reports are marked with CUI // SBIZ// FEDONLY, and the Initial Project Summary as well as the Final Project Summary should reference compliance with FOR PUBLIC RELEASE.

E. Copyrights, Patents and Technical Data Rights. DLA handles all Copyrights, Patents, and Technical Data Rights in accordance with the guidelines in the DoD SBIR Program BAA.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DLA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program) for Phase I or Phase II. Contractors should not submit proposals that include Technical and Business Assistance.

PHASE II PROPOSAL GUIDELINES

Per SBA SBIR Phase II Proposal guidance, **all** Phase I awardees are permitted to submit a Phase II proposal for evaluation and potential award selection, without formal invitation. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the DLA SBIP PMO on/around the midway point of the Phase I period of performance. Only firms who receive a Phase I award may submit a Phase II proposal.

DLA will evaluate and select Phase II proposals using the same criteria as Phase I evaluation. Funding decisions are based upon the results of work performed under a Phase I award, the Scientific & Technical Merit, Feasibility, and Commercial Potential of the Phase II proposal; Phase I final reports may be reviewed as part of the Phase II evaluation process. The Phase II proposal should include a concise summary of the Phase I effort including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I effort, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology.

Due to limited funding, DLA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Phase II Proposals should anticipate a combination of any or all the following deliverables:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking
- Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing)
- Monthly Status Report. A format will be provided at the PAC.
- Meeting schedule to be determined by the Technical Point of Contact (TPOC) and PM at the PAC
- Phase II awardees expect Monthly (minimum) Project Reviews (format provided at the PAC)
- Draft Final Report including major accomplishments, commercialization strategy and transition plan and timeline.
- Final Report including major accomplishments, commercialization strategy, transition plan, and timeline.
- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, non-proprietary high-resolution photos, or graphics intended for public viewing)
- Applicable Patent documentation.
- Other Deliverables as defined in the Phase II Proposal.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. DLA will evaluate and select Phase I and Phase II proposals using scientific review criteria based upon technical merit and other criteria as discussed in this Announcement document.

- DLA reserves the right to award none, one, or more than one contract under any topic.
- DLA is not responsible for any money expended by the offeror before award of any contract.
- Due to limited funding, DLA reserves the right to limit awards under any topic
- Only proposals considered to be “Highly Acceptable” as determined by DLA will be funded.

Phase I proposals will be evaluated based on the criteria outlined below, including potential benefit to the DLA. Selections will be based on best value to the Government considering the following factors which are listed in descending order of importance:

a) The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.

b) The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

c) The potential for commercial (Government or private sector) application and the benefits expected to accrue from its commercialization.

Please note that potential benefit to the DLA will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions only on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be listed in the proposal and will count toward the applicable page limit.

The final selection for proposals on topics identified for Collider Day will require an oral presentation. This may include an in-person meeting or a Zoom.gov meeting. **(Topics DLA222-004, 005,006 and 007)**

The two-part evaluation process is explained below:

Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in the DoD SBIR BAA. Once the initial evaluations are complete, all Offerors will be notified as to whether they were selected to present the slide deck portion of their proposal within 60 days of the BAA close date. Only proposals receiving a "Highly Acceptable" rating will receive an invitation to present orally.

Part II: If selected for an oral presentation, Offerors shall submit a slide deck not to exceed 15 PowerPoint slides to DLASBIR@dla.mil.

- There are no set format requirements other than the 15-page maximum page length.
- It is recommended (but not required) that more detailed information is included in the technical volume and higher-level information is included in the slide deck.

Selected Offerors will receive an invitation to present a slide deck (15-minute presentation time / 15-minute question and answer) in a technical question and answer forum to the DLA evaluation team via electronic media. This presentation will be evaluated by a panel against the criteria listed above and your overall presentation. DLA will evaluate the presentation for Business Acumen, and Core Business Capabilities (Customer Engagement / Presentation Skills). The rating of the presentation will be a Go/No-Go rating

Notification of the Go/No-Go rating decision will occur within 5 days of the presentation. Input on technical aspects of the proposals may be solicited by DLA from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements.

Non-Government personnel will not establish final assessments of risk, rate, or rank Offeror's proposals. Further, these advisors are expressly prohibited from competing for DLA SBIR awards.

All administrative support contractors, consultants, and advisors having access to any proprietary data will certify that they will not disclose any information pertaining to this announcement, including any submission, the identity of any submitters, or any other information relative to this announcement; and shall certify that they have no financial interest in any submission. Submissions and information received in response to this announcement constitutes the Offeror's permission to disclose that information to administrative support contractors and non-Government consultants and advisors.

The SBIP PMO will distribute selection and non-selection email notices to all firms who submit a SBIR/STTR proposal to DLA. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. DLA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission. DLA will distribute the selection and non-selection notifications to all offerors within 90 days of the BAA close date.

DLA will provide written feedback to unsuccessful offerors regarding their proposals on the non-selection notification. Only firms that receive a non-selection notification are eligible for written feedback.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: DCSO Small Business Innovation Program SBIP.DCSO@dla.mil. This is the DLA Contracting Team workflow email address.

AWARD AND CONTRACT INFORMATION

Typically, the contract period of performance for Phase I should be up to twelve (12) months and the award should not exceed $100,000. However, each topic may have a different threshold. The DLA Contracting Office utilizes a Firm Fixed Price (FFP) Contract for DLA Phase I Projects

The expected budget for Phase II should not exceed $1M unless approved by the DLA Program Manager, and the duration should not exceed 24 Months. Proposals in excess of $1M will not be considered without written PM approval. The DLA Contracting Office utilizes a Firm Fixed Price Level of Effort (FFP/LOE) Contract for DLA Phase II Projects.

Proposals not conforming to the terms of this Announcement will not be considered. DLA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DLA will be funded.

DLA reserves the right to withdraw from negotiations at any time prior to contract award.

Post Award, DLA may terminate any award at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD Announcement and DLA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about/about-sbir#sbir-policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

Use of Support Contractors in the Evaluation Process
Only Government personnel with active non-disclosure agreements will evaluate proposals.

Non-Government technical consultants (consultants) to the Government may review and provide support in proposal evaluations during source selection.

Consultants may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. Consultants will not establish final assessments of risk and will not rate or rank offerors’ proposals. They are also expressly prohibited from competing for DLA SBIR awards in the SBIR topics they review and/or on which they provide comments to the Government.

All consultants are required to comply with procurement integrity laws. Consultants will not have access to proposals or pages of proposals that are properly labeled by the offerors as "FEDONLY." Pursuant to FAR 9.505-4, DLA contracts with these organizations include a clause which requires them to

(1) Protect the offerors’ information from unauthorized use or disclosure for as long as it remains proprietary and

(2) Refrain from using the information for any purpose other than that for which it was furnished. In addition, DLA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the DLA SBIP PMO.

Non-Government consultants will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the organizations may require access to proprietary information contained in the offerors' proposals.

USE OF FOREIGN NATIONALS (also known as Foreign Persons), GREEN CARD HOLDERS AND DUAL CITIZENS

If proposing to use foreign nationals (also known as foreign persons), they must be green card holders, and/or dual citizens. (No Student or Temporary Visa holders will be approved). The offeror must identify the personnel they expect to be involved on this project, the type of visa or work permit under which they are performing, country of origin and level of involvement.

You will be asked to provide additional information during negotiations to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens, or green card holders listed will be subject to security review during the contract negotiation process (if selected for award).

DLA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement.

In the event a proposed person and/or firm is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but is not required to disclose the underlying rationale.

V. EXPORT CONTROL RESTRICTIONS

The technology within most DLA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. The offeror must ensure that their firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: https://www.pmddtc.state.gov/ and https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.

Most DLA SBIR topics are subject to ITAR and/or EAR. If the topic write-up indicates that the topic is subject to International Traffic in Arms Regulation (ITAR) and/or Export Administration Regulation (EAR), your company may be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)
Clause H-08 pertaining to the public release of information is incorporated into all DLA SBIR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under DLA SBIR contracts must be submitted to DLA for review and approval prior to its release to the public. This mandatory clause also includes the subcontractor who shall provide their submission through the prime contractor for DLA's review for approval.

FLOW-DOWN OF CLAUSES TO SUBCONTRACTORS
The clauses to which the prime contractor and subcontractors are required to comply include but are not limited to the following clauses:

1) DLA clause H-08 (Public Release of Information),
2) DFARS 252.204-7000 (Disclosure of Information),
3) DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), and
4) DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements). Your proposal submission confirms that any proposed subcontract is in accordance with the clauses cited above and any other clauses identified by DLA in any resulting contract.
5) DFARS Clause 252.223-7999 Ensuring Adequate COVID-19 Safety Protocols for Federal Contractors

OWNERSHIP ELIGIBILITY
Prior to award, DLA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR Program Eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers.

If requested by DLA, the contractor shall provide all necessary documentation for evaluation prior to SBIR award. Failure to submit the requested documentation in a timely manner as indicated by DLA may result in the offeror's ineligibility for further consideration for award.

ADDITIONAL INFORMATION

Classified Proposals
Classified proposals **ARE NOT** accepted under the DLA SBIR Program. The inclusion of classified data in an unclassified proposal is grounds for the Agency to determine the proposal as non-responsive and the proposal not to be evaluated.

Contractors currently working under a classified contract must use the security classification guidance provided under that contract to verify new SBIR proposals are unclassified prior to submission.

Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on DLA SBIR/STTR contracts will require security clearances. If a DLA SBIR/STTR contract develops into or identifies classified work, the offeror must have a facility clearance, appropriate personnel clearances to perform the classified work and coordinate the DD254 with the Contract Officer and the service owning the classified data.

For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency Web site at: https://www.dcsa.mil.

Use of Acronyms
Acronyms should be spelled out the first time they are used within the technical volume (Volume 2), the technical abstract, and the anticipated benefits/potential commercial applications of the research or development sections. This will help avoid confusion when proposals are evaluated by technical reviewers.

Communication
All communication from the DLA SBIR/STTR PMO will originate from the DLASBIR2@DLA.mil email address. Please white list this address in your company's spam filters to ensure timely receipt of communications from our office.

All attachments sent via email require encryption. The firm will have to purchase ECA certificates to send and receive encrypted email if they do not have a CAC or PIV issued. The cost is approximately $100 per year per user. This will be a CMMC requirement for all future contracts.

ORGANIZATIONAL CONFLICTS OF INTEREST (OCI)
The basic OCI rules for Contractors which support development and oversight of SBIR topics are covered in FAR 9.5 as follows (the Offeror is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract.

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All applicable rules under the FAR Section 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any SBIR requirement or topic, please be advised that your company may have an OCI. Your company could be precluded from an award under this BAA if your proposal contains anything directly relating to the development of the requirement or topic. Before submitting your proposal, please examine any potential OCI issues that may exist with your company to include subcontractors and understand that if any exist, your company may be required to submit an acceptable OCI mitigation plan prior to award.

PHASE III GUIDELINES & INSTRUCTIONS

Phase III is any proposal that "Derives From", "Extends" or completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLASBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply. More specific Instructions may be available when a firm submits a Phase III proposal.

DLA 22.2 SBIR Phase I Topic Index

The topics below are scheduled for DLA Collider / Industry Day. If selected, The firm will have to make a 15 minute presentation to a panel who will make the final selection decision.

DLA222-001 TITLE: Engaging the Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

OUSD (R&E) MODERNIZATION PRIORITY: Nuclear; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Ground Sea; Nuclear; Weapons; Materials; Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Expand the Small Business Manufacturer (SBM) base to address the Agency's need to develop qualified sources of supply to improve DLA product availability, provide competition for reduced lead time and cost, as well as address lifecycle performance issues. Through participation in DLA SBIR, SBMs will have an opportunity to collaborate with DLA Weapons System Program Managers (WSPMs) and our customer Engineering Support Activities (ESAs) to develop innovative solutions to DLA's most critical supply chain requirements. In the end, the SBM benefits from the experience by qualifying as a source of supply as well as from the business relationships and experience to further expand their product lines and readiness to fulfill DLA procurement requirements.

DESCRIPTION: Competitive applicants will have reviewed the parts list provided on DLA Small Business Innovation Program (SBIP) website, (Reference 4) as well as the technical data in the cFolders of DLA DiBBs, (Reference 3). Proposals can evolve in one of four ways depending on the availability of technical data and NSNs for reverse engineering as follows. Information on competitive status, RPPOB, and tech data availability will be provided on the DLA SBIP website, (Reference 4).

a. Fully Competitive (AMC/AMSC-1G) NSNs where a full technical data package is available in cFolders. The SBM proposal should reflect timeline, statement of work and costs associated with the manufacturing and qualification of a representative article.

b. Other than (AMC/AMSC-1G) NSNs where a full Technical Data Package (TDP) is available in cFolders. These items may also require a qualification of a Representative Article. The SBM proposal should reflect timeline, statement of work, and costs associated with producing a Source Approval Request (SAR) and (if applicable) qualification of a Representative Article. Contact the TPOC if necessary. The scope and procedures associated with development of a SAR package are provided in Reference 1.

c. Repair Parts Purchase or Borrow (RPPOB) or Surplus may be an option for other than 1G NSNs where partial or no technical data is available in cFolders. NSNs, if available, may be procured or borrowed through this program for the purposes of reverse engineering. The instructions for RPPOB can be found on the websites, Reference 5. The SBM proposal should reflect timeline, statement of work and costs associated with the procuring the part and reverse engineering of the NSN. Depending on complexity, producing both the TDP and SAR package may be included in Phase I.

d. Reverse Engineering (RE) without RPPOB or Surplus available is when the NSN will be provided as Government Furnished Material (GFM) if available from the ESA or one of our Service customers post award. In this case, contact the TPOC to discuss the availability of the NSN prior to starting the proposal. Typically, a competitive SBM will have relevant experience in producing a similar item which will enable them to propose without a representative article. The SBM proposal should reflect timeline, statement of work and costs associated with the reverse engineering of the NSN and depending on complexity producing a TDP and SAR package in Phase I.

Specific parts may require minor deviations in the process dependent on the Engineering Support Activity (ESA) preferences and requirements. Those deviations will be addressed post award.

PROJECT DURATION and COST:
PHASE I: Not to exceed a duration of 12 months and cost of $100,000. The project schedule should plan to complete the TDP and SAR in the first six months.

PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000.

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation and engineering capability and the availability of appropriate requirements. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.

Participating small businesses must have an organic manufacturing capability and a Commercial and Government Entity (CAGE) code and be Joint Certification Program (JCP) certified in order to access technical data if available.

Refer to “link 2” below for further information on JCP certification. Additionally, small businesses will need to create a DLA’s Internet Bid Board System (DIBBS) account to view all data and requirements in C Folders.

Refer to “links 3 and 4” below for further information on DIBBS and C Folders. All available documents and drawings are located in the C Folder location “SBIR222A”. If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE I: The goal of phase I is for the Small Business Manufacturer to qualify as a source of supply for the DLA NSN(s) to improve DLA NSN availability, provide competition for reduced lead time and cost, and address lifecycle performance issues. In this phase, manufacturers will request TDP/SAR approval from the applicable Engineering Support Activity (ESA), as required, for the NSN(s). At the Post Award Conference, the awardee will have the opportunity to collaborate with program, weapon system, and/or engineering experts on the technical execution and statement of work provided in their proposal.

All Phase I Proposals should demonstrate an understanding of the NSN(s) and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the part will be rejected.

PHASE II: The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation, engineering and manufacturing capability and the availability of appropriate requirements and funding. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.
The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, SBM engineering capability and innovation, the technical maturity of the proposed technology, as applicability to the requirement, and availability of funding.

PHASE III DUAL USE APPLICATIONS: Technology transition via successful demonstration of a new process technology. This demonstration should show near-term application to one or more Department of Defense systems, subsystems, or components. This demonstration should also verify the potential for enhancement of quality, reliability, performance, fuel economy and/or reduction of unit cost or total ownership cost of the proposed subject.

Phase III is any proposal that “Derives From”, “Extends” or “Completes” a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects. There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified but not limited to this BAA.

REFERENCES:

1. DLA Aviation SAR Package instructions. DLA Small Business Resources: http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx
2. JCP Certification: https://public.logisticsinformationservice.dla.mil/PublicHome/jcp
3. Access the web address for DIBBS at https://www.dibbs.bsm.dla.mil, then select the “Tech Data” Tab and Log into c-Folders. This requires an additional password. Filter for solicitation “SBIR213C”
4. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms
5. DLA Aviation Repair Parts Purchase or Borrow (RPPOB) Program: https://www.dla.mil/Aviation/Offers/Services/AviationEngineering/Engineering/ValueEng.aspx

KEYWORDS: Nuclear Enterprise Support (NESO), Source Approval, Reverse Engineering

DLA222-002 TITLE: Innovative Approaches to the Electrification of Aircraft Systems

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: DLA seeks diverse technologies for manufacturing which would lead to the highest level of innovation in the discrete-parts support of fielded weapon systems (many of which were designed in the 1960’s, 1970’s and 1980’s) with a future impact on both commercial technology and government applications. One area of interest includes electrified aviation which covers a wide range of aircraft types and varies in the extent of and approach to electrification. Classes of electrification include more electric, hybrid electric, and fully electric as described in reference 1.

For example, today's wheel braking systems rely almost exclusively on friction brakes to convert an aircraft's kinetic energy at landing into heat energy. Traditional brakes require large investments in high-cost spares to replace worn friction components. They require significant engineering resources to manage heat dissipation to avoid material degradation. Friction brakes require time to cool after landing, which restricts fleet operating tempos. Cooling is needed to avoid brake or refueling fires, to minimize risk of ground crew injuries, and to recover full braking performance prior to next flight. The primary goal of developing this new technology is to regenerate or otherwise harness an aircraft’s generated heat energy for use in operations. Secondary goals include maintaining or improving brake performance as compared to existing brake technology; reducing or eliminating replacement of friction-based consumable braking components, thereby providing DoD significant spare procurement savings; and improve overall thermal performance of the braking system as compared to carbon brakes.

For this topic, Small Business Manufacturers (SBMs) will address the Agency's need to develop new and qualified sources of technology that will improve DLA products for electrified systems in military and commercial aircraft. The technology concept should reduce product lead times and acquisition costs; optimize aircraft fuel economy; minimize environmental pollution and overall footprint; and address lifecycle cost and performance issues associated with conventional aircraft braking technologies. The SBM will benefit from building business relationships in the public and private sectors to further expand product lines and readiness to fulfill DLA procurement requirements. Proposed efforts must be judged to be at a Technology Readiness Level of less than 6 -- system/subsystem model or prototype demonstration in a relevant environment -- but greater than 3 -- analytical and experimental critical function and/or characteristic proof of concept -- to receive funding consideration.

DESCRIPTION: Conduct a Feasibility Study that includes a lifecycle cost analysis comparing the conventional to the novel technological approach. Lifecycle estimates should include labor, materials and equipment savings across all DoD branches and aircraft systems. Savings estimates must include estimates of fuel saving for alternative aircraft taxi methods, including gallons of fuel and tons of carbon emissions avoided and green energy saved. Include an estimate of additional savings due to the use of this technology. This estimate should include a calculation of particulates avoided, a major contributor to air quality non-attainment at airport. Proposals must include and will be judged, in part, on an economic analysis of the expected market impact of the technology proposed, in addition to an environmental impact analysis. This topic seeks a revolution in the reduction of unit cost metrics. Incremental advancements will receive very little consideration. DLA seeks herein only projects that are disruptive in cost savings and environmental impact but are too risky for ordinary capital investment by the private sector

PROJECT DURATION and COST:
PHASE I: Not to exceed a duration of 12 months and cost of $100,000 .
PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: The goal of Phase I is for the SBM to design and quantify through a feasibility study the level of carbon emission avoidance using a novel system for aircraft applications. The Phase I work will include detailed modeling and simulation of the proposed solution; a lifecycle cost analysis for the new technology compared to the conventional; and estimates of savings in consumables, other disposables, and maintenance labor costs. The SBM will develop a plan to demonstrate the technology and prove out its green energy impact at subscale during a Phase II program.

Phase I Milestones:
- Design and quantify through a feasibility study the level of carbon emission avoidance using a novel electrified system for aircraft applications,
- Provide detailed modeling and simulation of the proposed solution,
- Estimate lifecycle cost for the new technology compared to the conventional with estimates of savings in consumables, other disposables, and maintenance labor costs,
- Develop plan to demonstrate the technology and prove out its green energy impact at subscale during a Phase II program,
- Document technology recommendations to be prototyped in Phase II.
- All Phase I Proposals should specify a mature technology capable of achieving the Phase I goals. Proposals that fail to demonstrate that they have a technology prepared to achieve the goals will be rejected.

PHASE II: Develop applicable and feasible prototype demonstrations for the approach described in Phase I and demonstrate a degree of commercial viability and positive environmental impact. Validate the feasibility of the system to perform against the requirements generated in Phase I and evaluate the demonstrated component sizes to fit realistically in an aircraft envelope. Validation would include, but not be limited to, system simulations, operation in testbeds, or operation in a demonstration system. Interface requirements specifically include, but are not limited to, system outputs within the structural capabilities of the airframe, physical envelope requirements, command input signals, electrical power requirements within the aircraft's electrical system capacity. Additionally, the new technology will need to be laboratory qualified to specific airframe requirements for environmental, vibration, and EMI standards. The SBM is responsible for identifying the aircraft and a sponsor for the military or commercial aircraft. From this, qualified prototype hardware would be provided for installation on a military or commercial aircraft for ground/flight testing in a Phase II modification.

Phase II Milestones:
- Develop applicable and feasible prototype demonstrations for the approach described in Phase I and demonstrate a degree of commercial viability and positive environmental impact,
- Validate the feasibility of the system to perform against the requirements generated in Phase I and evaluate the demonstrated component sizes to fit realistically in an aircraft envelope. Validation would include, but not be limited to, system simulations, operation in testbeds, or operation in a demonstration system,

- Develop interface requirements to specifically include, but are not limited to, system outputs within the structural capabilities of the airframe, physical envelope requirements, command input signals, electrical power requirements within the aircraft's electrical system capacity,
- Laboratory qualified to specific airframe requirements for environmental, vibration, and EMI standards,
- Provide qualified prototype hardware for installation on a military or commercial aircraft for ground/flight testing in a Phase II modification,
- Establish transition plan, and commercialization strategy.

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, SBM engineering capability and innovation, the technical maturity of the proposed technology, as applicability to the requirement, and availability of funding.

PHASE III DUAL USE APPLICATIONS: Technology transition via successful demonstration of a new process technology. This demonstration should show near-term application to one or more Department of Defense systems, subsystems, or components. This demonstration should also verify the potential for enhancement of quality, reliability, performance, fuel economy and/or reduction of unit cost or total ownership cost of the proposed subject.

Phase III is any proposal that "Derives From", "Extends" or "Completes" a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects. There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through transition to a government aircraft program of record and/or private sector aircraft.

REFERENCES:

1. Electrification of Aircraft: Challenges, Barriers, and Potential Impacts, National Renewable Energy Laboratory (NREL) web site: https:///www.nrel.gov/publications/TP-6A20-80220, October 2021.

KEYWORDS: aircraft systems, green technology, environmentally friendly, energy management, green energy, lifecycle cost savings, fuel efficiency, fuel economy, particulate matter reduction, particle pollution reduction

DLA222-D03 TITLE: Engaging Flexible Fuel Bladders Manufacturers for Aircraft Systems

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Air Platform

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: DLA seeks to expand the qualified industrial base for flexible fuel bladder technologies for aircraft systems. As this is a Direct to Phase II, the fuel bladder manufactures must demonstrate that they have been Phase I qualified on one or more military aircraft fuel cells to MIL-DTL-63961. Through participation in DLA SBIR, Small Business Manufacturers (SBMs) will have an opportunity to collaborate with DLA Weapons System Program Managers (WSPMs) and our customer Engineering Support Activities (ESAs) to develop innovative solutions to qualify as an approved source of supply. In the end, the SBM benefits from the experience by qualifying as a source of supply as well as from the business relationships and experience to further expand their product lines and readiness to fulfill DLA procurement requirements.

DESCRIPTION: As a SBIR PHASE I project will not not required, the proposal must demonstrate that the techonology meets or exceeds the minimum requirements of SBIR PHASE I research below:

- Phase I qualification data for one or more military aircraft fuel cells to MIL-DTL-6396,
- Completed design and feasibility to produce fuel cells to include lead time, cost, and projected manufacturing volume per month,
- Historical data on the SBM production of flexible fuel bladders for aircraft,
- Plan to accomplish MIL-DTL-6396 Phase II Qualification.

All Direct to Phase II Proposals should specify a mature technology and manufacturing capable of achieving the Phase II goals. Proposals that fail to demonstrate that they have a technology prepared to achieve the goals will be rejected.

PHASE II: Direct to Phase II – Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: As a SBIR PHASE I project will not not required, the proposal must demonstrate that the techonology meets or exceeds the minimum requirements of SBIR PHASE I research below:

- Phase I qualification data for one or more military aircraft fuel cells to MIL-DTL-6396,
- Completed design and feasibility to produce fuel cells to include lead time, cost, and projected manufacturing volume per month,
- Historical data on the SBM production of flexible fuel bladders for aircraft,
- Plan to accomplish MIL-DTL-6396 Phase II Qualification.

PHASE II: DIRECT PHASE II: Develop prototype demonstrations for the approach described in the Phase II Qualification Plan. Perform test and evaluation against the requirements generated in the Phase II Qualification Plan in accordance with MIL-DTL-6396. Upon successful completion of Phase II qualification, produce Low Rate Production fuel cells.

PHASE III DUAL USE APPLICATIONS: Technology transition via successful demonstration of a new process technology. This demonstration should show near-term application to one or more Department of Defense systems, subsystems, or components. This demonstration should also verify the potential for enhancement of quality, reliability, performance, fuel economy and/or reduction of unit cost or total ownership cost of the proposed subject.

Phase III is any proposal that "Derives From", "Extends" or "Completes" a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects. There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through transition to a government aircraft program of record and/or private sector aircraft.

REFERENCES:

1. MIL-DTL-6396 Tanks, Fuel, Oil, Cooling Fluids, Internal, Removable Non-Self Sealing, Revision F/AM-1, December 2021.

KEYWORDS: aircraft, fuel bladder, non-self sealing, fuel

DLA222-004 TITLE: Sustainable Green Efforts in Support of the Clothing and Textile (C&T) Supply Chain

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Collider Day Topic - Oral Presentation Required. Please see instructions provided under "Evaluation and Selection" section of the Component-specific instructions.

The Defense Logistics Agency (DLA) is seeking a SBIR Phase I Proof of Concept regarding the end-of-life cycle for uniform segment of the C&T supply chain. The proof of concept should identify the risks and opportunities that support sustainability process with a "Greening" focus as a modernization effort. The objective is to define, develop, and deliver an ethical means of disposal that leads to process improvements and determines value added methods to upcycle or recycle goods for all branches of military services.

DESCRIPTION: One of DLA's largest consumables is uniforms. DLA provides uniforms to more than two million active-duty Warfighters, and the Agency's practices represent a major opportunity to support positive climate change. DLA is working to lead the charge in environmental responsibility and is seeking ways to leverage recycling and/or upcycling.

DLA's goal is to transition the linear "cradle to grave" traditional model to a circular "cradle to cradle" green supply chain model. A green supply chain is a complete business model providing a circular flow that would decrease environmental impacts without compromising cost and technical performance.

Collider Day Topic - Oral Presentation Required

PHASE I: Not to exceed a duration of 12 months and cost of $100,000
PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: PHASE I: The successful proposal should include best-practices, as well as innovative, and novel technologies to extend the useful life of textiles and reduce environmental impacts. Demonstrate the feasibility of green methods of disposal that support sustainability. This Phase of the project should be

1. Define the Modernization Effort
2. Demonstration of Recycling/Upcycling as methods for disposal are key to this concept.
3. Develop a plan for Military and Commercial transition
4. At the completion of this Phase I project, the Technology Readiness Level (TRL) should be TRL 2-3.

PHASE II: PHASE II: Develop a prototype for the process(es) proven in Phase I that demonstrate green methods to support sustainability in a DLA environment.

1. Refine the Transition Plan. Identify Military and Commercial partners and customers
2. At the completion of this Phase II project, the Technology Readiness Level (TRL) should be TRL 3-6.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in a functional product that could transition into other areas.

COMMERCIALIZATION: The partners identified in the Phase II transition plan should be aware of as well as involved in the project and have a plan to incorporate the project into their program of record, or commercial portfolio.

REFERENCES:

1. Source: https://www.dla.mil/TroopSupport/ClothingandTextiles.aspx
2. Source: https://dwp.dmdc.osd.mil/dwp/app/dod-data-reports/workforce-reports

KEYWORDS: Supply chain; greening; sustainability; upcycling, recycling

DLA222-005 TITLE: Production of Energic Materials and Associated Precursors

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Collider Day Topic - Oral Presentation Required. Please see instructions provided under "Evaluation and Selection" section of the Component-specific instructions.

The Defense Logistics Agency (DLA) in an effort to reduce costly foreign reliance and/or single points of failure is looking for domestic manufacturing of energetic materials and energetic precursors. Due to the high level of performance required for Department of Defense's (DOD) applications material must comply with the Mil-Spec. The end goal of the project would be for the development of a domestic source that could produce these energetic materials at industrial quantities with a preference for the possibility of producing multiple materials with the same capital equipment.
Research and Development efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology Readiness Level (TRL) 6 or less, but greater than TRL 3 to receive funding consideration.

TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: Description: The DOD has a need for robust energetic supply chains to support operational requirements. To this end the DLA is looking for domestic production of energetic materials and precursors for these materials including but not exclusive to the following materials: Lead Nitrate, Potassium Nitrate, Strontium Nitrate, TNT, Hexamine, and Black Powder. These materials must meet their respective Mil-Spec. A desire for the process to use friendly sources of feed materials is preferred but not required. Additionally, if the proposal would be able to produce multiple materials with the same capital equipment that proposal will be shown preference. The ideal production process will be both modular and easily scalable.

PHASE I: Not to exceed a duration of 6 months and cost of $100,000 .
PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: The phase I will consist of producing a minimum of three lots. Each of which must be tested in accordance with the relevant Mil-Spec. The expectation is that by the end of phase I material will be able to meet the Mil-Spec. Additionally an outline for scaling up the production to pilot/low-rate production levels including material sourcing must be completed. A preliminary economic review must be carried out evaluating the cost vs. currently available products as well as determining the cost of production when using North American precursors to the greatest extent practical.

PHASE II: The Phase II will consist of making a pilot/ low-rate production plant that will produce 5 batches of material that DLA can provide to end users to initiate DoD qualification efforts. Two sources of raw materials should be identified and tested in this process for each major precursor. Pricing and cost information will need to be validated. A business case will need to be generated using both DoD and commercial markets.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in a functional product that could transition into other areas.

COMMERCIALIZATION: The partners identified in the Phase II transition plan should be aware of as well as involved in the project and have a plan to incorporate the project into their program of record, or commercial portfolio.

REFERENCES:

1. https://sam.gov/opp/1f752bef48ab4f34b063e36ea89b7cd2/view

KEYWORDS: Energic Materials, Lead Nitrate, Potassium Nitrate, Strontium Nitrate, TNT, Hexamine, and Black Powder

DLA222-006 TITLE: Verifying Domestic Sourced or Manufactured Coal Tar Pitch Can Meet Military Requirements

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

Collider Day Topic - Oral Presentation Required. Please see instructions provided under “Evaluation and Selection” section of the Component-specific instructions.

The Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies consistently to our customers. DLA continually investigates diverse technologies for manufacturing which would lead to the highest level of innovation in the discrete-parts support of fielded weapon systems (many of which were designed in the 1960’s, 1970’s and 1980’s) with a future impact on both commercial technology and government applications. As such, advanced technology demonstrations for affordability and advanced industrial practices to demonstrate the combination of improved discrete-parts manufacturing and improved business methods are of interest. All these areas of manufacturing technologies provide potential avenues toward achieving breakthrough advances. Proposed efforts funded under this topic may encompass any specific discrete-parts or materials manufacturing or processing technology at any level resulting in a unit cost reduction.

Research and Development efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology Readiness Level (TRL) 6 or less, but greater than TRL 3 to receive funding consideration.

TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: DLA R&D is looking for a domestic capability to address the lacking viable domestic source of defense grade coal tar pitch solid. Coal tar pitch is a pre-cursor material for a variety of military applications, including tactical munitions, strategic rockets and missiles, and large, advance-launch systems, and hypersonic veichles. The United States has been dependent on foreign sources or a single domestic source of coal tar pitch. Verifying a domestic manufacturing production process for coal tar pitch meets military reuqirements would elimate the costly foreign alliance for this material.
R&D tasks include qualifying domestically manufactured or sourced coal tar pitch meets militrary requirements, and qualify the material on military applictions.

PROJECT DURATION and COST:
PHASE I: Not to exceed a duration of 12 months and cost of $250,000
PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: Validate that domestically sourced coal tar pitch pre-cursor materials for the coal tar pitch material can be utilized. Validation would include, but not be limited to, prototype quantities, data analysis, and labortaory tests. Validate the prouction process can manufature coal tar pitch can meet property specifications of previously used coal tar pitch for military applications. Validation would include, but not be limited to, prototype quantities, data analysis, and labortaory tests. Qualify the coal tar pitch material on military applications.

PHASE II: The Phase II will consist of making a pilot/ low-rate production plant that will produce 5 batches of material that DLA can provide to end users to initiate DoD qualification efforts. Two sources of raw materials should be identified and tested in this process for each major precursor. Pricing and cost information will need to be validated. A business case will need to be generated using both DoD and commercial markets.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in a functional product that could transition into other areas.

COMMERCIALIZATION: The partners identified in the Phase II transition plan should be aware of as well as involved in the project and have a plan to incorporate the project into their program of record, or commercial portfolio.

REFERENCES:

1. https://apps.dtic.mil/sti/pdfs/ADA542014.pdf

KEYWORDS: Coal tar pitch

DLA222-007 TITLE: Increasing Innovation in High Temperature Resistant Thermal Protection Materials, Manufacturing, and Resilient Supply Chains for Hypersonics and Related Applications

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

Collider Day Topic - Oral Presentation Required. Please see instructions provided under "Evaluation and Selection" section of the Component-specific instructions.

High temperature resistant Thermal Protection System (TPS) materials are critical to the success of new hypersonic weapons and related U.S. defense modernization priorities. Key to their success is increased domestic production capacity, affordability, and supply chain resiliency. The Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies of related materials consistently to our customers. DLA continually investigates diverse technologies for new or improved materials, more efficient means of their production, and more competitive domestic supply chains which would lead to the higher levels of innovation in current and future weapon systems combined with benefits to other commercial and government technology applications. As such, advanced technology demonstrations for increasing production capacity, affordability and supply chain resiliency for high temperature resistant TPS and related materials and processing are of high interest. These areas of materials and manufacturing technologies provide potential opportunities toward achieving breakthrough advances for national defense. Proposed efforts funded under this topic may encompass diverse TPS materials and processing at any level that will result in increasing production capacity, affordablity, and supply chain resiliency. Research and Development (R&D) efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology and/or Manufacturing Readiness Level (TRL/MRL) 6 or less, but greater than TRL/MRL 3 to receive funding consideration.

TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: DLA R&D is looking for domestic capabilities and capacity that demonstrates new or improved high temperature resistant materials, processing, and supply chains that increase domestic defense industrial base production capacity, affordability, and supply chain resiliency for hypersonic systems and other defense programs that depend on similar materials (e.g., other conventional weapons, strategic programs, and space systems).

R&D tasks include identifying, developing, and demonstrating new and/or improved high temperature resistant materials and production processes that support this topic area's objectivites for increasing production capacity, affordablity, and supply chain resilieancy. Related areas of interest include materials processing and composites manufacturing of TPS components and structures as well as their various consitutent materials and processes (e.g., fiber reinforcements and their precursors, woven textiles and preforms, matrix precursors and prepreg, rapid densificiation, heat treating, additive manufacturing, production automation of weaving and prepreg application, and oxidation resistant coatings).

PROJECT DURATION and COST:
PHASE I: Not to exceed a duration of 6 months and cost of $100,000
PHASE II: Not to exceed a duration of 24 months and cost of $1,000,000

PHASE I: Determine, insofar as possible, the scientific, technical, and commercial feasibility of the concept. Include a plan to demonstrate the innovative materials process and/or discrete-parts manufacturing and address implementation approaches for near term insertion into the manufacturing of Department of Defense (DoD) systems, subsystems, components, parts, or related material supply chains.

PHASE II: Develop applicable and feasible process demonstration for the approach described, and demonstrate a degree of commercial viability. Validate the feasibility of the innovative process by demonstrating its use in the production, testing, and integration of items, and/or materials and processes, for DLA and key DoD stakeholders. Validation would include, but is not be limited to, prototype quantities, data analysis, laboratory tests, system simulations, operation in test-beds, or operation in a demonstration system. A partnership with a current or potential supplier to DoD, OEM, or other suitable partner is highly desirable. Identify commercial benefit or application opportunities of the innovation. Innovative processes should be developed with the intent to readily transition to production in support of DoD and its supply chains.

PHASE III DUAL USE APPLICATIONS: Technology transition via successful demonstration of a new process technology. This demonstration should show near-term application to one or more DoD systems, subsystems, components, or their related material supply chains. This demonstration should also verify the potential for enhancement of increased producton capacity, affordablity, and supply chain resilancy (e.g., single point of failure supply, obsolesence, foreign reliance, long-lead times, and low manufacturing yields).

Private Sector Commercial Potential: Materials and manufacturing improvements, including development of domestic manufacturing capabilities, increased capacity, and affordability, have a direct applicability to diverse defense system technologies. Material manufacturing technologies, processes, and systems have wide applicability to the defense industry including air, ground, sea, space, and related defense technologies. Competitive material manufacturing improvements should have leverage into private sector industries as well as civilian sector relevance. Advancements in high temperature resistant materials, processing, and supply chain resiliency will benefit the defense industrial base and key weapon systement development, production, and sustainablity, as well as afford spin-off opportunities to civilian and other commercial sectors that depend on associated technogies and their innovatoins.

REFERENCES:

1. Affordable Hypersonic Missiles for Long-Range Precision Strike https://www.jhuapl.edu/content/techdigest/pdf/V20-N03/20-03-White.pdf
2. Increasing Production Is Important for Hypersonics, Defense Official Says: https://www.defense.gov/News/News-Stories/Article/Article/2927403/increasing-production-is-important-for-hypersonics-defense-official-says/

KEYWORDS: High temperature resistant materials (e.g., carbon/carbon, ceramics, metals and alloys); materials and processing (e.g., fiber reinforcement, matrix precursors, woven textiles and preforms, prepreg, rapid densificiation, heat treating, additive manufacturing, automation in weaving and prepreging, and oxidation resistant coatings; and composites fabrication (e.g., assembly, joining, and machining).

VERSION 2

Defense Threat Reduction Agency
SBIR 22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

1.0 INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA SBIR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY22.2 topics solicited for the Defense Threat Reduction Agency (DTRA) Small Business Innovation Research (SBIR) Program is included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

The DTRA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA SBIR Program and these proposal preparation instructions should be submitted to:

Mr. Mark D Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at odsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD announcement and DTRA instructions carefully prior to submitting your proposal as there have been significant updates to the requirements.

The SBIR/STTR Policy Directive is available at:
https://www.sbir.gov/sites/default/files/SBIRSTTR_Policy_Directive_2019.pdf.

VERSION 2

2.0 SMALL BUSINESS ELIGIBILITY REQUIREMENTS

2.1 The Offeror

Each offeror must qualify as a small business at time of award per the Small Business Administration (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Those small businesses selected for award will also be required to submit a Funding Agreement Certification document provided by DTRA Contracts prior to award.

2.2 SBA Company Registry

Per the 2019 SBIR-STTR Policy Directive, all SBIR applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the eleven (11) participating agencies in the program. For more information, please visit the SBA's Firm Registration Page: https://www.sbir.gov/user/login/.

2.3 Use of Foreign Nationals, Green Card Holders and Dual Citizens

See the "Foreign Nationals" section of the DoD SBIR Broad Agency Announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Offers must identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For those individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). DTRA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export-controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale. In the event a firm is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

3.0 PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

VERSION 2

3.1 Technical Volume (Volume 2)

The Phase I technical volume is not to exceed 20 pages in length and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages in the technical volume over the 20 pages will not be considered in the proposal evaluations.

3.2 Content of the Technical Volume

The Technical Volume should cover the following items in the order given below:

(a) Identification and Significance of the Problem or Opportunity.
Define the specific technical problem or opportunity addressed and its importance.

(b) Phase I Technical Objectives.
Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(c) Phase I Statement of Work (including Subcontractors' Efforts)

(1) Provide an explicit, detailed description of the Phase I approach. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

(2) This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained. **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(d) Related Work.
Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

(1) Short description,
(2) Client for which work was performed (including individual to be contacted and phone number), and
(3) Date of completion.

(e) Relationship with Future Research or Research and Development

(1) State the anticipated results of the proposed approach if the project is successful.

(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

(3) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(f) Commercialization Strategy. Describe in approximately one page your company's strategy for commercializing this technology in DoD (such as a formal DoD Program), other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(g) Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(h) Foreign Citizens. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in the BAA. You may be asked to provide additional information (e.g., copy of valid passport, visa, work permit, etc.) during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(i) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(j) **Subcontractors/Consultants.** Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two-thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposer must certify their use of such facilities on the Cover Sheet of the proposal.

(k) **Prior, Current, or Pending Support of Similar Proposals or Awards.** If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information. Refer to the instructions provided in the DoD STTR BAA for this requirement.
Note: If this does not apply, state in the proposal "No prior, current, or pending support for Proposed work"

3.3 Cost Volume (Volume 3)

The Phase I Base amount must not exceed $167,500.00. Proposers must use the online cost volume form in DSIP.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded. Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotiations if selected. Refer to the instruction provided in the DoD SBIR program BAA for additional details on the content of the Cost Volume.

Note: Cost for travel funds must be justified and related to the needs of the project. DTRA does not include any fee on travel costs, so proposal should exclude fee on any travel costs proposed.

For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit- Process-Overview/.

3.4 Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA during proposal evaluations.

3.5 Supporting Documents (Volume 5)

Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

(a) All proposers are REQUIRED to submit the following documents to Volume 5:
    1. Contractor Certification Regarding Provision of Prohibition on Contracting for

Certain Telecommunications and Video Surveillance Services or Equipment (BAA Attachment 1) (REQUIRED)

2. Foreign Ownership or Control Disclosure (BAA Attachment 2) (Proposers must review Attachment 2: Foreign Ownership or Control Disclosure to determine applicability)

(b) Any of the following documents may be included in Volume 5 if applicable to the proposal.

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights

4.0 DIRECT TO PHASE II PROPOSAL GUIDELINES

The Defense Threat Reduction Agency does not participate in the Direct to Phase II Program.

5.0 PHASE II PROPOSAL GUIDELINES

Small business concerns awarded a Phase I contract are permitted to submit a Phase II proposal for evaluation and potential award selection. The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All SBIR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

Phase II Proposal Instructions

Each Phase II proposal must be submitted through the Defense SBIR/STTR Innovation Portal by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. **The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages.** Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see the appropriate section of the BAA Announcement) and Volume 5. The Commercialization Strategy Volume should be more specific than was required for Phase I.

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As indicated in the DoD STTR Program BAA, the CCR is generated by the submission website based on information provided by you through the "Company Commercialization Report" tool.

Commercialization Strategy

See the appropriate section DoD SBIR 22.2 BAA.

Phase II Evaluation Criteria

Phase II proposals will be reviewed for overall merit based upon the criteria specified in this Broad Agency Announcement and will be similar to the Phase I process.

Public Release of Award Information

If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil/submissions/login.

6.0 DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II SBIR award to purchase Discretionary Technical & Business Assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting such concerns as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.

Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.

For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

7.0 EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

7.1 DTRA Evaluation Authority. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

7.2 Notifications. Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "SBIR 22.2 / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

7.3 DTRA Support Contractors

Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc (contract specialist support), Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Kapili Services, LLC and TekSynap (DTRIAC) and Savantage Solutions (Accounting and Financial Systems Support). This list is not all inclusive (e.g., subcontractors) and is subject to change.

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7.4 Protests. Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Service of Protest (Sept 2006)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

8.0 AWARD AND CONTRACT INFORMATION

DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $167,500.00 not withstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24 month period of performance. The award size of a Phase II contract is no more than $1,100,000.00 not withstanding a maximum of $50,000.00 for the entire project.

9.0 ADDITIONAL INFORMATION

9.1 Export Control Restrictions

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**
NOTE: Export control compliance statements found in these proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

9.2 Cyber Security

Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

9.3 Feedback

In an effort to encourage participation in, and improve the overall SBIR award process, offerors may submit feedback on the SBIR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future SBIR BAAs.

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DTRA SBIR 22.2 Phase I Topic Index

DTRA222-001	Application of Machine Learning, Artificial Intelligence, and Data Science techniques to improve NL Data Management and Application Services
DTRA222-002	Geiger–Müller Tube Alternative with Electronics
DTRA222-003	Graphene and helix shaped steel fiber dosed concrete for EMP and Blast Protection
DTRA222-004	Perovskite Radiation Detectors and Imagers
DTRA222-005	Subterranean Wireless Communications for Counter-WMD Missions

VERSION 2

DTRA222-001 TITLE: Application of Machine Learning, Artificial Intelligence, and Data Science techniques to improve NL Data Management and Application Services

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/ Machine Learning; Cybersecurity; Nuclear

TECHNOLOGY AREA(S): Information Systems; Nuclear

OBJECTIVE: To develop proof of concept and demonstrate feasibility for a customized application development platform and database management integrated with intelligent, self-learning cybersecurity control monitoring system prototype. As envisioned, the capability will use industry leading technologies, such as Machine Learning (ML), Artificial Intelligence (AI) and Data Science (DS) capabilities, to recognize normal usage patterns for Nuclear Logistics management and reporting application, then apply data analytics and reporting to identify, report and suspend anomalous activities that may represent a cybersecurity threat or operating environment deviation from normal. NL goal is to develop customized applications and database management system using no-code or low-code application environments and commercial of the shelf database software. While these tools incorporate proven components implementing secure coding best practices, we expect incorporating AI/ML/DS technologies and analytics with the low-code environment will enable developing more intelligent monitoring capabilities directly within the applications. The amount of data inherent within custom Nuclear Logistics applications is relatively small by contemporary standards, but usage data from module and database field access is orders of magnitude greater and significantly more dynamic. Automatically incorporating big data analytics and reporting capabilities into low-code developed applications to warrant Surety and Accountability of the nation's deterrence stockpile. AI/ML/DS capabilities will be integrated into application usage and database access patterns to learn "normal" expected behavior and quickly identify, alert and block anomalous actions.

DESCRIPTION: Nuclear Logistics Technical Division (NLT) is directly responsible for providing application and database services to the DoD customers as part of their mission to maintain the national nuclear stockpile databases. NLT requires next generation systems that will provide the capabilities to securely maintain the integrity of mission essential applications and databases by applying cybersecurity protections through the application AI/ML/DS technologies. To support future requirements and nuclear system modernization, NLT is interested in developing a next generation rapid application development platform and database management prototype integrated with intelligent cybersecurity protection measures. NLT's goal is to prototype and demonstrate an enhanced NL Application development platform and Database Service using AI/ML/DS and low-code generated custom applications to support robust and secure user applications for NL needs. The application development platform will be configured to use COTS no-code or low-code platforms, and deliver the prototype system using innovative which can effective make use of AI/ML/DS techniques for both user application data and system collected usage and access patterns. As the Restricted Data aspects of the NLT information systems necessitate a cryptographically isolated environment, this prototype system will leverage AI/ML/DS capabilities within a relatively closed environment to support enhanced analytics, monitoring and reporting for Nuclear Logistics and enhance nuclear logistics management capabilities and system modernization as the foundation for future applications beyond current capabilities. This proposal allows development teams to become part of a paradigm that introduces an end-user application design that creates a fundamental connection between the user, mission essential tasks, business operations procedures and the software that directly impacts department specific productivity. This innovation also facilitates a custom application design from idea to an operational reality within a few weeks, perhaps even days.

PHASE I: Design a concept for enhancing low-code application development platforms to automatically incorporate capabilities for reviewing all logged system, module and database access events, identifying patterns representing “normal” system usage over a period of time, which will account for monthly, quarterly and annual data entry and reporting activities, as well as ad hoc activities, such as emergency operations exercises. Using this growing collection of event data, the low-code application development platform enhancements will continually monitor the cyber-health of the application environment using AI/ML/DS services and alert system administrators as to anomalous conditions. If possible, the AI/ML/DS services will also be able to identify and alert operational anomalies, such as network, storage or processing issues before actual system failures occur. In addition to identifying concepts and methods for accomplishing these intelligent system monitoring capabilities, analyze additional processing, storage and network loads to support these capabilities. The analysis should include identifying typical cybersecurity monitoring services and controls that may be able to be replaced by the intelligent system monitoring capabilities.

PHASE II: Design, develop, demonstrate and validate a proof of concept technology demonstration for one or more representative modules incorporating the AI/ML/DS services for enhanced intelligent monitoring in parallel with developing the new module(s). Provide a detailed project plan for developing such a capability, and benchmarking against a similar complexity low-code developed module to quantitatively and qualitatively identify specific operational improvements. Conduct formal acceptance testing with user community stakeholders on the module to confirm its correct operation, then monitor the ability to enhanced capability to collect system events, identify normal usage patterns, and alert when repeated anomalous events occur outside the normal range. Once fielded to a select group of operational users, test the system effectiveness for intelligently adapting to changing usage events by introducing specific anomalies. Document the comparison of the representative baseline module against the enhancement intelligent monitoring module, including benefits, weaknesses and opportunities for improvement. Prior to completion of Phase II, perform typical software maintenance and functional enhancements, as would be typical of user reported problem reports and new / improved functionality change requests, and analyze how the intelligent monitoring capabilities respond to a modified software codebase.

PHASE III DUAL USE APPLICATIONS: Working with NL and the low-code application development platform software vendor, jointly develop functional requirements, specifications, high level designs for incorporating the AI/ML/DS techniques, services and capabilities. Document lessons learned from the Phase II proof of concept capability and identify suggested improvements. Identify changes necessary to generalize the AI/ML/DS service enhancements for the COTS low-code application development platform, including approximate estimates of complexity to accomplish. For NL, identify necessary actions to incorporate the intelligent monitoring capabilities into existing low-code based applications. Also identify actions necessary to extend the AI/ML/DS based intelligent monitoring capabilities from being able to alert system administrators regarding anomalous conditions to enhancements necessary for the intelligent cyber monitoring capabilities to proactively take actions to automatically shut down identified threats. It is assumed identified network, storage and system identified anomalies will need to be manually addressed by system administrators at the end of Phase III. If there are opportunities for commercializing corrective actions in response to system failure modes identified, these should be documented and communicated to NL and the COTS low-code application development platform vendor as well.

VERSION 2

REFERENCES:
1. Low Code Development Platform: https://www.helpnetsecurity.com/2022/02/10/low-code-applications
2. https://safe.menlosecurity.com/doc/docview/viewer/docNAC769ABB678Dc422920aa9c3d6eaf2d662394fa07e662eba489423543de314ebba0ff35a05e7
3. AI/ML/DS techniques in application to cyber security: https://www.securityhq.com/blog/debunking-the-myths-how-machine-learning-ml-benefits-cyber-security/
4. Database machine learning: https://www.infoworld.com/article/3607762/8-databases-supporting-in-database-machine-learning.html

KEYWORDS: Machine Learning, Artificial Intelligence, Data Science, Database Management System, Application Development, and low-code application development.

VERSION 2

DTRA222-002 TITLE: Geiger–Müller Tube Alternative with Electronics

OUSD (R&E) MODERNIZATION PRIORITY: Nuclear

TECHNOLOGY AREA(S): Electronics; Materials; Nuclear; Sensors

OBJECTIVE: DTRA seeks to develop and field an alternative to Geiger–Müller tubes to include the accompanying acquisition and analysis electronics that will provide similar or enhanced detection capabilities while also allowing the instrument to operate in a high radiation environment without causing damage to the detector or the electronics.

DESCRIPTION: Geiger–Müller tubes have been an important option for designers of radiation detection instrumentation for the past century primarily due to sensitivity and low costs. Under typical fielding environments, they prove to be rugged while providing long-term acquisition stability when used in the intended radiation fields. However, application of these devices in high radiation fields can lead to their failure due to system deadtime limitations and the degradation of fill gas. This development will conceptualize (Phase I), prototype (Phase II), and commercialize (Phase III) a Geiger–Müller tube alternative that would meet the desired requirements while providing a detector that can withstand prolonged exposure in radiation fields of up to 10,000 cGy/hour. This development must also include the associated electronics which must also be able to operate following the same exposure to high radiation fields without damage.

Requirements for this development are as follows:

- The detector could include, but is not limited to, solid state or scintillator detectors. No photomultiplier tubes are allowed, however, solid state photomultipliers can be employed.
- The sensitivity should not be less than that of Geiger–Müller tubes.
- The electronics must be designed to allow common integration into various systems.
- The detector system and electronics must be designed to allow operation in high radiation environemnts without damage.
- This capability must be general in its application, not designed to fill a limited need.

PHASE I: Development of the design approach to include risk reduction followed by a concept design. This phase should demonstrate the ability of a Phase II prototype to meet the performance goals described in the Description Section. Consideration should be given to literature search, analysis, and modeling to demonstrate to applicability of the proposed capability. Preliminary fabrication can be performed to obtain engineering data for analysis. The phase I deliverable is a final report detailing work performed in Phase I, analysis of the results, the conceptual design, and application to Phase II development.

PHASE II: Phase II projects should develop a prototype device. The prototype should be characterized and tested in a laboratory and/or field environment. The prototype should demonstrate the capabilities as described in the Description Section. The phase II deliverable is a final report and hardware deliverable.

PHASE III DUAL USE APPLICATIONS: Field-deployablity of this development would have commercial applications including operation in high radition fields. Finalize and commercialize this sensor for use by customers (e.g., government, industry). Although additional funding may be provided through DoD sources, the awardee should look to other public or private sector funding sources for assistance with transition and commercialization.

REFERENCES:

1. G.F. Knoll, Radiation Detection and Measurement – 4th edition (Chapter 7), John Wiley & Sons, 2010.
2. C.H. Park, J.H. Moon, B.K. Seo, Development of a scintillating fiber-optic sensor for the radioactive contamination measurement in a narrow area, Radiation Measurements, Volume 46, Issue 8, 2011, Pages 687-693.

KEYWORDS: High Radiation Environment, Radiation Detection, Radiation Damage, Radiation Harden

VERSION 2

DTRA222-003 TITLE: Graphene and helix shaped steel fiber dosed concrete for EMP and Blast Protection

OUSD (R&E) MODERNIZATION PRIORITY: 5G, General Warfighting Requirements (GWR); Nuclear

TECHNOLOGY AREA(S): Electronics; Materials; Nuclear

OBJECTIVE: Develop and demonstrate commercially viable building constructed with light-weight concrete stay-in-place forms and structural poured concrete both dosed with graphene and screw shaped steel microfibers to provide electrically conductive, thermally insulated, ultra-strong, blast, fire and EMP/GMD resistant buildings.

DESCRIPTION: It has been demonstrated that graphene oxide, graphene nano-sheets or carbon-nanotube dosed concrete has improved thermal properties, reduced water absorption, greatly increased strength and electrical conductivity (see references (a) through (e)). The addition of screw shaped steel micro-fibers has also been demonstrated to increase concrete strength (see reference (f)), and steel fibers in conjunction with graphene has higher strength and electrical conductivity (see reference (g)). The electrical conductivity would allow graphene / screw shape steel microfiber dosed concrete to function as a Faraday Cage and provide protection from an EMP induced by an EMP weapon, high altitude nuclear explosion or a geomagnetic disturbance such as a solar flare. Autoclaved Aerated Concrete (AAC) and / or Foam-Crete can be used as stay-in-place forms for construction of concrete facilities; both of their strength increase from use of graphene and / or steel fibers (see references (h) through (l)). Use of AAC or Foam-Crete perform well regarding insulation and fire resistance which would further improve facility performance and survivability. The cost of manufacturing graphene has drastically reduced in the past several years, and it is expected due to recent breakthroughs that the cost will be further reduced (estimated to decrease to 1/200th of the current cost); see references (m) through (n), which makes the application of these materials for these potential applications even more attractive.

PHASE I: Conduct extensive document research to determine state of the art and properties identified from previous experiments and testing regarding graphene oxide concrete, AAC, and Foam-Crete. Identify any knowledge gaps and conduct experiments and testing to fill these gaps (if any). Determine the optimum mix of graphene oxide and / or graphene sheets with screw shaped micro-steel fibers for AAC or Foam-Crete stay-in-place formed Concrete building construction to serve as an EMP/GMD resistant bomb shelter. Demonstrate the material's ability to be welded, or electrically fused with point of entry protections such as EM doors, waveguides, and filters. Provide a written report of the findings.

PHASE II: Based on the knowledge and determination of feasibility obtained in phase I, construct a structure of adequate size using graphene and screw shaped fiber steel dosed AAC or Foam-Crete stay-in-place forms and concrete to test with respect to EMP, flame, and blast resistance using both Non-Destructive, and Destructive Testing.

PHASE III DUAL USE APPLICATIONS: Provision of affordable materials and methods for high strength, fire resistant Insulated Composite Concrete Forms (ICCF) for stay-in-place Concrete construction of High Performance Concrete for Highly survivable facilities to include EMP/GMD protection.

VERSION 2

REFERENCES:

1. Reference (a)https://www.scientific.net/MSF.809-810.485
2. Reference (b)https://ore.exeter.ac.uk/repository/bitstream/handle/10871/32568/GRCmanuscript accepted version.pdf
3. Reference (c)https://journals.sagepub.com/doi/pdf/10.1177/1847980417742304
4. Reference (d)https://www.sciencedirect.com/science/article/abs/pii/S0950061819325589
5. Reference (e)https://www.sciencedirect.com/science/article/pii/S2352710217301079
6. Reference (f)https://www.helixsteel.com/
7. Reference (g)https://www.sciencedirect.com/science/article/pii/S2352710217301079
8. Reference (h) https://www.sciencedirect.com/science/article/pii/S2214785318314718
9. Reference (i)https://www.research.manchester.ac.uk/portal/files/146437328/FULL_TEXT.PDF
10. Reference (j)https://www.researchgate.net/publication/236611170_Physical_and_Mechanical_Characterization_of_Fiber-Reinforced_Aerated_Concrete_FRAC
11. Reference (k)https://res.mdpi.com/d_attachment/materials/materials-13-04323/article_deploy/materials-13-04323-v4.pdf
12. Reference (l)https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.113.9722&rep=rep1&type=pdf
13. Reference (m)https://www.rmit.edu.au/news/all-news/2019/jun/graphene-from-gum-trees
14. Reference (n)https://www.forbes.com/sites/scottsnowden/2020/07/24/ground-breaking-method-to-make-graphene-from-garbage-is-modern-day-alchemy/

KEYWORDS: Insulated Composite Concrete Forms (ICCF), Autoclaved Aerated Concrete (AAC), Graphene, electromagenetic pulse (EMP), Blast, Spalling , Helix steel fibers, geomagnetic distrubance (GMD)

VERSION 2

DTRA222-004 TITLE: Perovskite Radiation Detectors and Imagers

OUSD (R&E) MODERNIZATION PRIORITY: Nuclear

TECHNOLOGY AREA(S): Sensors; Nuclear; Materials; Electronics

OBJECTIVE: Develop a portable, handheld, high-resolution, low operating voltage, spectroscopic-capable radiation detector using direct semiconductor radiation sensing elements that are based on perovskites. The detector could be carried by the warfighter or easily integrated into light vehicles to enable the operator to identify radioisotopes present in the battlefield or operational environment.

DESCRIPTION: Currently available radiation detection and imaging systems capable of high-resolution, spectroscopic operation necessary for radioisotope identification and positioning are either incapable of being deployed in handheld, portable systems (due to SWAP or the requirements for cryogenic operation) or are prohibitively expensive to deploy to the general warfighter. Perovskite materials, including organic-inorganic hybrid perovskites and inorganic perovskites, are high-quality semiconductor materials with a high absorption cross-section to ionizing radiation. Additionally, perovskite materials exhibit a long carrier lifetime, moderate mobility, and can be grown using scalable, inexpensive methods, including solution processing. The use of inexpensive, earth-abundant materials in perovskites shows promise to significantly reduce the cost of radiation detection and imaging systems, enabling wider deployment of these systems. Although perovskite materials have been demonstrated to have a good energy resolution (near 2% at 662 keV), they can suffer from bias-induced performance degradation, and the material uniformity, material yield, surface and contact engineering, and compatible readout electronics and imaging systems still need optimization to enable deployment to the warfighter. DTRA envisions the use of such systems in battlefield radioisotope monitoring and warning, and general imaging usage (i.e. non-destructive testing of DoD components). Specific requirements of these systems include:

- Energy resolution < 2% at 662 keV
- Energy resolution < 5% at 2 MeV
- Detection efficiency > 80% at 662 keV
- Detection efficiency > 50% at 2 MeV
- Operating bias < 300 V
- Capability for dual-mode (gamma and fast neutron) operation
- Detector material cost < $15 USD per cubic centimeter
- Radiation survivability up to 10,000 cGy
- Maximum degradation in energy resolution of 20% (in terms of the zero-dose energy resolution) at a TAD of 3,600 cGy of neutrons and gammas in any proportion
- Detector yield > 75 %
- Detector variability (in terms of energy resolution) < 10 %
- Angular resolution for imager < 3 degrees
- System mass for imagers (excluding power supply) < 20 kg.
- Additionally, DTRA seeks the following innovations during the SBIR project:
- Ability for computer-controlled growth and optimization of the perovskite material, with minimal user intervention.
- Optimization of contact materials, interfaces, passivation and deposition techniques to minimize damage to the perovskite material.
- Design and optimization of readout electronics tailored to the material capacitance and carrier mobility and lifetime of the perovskite material.

VERSION 2

PHASE I: Demonstrate the feasibility of low-cost, handheld, portable, high-resolution perovskite detection systems by demonstrating a single-pixel detector meeting the above requirements of: energy resolution, detector efficiency, operating bias, material cost, and radiation survivability. Deliverables will include: radiation response characterization (in the form of spectra from various detectors), perovskite crystal detectors, and material growth procedures and recipes. The design of a customized circuit to improve the detector performance, if needed for performance improvement, can be part of Phase I. The development of stable material performance under bias which can include optimal rectifying contacts and surface passivation and deposition strategies is a critical goal of Phase I. The Phase I effort will include prototype design plans to be developed under Phase II.

PHASE II: Develop a prototype imager, with a minimum of 144 pixels, meeting all the above project requirements. The design of a GUI for the imager, and if applicable, a working, computer-controlled material growth system will be completed. Phase II will include the demonstration of the performance of the prototype system to imaging both gamma-rays and fast neutrons. This demonstration will include mature hardware designs and documentation and prototype testing. A prototype imager, which may include an off-board power supply and data processing, will be delivered to the Government for testing.

PHASE III DUAL USE APPLICATIONS: Final prototype development, including on-boarding all components (including the power supply and data processing systems) will be completed, and designs and initial prototypes for larger (greater number of pixel) imaging systems will be completed. The imaging system will transition to manufacturing, with a focus on acquisition of such systems by the DoD.

Handheld radiation imaging systems, of varying design, are needed across industry for both defense and commercial applications, the latter of which include: medical imaging, non-destructive testing, contraband interdiction, and nonproliferation compliance enforcement.

REFERENCES:

1. H. Wei and J. Huang, Halide Lead Perovskites for Ionizing Radiation Detection, Nat. Commun. 10, 1 (2019).
2. S. Yakunin, M. Sytnyk, D. Kriegner, S. Shrestha, M. Richter, G. J. Matt, H. Azimi, C. J. Brabec, J. Stangl, M. V. Kovalenko, and W. Heiss, Detection of X-Ray Photons by Solution-Processed Lead Halide Perovskites, Nat. Photonics 9, 444 (2015).
3. W. Wang, et al., Electronic-Grade High-Quality Perovskite Single Crystals by a Steady Self-Supply Solution Growth for High-Performance X-ray Detectors, Adv. Mater., 32, 2001540 (2020).
4. W. Pan, H. Wei, and B. Yang, Development of Halide Perovskite Single Crystal for Radiation Detection Applications, Front. Chem. 8, 1 (2020).
5. L. Xu, W. Jie, G. Zha, Y. Xu, X. Zhao, T. Feng, L. Luo, W. Zhang, R. Nan, and T. Wang, Radiation Damage on CdZnTe:In Crystals under High Dose 60Co γ-Rays, CrystEngComm 15, 10304 (2013).
6. Y. He, L. Matei, H. J. Jung, K. M. McCall, M. Chen, C. C. Stoumpos, Z. Liu, J. A. Peters, D. Y. Chung, B. W. Wessels, M. R. Wasielewski, V. P. Dravid, A. Burger, and M. G. Kanatzidis, High Spectral Resolution of Gamma-Rays at Room Temperature by Perovskite CsPbBr3 Single Crystals, Nat. Commun. 9, 1 (2018).
7. J. Res. Natl. Inst. Stand. Technol. 109, 451-456 (2004)
8. T. Gozani et al., Passive Nondestructive Assay of Nuclear Materials, NUREG/CR-5550 (US Nuclear Regulatory Commission, Washington, DC, 1991)

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9. M. Liu, Z. Li, W. Zheng, L. Kong, and L. Li, Improving the Stability of $CsPbBr_3$ Perovskite Nanocrystals by Peroxides Post-Treatment, Front. Mater. 6, 1 (2019).
10. P. Zhang, G. Zhang, L. Liu, D. Ju, L. Zhang, K. Cheng, and X. Tao, Anisotropic Optoelectronic Properties of Melt-Grown Bulk $CsPbBr_3$ Single Crystal, J. Phys. Chem. Lett. 9, 5040 (2018).

KEYWORDS: radiation detection, radiation sensor, radiation imaging, perovskite, gamma, neutron

VERSION 2

DTRA222-005 TITLE: Subterranean Wireless Communications for Counter-WMD Missions

OUSD (R&E) MODERNIZATION PRIORITY: 5G, General Warfighting Requirements (GWR); Network Command, Control and Communications; Cybersecurity

TECHNOLOGY AREA(S): Electronics;Information Systems

OBJECTIVE: Investigate novel means to provide practical wireless communications which outperform traditional free-space radio frequency (RF) communications in subterranean environments during DoD missions. Characterize technology performance in underground spaces, especially man-made underground facilities typical of those used for production, storage, and deployment of weapons of mass destruction (WMDs). Demonstrate the ability of the technology to be used for remote operation of multiple robotic systems in an environment typifying an underground facility used for WMD production, storage, or use.

DESCRIPTION: Traditional wireless communications links (RF and non-RF) suffer a number of impairments when used in subterranean spaces. The Army Techniques Publication for subterranean operations acknowledges this, stating:

"Wireless communications [in subterranean spaces] are usually very limited. These include within the [subterranean] facility, subterranean to surface (vice versa), and potentially even surface to surface near a subterranean facility due to excessive noise, confusion, depth (overburden), confined space acoustics, little to no light, combined with surface terrain that is usually restrictive and with limited lines of sight. Strained communications, degraded global positioning systems, confined space in unknown terrain, and other difficult environmental factors make navigation, command and control, and even fratricide prevention measures extremely difficult. [1]"

Underground facilities provide concealment and protection for an array of activities conducted by US adversaries, including production, storage, and deployment of WMDs. These facilities have proliferated globally, with “hundreds” being acknowledged to exist at the turn of the century, and many more being constructed. Their multitude has created a number of challenges which the DoD has made a priority to solve. [2] The problem of communicating in sprawling underground facilities while conducting counter-WMD operations is one such challenge, the solution to which currently relies on conventional free-space RF radio links.

While above-ground radio links are ubiquitous, well understood, and can be accurately modeled in most cases, RF propagation underground is not well understood, in part because it is less commonly needed and also because it is highly dependent on the geometry and electrical properties of a given subterranean environment. [3] The variable and unknown nature of adversary subterranean facilities greatly inhibits the ability of engineers to optimize communication links for these environments, and leads to conventional radio links being repurposed without significant modification for use during subterranean operations. This, combined with the impacts of tunnel curvature, corners, intersections, and discontinuities, results in greatly reduced and highly variable radio link performance in subterranean environments. [4]

Missions conducted by DoD personnel in subterranean environments require the real-time exchange of substantial amounts of information such as voice, video, and sensor data among personnel, sensors, and robotic systems. Accomplishing this with traditional RF radio links requires the use of relay nodes, which may be either static or mobile, and may be separate from or part of the robotic systems being used. Creating an RF communications network within a large underground facility requires the use of a substantial number of network nodes, as well as the means to command and the logistics to deploy them. A method of communicating in subterranean environments which is not reliant on traditional RF propagation, and which reduced the operational and logistics burdens on the operator, would significantly contribute to the success of operations conducted in underground facilities.

Such a novel solution may rely on the innovative use of a number of physical phenomena (optical, magnetic, plasmonic, acoustic, etc.) to transmit and receive information, and may also leverage infrastructure typically found in underground facilities. Solutions may require a multidisciplinary approach to combine phenomena in order to account for the impacts of dust, smoke, loud noises, illuminators, and other link impairments that may be encountered during DoD operations. Technology developed under this SBIR topic would be invaluable to DoD groups conducting operations in underground facilities, as well as those operating in dense, urban environments, which also are affected by impaired RF propagation. The nature of a non-traditional, non-RF communications capability also lends itself to many other military applications, especially those requiring a low probability of detection (LPD) such as unattended ground sensors, robotic systems, data exfiltration, and intra-squad communications, as well as use in systems which are susceptible to conventional electronic warfare attacks.

PHASE I: The Phase I deliverables are a report and proof of concept demonstrating point-to-point information exchange using novel means of wireless communications as described above. The performer shall characterize basic properties of the communications link in a representative environment, including throughput, latency, and bit error rate as a function of transmitter/receiver separation distance in line-of-sight and non-line-of-sight configurations. The report shall discuss the advantages/disadvantages of the proposed approach, characterization data & metrics, potential network configurations, and suggested applications beyond subterranean communications.

PHASE II: The Phase II deliverable is a final report and final proof of concept demonstration of 3 small unmanned ground vehicles (sUGVs) being simultaneously operated in a relevant environment via the novel wireless communications network developed during this phase. The performer shall execute all integration necessary to remotely control the sUGVs during this phase, and shall characterize the operational utility of the network by conducting simulated, simplified counter-WMD scenarios in a relevant environment and assessing mission outcomes. The performer shall also characterize performance of the communications link in the presence of environmental impairments, as applicable. The performer shall continue to measure performance based on characterization methods developed in Phase I. The final report shall discuss the advantages and disadvantages of the technology, characterization data, and potential use cases beyond subterranean environments. The final report shall also outline a fieldable configuration of the technology.

PHASE III DUAL USE APPLICATIONS: During Phase III, the performer would develop and produce fieldable prototypes using accepted systems engineering practices to ensure satisfaction of functional requirements and proper management of system configuration. The performer would also enable preliminary usage by DoD customers, including DTRA RD-CX and counter-WMD stakeholders, and develop configurations for other DoD systems requiring LPD communication solutions. Although additional funding may be provided through DoD sources, the awardee should look to other public or private sector funding sources for assistance with transition and commercialization.

VERSION 2

REFERENCES:

1. US Department of the Army, Army Techniques Publication 3-21.51: Subterranean Operations (2019). Accessible at: https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN19656_ATP 3-21x51 FINAL WEB.pdf
2. The MITRE Corporation, JASON Report: Characterization of Underground Facilities (1999). Accessible at: https://apps.dtic.mil/sti/pdfs/ADA363359.pdf
3. IEEE Antennas & Propagation Magazine, RF Propagation in Mines and Tunnels (2015). Accessible with subscription at: https://ieeexplore.ieee.org/document/7225146IEEE
4. Aerospace Conference, A Self-Deployed Multi-Channel Wireless Communications System for Subterranean Robots (2020). Accessible with subscription at: https://ieeexplore.ieee.org/document/9172496

KEYWORDS: Subterranean, Communications, Underground Facilities, UGF, Low Probability of Detection, Low Probability of Intercept, LPI, LPD

Defense Human Resources Activity (DHRA)
22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Human Resources Activity (DHRA) SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize technologies.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DHRA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the DHRA Program and these proposal preparation instructions should be directed to: Tammy J. Proffitt, DHRA, Office of Small Business Programs, tammy.j.proffitt2.civ@mail.mil.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 10 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. DHRA will not consider any pages in excess of the 10-page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 10-page limit. Technical Volumes that exceed the 10-page limit will be reviewed only to the last word on the 10^{th} page. Information beyond the 10^{th} page will not be reviewed or considered in evaluating the offeror’s proposal. To the extent that mandatory technical content is not contained in the first 10 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

Content of the Technical Volume

Refer to the DoD SBIR Program BAA for detailed instructions on the content of the technical volume.

Cost Volume (Volume 3)

The nine-month Phase I Base amount must not exceed $256,000. There is no option period.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered DHRA during proposal evaluations.

Supporting Documents (Volume 5)

No supporting documents other than those required in the DoD Program BAA will be reviewed by DHRA.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II proposal submission window, notification process, and additional instructions will be provided in the Phase I contract or by subsequent notification. The expected budget and period of performance are as follows:

Base Period: Not to exceed a duration of 12 months and a cost of $800,000.
Option Period: Not to exceed a duration of 6 months and a cost of $300,000.
Total Phase II duration of 18 months and cost of $1,100,000.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
Technical and Business Assistance funds are not currently offered for DHRA topics.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The DHRA Office of Small Business Programs will notify proposing vendors via email of selection status and debriefing procedures.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:
Tammy J. Proffitt, DHRA Office of Small Business Programs and
Contracting Officer, DHRA, Enterprise Acquisition Division
via email to tammy.j.proffitt2.civ@mail.mil.

AWARD AND CONTRACT INFORMATION
Up to two awards are anticipated. DHRA plans to award FAR-based government Firm-Fixed Price contracts, subject to approval of the Contracting Officer. The amount of resources made available for this topic depend on the quality of the proposals received and the availability of funds.

END

DHRA SBIR 22.2 Phase I Topic Index

OSD222-003 TITLE: Personnel Accountability Data Management to Improve Accountability and Readiness

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Provide innovations for restructuring the current state of the Personnel Accountability Programs.

DESCRIPTION: A full scope portfolio assessment will be necessary to review capabilities, technical information, data feeds, and gaps to provide recommendations for the future state of the Personnel Accountability applications. Innovative and creative approaches to improving the systems, technology, or structure of the programs is desired for modernization of the systems. The research should result in achievable courses of action for portfolio rationalization to deliver improved application functions and facilitate the implementation of a zero trust architecture. The ultimate goal of the project is a fully intraoperative and cohesive portfolio of programs to accomplish the Department of Human Resources (DHRA)'s Personnel Accountability responsibilities as outlined in each Department of Defense Instruction in the references below.

Proposed solutions must consider/include:
1) Analysis of the current technical state of the applications and data feeds to the systems.
2) Identification of solution gaps and data quality issues resulting in conflicting information between systems
3) Beneficial technology advancements that can be incorporated in the applications (improved algorithms, machine learning, artificial intelligence, zero trust, etc).
4) Proposed courses of action for restructuring the programs/portfolio, associated costs, and plan for merging, migrating, or archiving the data as necessary. Options could include: re-engineering existing applications, re-platforming data delivery to reduce application footprints and overhead, or the development of a comprehensive, new streamlined application.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by [component] in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: White paper development: Develop a white paper of potential courses of action for the portfolio. The paper should describe the gaps, issues, and concepts for improvements. Each potential course of action should include rough costs to implement.

PHASE II: Prototyping. Based on the results of Phase I, the government will choose a solution for prototyping. The prototype will be able to demonstrate how the DoDI requirements will be successfully implemented in the new solution.

PHASE III DUAL USE APPLICATIONS: Portfolio Rationalization. Support the government in transitioning to the new solutions. Phase 3 will execute the full scoped solution and will consist of ensuring successful implementation of all chosen recommendations and fully functioning validated portfolio. Potential commercialization of this initiative would be applicable to any government or professional organization with personnel accountability goals in need of tracking employee locations.

REFERENCES:

1. DoDI 3001.02, Personnel Accountability in Conjunction with Natural Or Manmade Disasters;
2. National Defense Authorization Act for Fiscal Year 2008, Section 861, Memorandum of understanding on matters relating to contracting.
3. National Defense Authorization Act for Fiscal Year 2008, Section 862, Contractors performing private security functions in areas of combat operations.
4. DoDI 3020.50, Private Security Contractors (PSCs) Operating in Contingency Operations, Humanitarian or Peace Operations, or Other Military Operations or Exercises.
5. DoDI 3020.41, Operational Contract Support (OCS).
6. CJCSM 3150.13C, Joint Reporting Structure – Personnel Manual.
7. DoDI 6490.03, Deployment Health.
8. Joint Publication 1-0, Joint Personnel Support.
9. Joint Publication 3-68, Noncombatant Evacuation Operations.
10. DoDD 3025.14, Evacuation of U.S. Citizens and Designated Aliens from Threatened Areas Abroad.

KEYWORDS: Personnel Accountability, Readiness, Personnel Location, Noncombatant Evacuation, Contingency, Crisis, Disaster, Rationalization, Restructure, Modernization, Data Management

VERSION 3

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA)
22.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The National Geospatial-Intelligence Agency (NGA) has a responsibility to provide the products and services that decision makers, warfighters, and first responders need, when they need it most. As a member of the Intelligence Community and the Department of Defense, NGA supports a unique mission set. We are committed to acquiring, developing and maintaining the proper technology, people and processes that will enable overall mission success.

Geospatial intelligence, or GEOINT, is the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the Earth. GEOINT consists of imagery, imagery intelligence and geospatial information.

With our unique mission set, NGA pursues research that will help guarantee the information edge over potential adversaries. Additional information pertaining to the National Geospatial-Intelligence Agency's mission can be obtained by viewing the website at http://www.nga.mil/.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. NGA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the SBIR Program and these proposal preparation instructions should be directed to:

National Geospatial-Intelligence Agency
Attn: SBIR Program Manager, RA, MS: S75-RA
7500 GEOINT Dr., Springfield, VA 22150-7500
Email: SBIR@nga.mil

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively.

Content of the Technical Volume

Refer to the DoD SBIR Program BAA for detailed instructions on the content of the technical volume.

Cost Volume (Volume 3)

The Phase I Base must not exceed a cost of $100,000 and a duration of 9 months.

Company Commercialization Report (CCR) (Volume 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by NGA during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the Volume 5 requirements listed in the DoD SBIR Program BAA, the vendor may submit supporting documents (Volume 5) but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Items that may go into, not all inclusive, are additional cost proposal information, advocacy letters, etc.

DIRECT TO PHASE II PROPOSAL GUIDELINES
Topic OSD222-D02 is accepting Direct to Phase II proposals ONLY. **The maximum amount for a Direct to Phase II award is $1,000,000, and the maximum period of performance for a Direct to Phase II is 24 months.** While NGA participates in the majority of SBIR program options, NGA does not participate in the either the Commercialization Readiness Program (CRP), Technical and Business Assistance (TABA) or Phase II Enhancement programs.

The entire SBIR proposal submission must be submitted electronically through the DoD SBIR/STTR Proposal Submission system located at https://www.dodsbirsttr.mil/ehb-app/home for it to be evaluated.

- **Proposal Cover Sheet (Volume 1):** The Cover Sheet must include a brief technical abstract of no more than 200 words that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. Do not include proprietary or classified information in the Proposal Cover Sheet. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released.
- **Format of Technical Volume (Volume 2)**: The Technical Volume must include two parts, PART ONE: Feasibility Documentation and PART TWO: Technical Proposal. The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. Do not lock or encrypt the uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document. The length of each part of the technical volume are as follows: Feasibility Documentation is limited to 20 pages and Technical Proposal is limited to 40 pages. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively. Font size should not be smaller than 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.
    - **Content of the Technical Volume (Volume 2) PART ONE: Feasibility Documentation**: Provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of the topic has been met and describes the potential commercial applications. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Maximum page length for feasibility documentation is 20 pages. If you have references, include a reference list or works cited list as the last page of the feasibility documentation. This will count towards the page limit. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the Principle Investigator (PI). If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposer must either own the IP, or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work.

Documentation of IP ownership or license rights shall be included in the Technical Volume of the proposal. Include a one-page summary on Commercialization Potential addressing the following: i. Does the company contain marketing expertise and, if not, how will that expertise be brought into the company? ii. Describe the potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.

- **PART TWO: Technical Proposal:**
  - (1) Significance of the Problem. Define the specific technical problem or opportunity addressed and its importance.
  - (2) Phase II Technical Objectives. Enumerate the specific objectives of the Phase II work and describe the technical approach and methods to be used in meeting these objectives.
  - (3) Phase II Statement of Work. The statement of work should provide an explicit, detailed description of the Phase II approach, indicate what is planned, **how and where the work will be carried out**, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal. Include how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. **Additionally, please mark any tasks that are dedicated to Fundamental Research.**
  - (4) Section 508 Compliance: The contractor shall ensure that all systems, hardware, software, software engineering, and information technology associated with this effort is made in a manner that is accessible for people with the standards for people with disabilities as directed in the NGA Instruction 8400.4 and Section 508 of the Rehabilitation Act of 1973 as amended in 1998 (Section 508). Specifically, all Information and Communications Technology (ICT) associated with this contract, may use the Web Content Accessibility Guidelines (WCAG) 2.1 to comply with the Section 508 or use alternative designs or technologies which result in substantially equivalent or greater access to and use of the product for people with disabilities. Furthermore, the contractor shall pursue human centered design and usability guidelines to ensure that all services associated with this Topic Area are accessible by as many users as possible and to drive modernization, innovation, and enhance mission support. **As part of the vendor's proposal, the vendor should include an outline specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase 2 should provide an explicit, detailed description of the approach, indicate what is planned, how and where the work will be carried out, a schedule of major events, how the solution will be Section 508 Compliant, and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. If a determination is made that a Section 508 exception request is justified, the rationale for the exception request must be made and submitted as a part of the proposal.**
  - (5) Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the PI, the proposer, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state of the art in the specific topic.

Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number) and (3) date of completion.

- (6) Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. ii. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization effort.
- (7) Key Personnel. Identify key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the PI, including a list of relevant publications (if any), must be included. All resumes count toward the page limitation.
- (8) Foreign Citizens. Identify any foreign nationals you expect to be involved on this project.
- (9) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. **If proposing to perform classified activities during the period of performance, you need to provide the following: 1) Highest Level of Classification of the Research to include which SOW task; 2) Where the classified work will be performed (Address, Cage Code for Facility, Safeguarding Level); 3) Will the information include controlled unclassified information (CUI); 4) What classified/unclassified IT systems will be required and; 5) A statement on how you will comply with the information handing and classified work performance requirements as described in the paragraphs in the additional information section.**
- (10) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described according to the Cost Breakdown Guidance. Please refer to section 4.2 of this BAA for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.
- (11) Prior, Current or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information: a) Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received. b) Date of proposal submission or date of award. c) Title of proposal. d) Name and title of the PI for each proposal submitted or award received. e) Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received. f) If award was received, state contract number. g) Specify the applicable topics for each proposal submitted or award received. Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."
- (12) Commercialization Strategy. NGA is equally interested in dual use commercialization of SBIR/STTR projects that result in products sold to the U.S. military, the private sector market, or both. NGA expects explicit discussion of key activities to achieve this result in the commercialization strategy part of the proposal. The Technical Volume of each Direct to Phase II proposal must include

a commercialization strategy section. The Phase II commercialization strategy shall not exceed 5 pages. The commercialization strategy should include the following elements:

- a) A summary of transition and commercialization activities conducted during Phase I, and the Technology Readiness Level (TRL) achieved. Discuss how the preliminary transition and commercialization path or paths may evolve during the Phase II project. Describe key proposed technical milestones during Phase II that will advance the technology towards product such as: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.
- b) Problem or Need Statement. Briefly describe what you know of the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address.
- c) Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s). Identify the potential DoD end users, Federal customers, and/or private sector customers who would likely use the technology.
- d) Business Model(s)/Procurement Mechanism(s). Discuss your current business model hypothesis for bringing the technology to market. Describe plans to license, partner, or self-produce your product. How do you plan to generate revenue? Understanding NGA's goal of creating and sustaining a U.S. military advantage, describe how you intend to develop your product and supply chains to enable this differentiation.
- e) Target Market. Describe the market and customer sets you propose to target, their size, their growth rate, and their key reasons they would consider procuring the technology. Describe competing technologies existent today on the market as well as those being developed in the lab.
- f) Funding Requirements. Describe your company's funding history. How much external financing have you raised? Describe your plans for future funding sources (internal, loan, angel, venture capital, etc.).
- g) Commercialization Risks. Describe the major technology, market and team risks associated with achieving successful transition of the NGA funded technology. NGA is not afraid to take risks, but we want to ensure that our awardees clearly understand the risks in front of them.
- h) Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?
- i) Anticipated Commercialization Results. Include a schedule showing the anticipated quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase

II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.).

- **Format of Cost Volume (Volume 3):** The Cost Volume (and supporting documentation) DOES NOT count toward the page limit of the Technical Volume. Some items in the Cost Breakdown Guidance below may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. ALL proposed costs should be accompanied by documentation to substantiate how the cost was derived. For example, if you proposed travel cost to attend a project-related meeting or conference, and used a travel website to compare flight costs, include a screen shot of the comparison. Similarly, if you proposed to purchase materials or equipment, and used the internet to search for the best source, include your market research for those items. You do not necessarily have to propose the cheapest item or supplier, but you should explain your decision to choose one item or supplier over another. It's important to provide enough information to allow contracting personnel to understand how the proposer plans to use the requested funds. If selected for award, failure to include the documentation with your proposal will delay contract negotiation, and the proposer will be asked to submit the necessary documentation to the Contracting Officer to substantiate costs (e.g., cost estimates for equipment, materials, and consultants or subcontractors). It is important to respond as quickly as possible to the Contracting Officer's request for documentation. Cost Breakdown Guidance:
    - List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
    - Special tooling and test equipment and material cost may be included. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with NGA; unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by NGA.
    - Cost for travel funds must be justified and related to the needs of the project.
    - Cost sharing is permitted for proposals under this announcement; however, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal.
    - All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regard to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal. The Supporting Documents Volume (Volume 5) may be used if additional space is needed. For more information about cost proposals and accounting standards, see the DCAA publication titled "Audit Process Overview – Information for Contractors" available at: http://www.dcaa.mil.
- **Company Commercialization Report (Volume 4):** Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by NGA during proposal evaluations.
- **Supporting Documents (Volume 5):** In addition to the Volume 5 requirements listed in the DoD SBIR Program BAA, the vendor may submit supporting documents (Volume 5), but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Items that may go into, not all inclusive, are additional cost proposal information, Completed Form SF326, advocacy letters, etc.
- **Fraud, Waste and Abuse Training (Volume 6):** The Fraud, Waste and Abuse (FWA) training is required for Direct to Phase II proposals. Refer to the DoD SBIR Program BAA for full details.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. All NGA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. To minimize the gap between the Phase I and Phase II, it is suggested that the vendor submit their proposal during month 7 of the Phase I award.

The NGA SBIR Program is committed to minimizing the funding gap between Phase I and Phase II activities. Phase I awardees may submit a Phase II proposal without invitation; However, it is strongly encouraged that an UNCLASSIFIED Phase II proposal not be submitted until sufficient Phase I progress can be evaluated and assessed based on results of the Phase I proof-of-concept/feasibility study Work Plan. Therefore, it is highly recommended to submit your UNCLASSIFIED proposal 60 days prior to the end date of their Phase I contract in order to be considered for funding. All NGA SBIR Phase II proposals will receive a timely review.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at DoDSBIRSupport@reisystems.com.

The Phase II Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

- **Proposal Cover Sheet (Volume 1):** The Cover Sheet must include a brief technical abstract of no more than 200 words that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. Do not include proprietary or classified information in the Proposal Cover Sheet. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits may be publicly released.
- **Format of Technical Volume (Volume 2)**: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. Do not lock or encrypt the uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document. The length of each part of the technical volume is limited to 40 pages. The Government will not consider pages in excess of the page count limitations. Number all pages of your proposal consecutively. Font size should not be smaller than 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½” by 11” paper. The header on each page of the Technical Volume should contain your company name, topic number, and proposal number assigned by DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.
    - (1) Significance of the Problem. Define the specific technical problem or opportunity addressed and its importance.
    - (2) Phase II Technical Objectives. Enumerate the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objectives.
    - (3) Phase II Statement of Work. The statement of work should provide an explicit, detailed description of the Phase II approach, **indicate what is planned, how and where the work will be carried out,** a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

Include how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. **Additionally, please mark any tasks that are dedicated to Fundamental Research.**

- (4) Section 508 Compliance: The contractor shall ensure that all systems, hardware, software, software engineering, and information technology associated with this effort is made in a manner that is accessible for people with the standards for people with disabilities as directed in the NGA Instruction 8400.4 and Section 508 of the Rehabilitation Act of 1973 as amended in 1998 (Section 508). Specifically, all Information and Communications Technology (ICT) associated with this contract, may use the Web Content Accessibility Guidelines (WCAG) 2.1 to comply with the Section 508 or use alternative designs or technologies which result in substantially equivalent or greater access to and use of the product for people with disabilities. Furthermore, the contractor shall pursue human centered design and usability guidelines in order to ensure that all services associated with this Topic Area are accessible by as many users as possible and as a means to drive modernization, innovation, and enhance mission support. **As part of the vendor's proposal, the vendor should include an outline specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase 2 should provide an explicit, detailed description of the approach, indicate what is planned, how and where the work will be carried out, a schedule of major events, how the solution will be Section 508 Compliant, and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail. If a determination is made that a Section 508 exception request is justified, the rationale for the exception request must be made and submitted as a part of the proposal.**
- (5) Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the PI, the proposer, consultants or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state of the art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number) and (3) date of completion.
- (6) Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. ii. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization effort.
- (7) Key Personnel. Identify key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the PI, including a list of relevant publications (if any), must be included. All resumes count toward the page limitation.
- (8) Foreign Citizens. Identify any foreign nationals you expect to be involved on this project.
- (9) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. **If proposing to perform classified activities during the period of performance, you need to provide the following: 1) Highest Level of Classification of the Research to include which SOW task; 2) Where the classified work will be performed (Address, Cage Code for Facility, Safeguarding Level); 3) Will the information include controlled unclassified information (CUI); 4) What classified/unclassified IT systems will be required and;**

5) A statement on how you will comply with the information handing and classified work performance requirements as described in the paragraphs in the additional information section.

- (10) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described according to the Cost Breakdown Guidance. Please refer to section 4.2 of this BAA for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.
- (11) Prior, Current or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information: a) Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received. b) Date of proposal submission or date of award. c) Title of proposal. d) Name and title of the PI for each proposal submitted or award received. e) Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received. f) If award was received, state contract number. g) Specify the applicable topics for each proposal submitted or award received. Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."
- (12) Commercialization Strategy. NGA is equally interested in dual use commercialization of SBIR/STTR projects that result in products sold to the U.S. military, the private sector market, or both. NGA expects explicit discussion of key activities to achieve this result in the commercialization strategy part of the proposal. The Technical Volume of each Direct to Phase I proposal must include a commercialization strategy section. The Phase I commercialization strategy shall not exceed 5 pages. The commercialization strategy should include the following elements:
    - a) Problem or Need Statement. Briefly describe what you know of the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address.
    - b) Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s). Identify the potential DoD endusers, Federal customers, and/or private sector customers who would likely use the technology.
    - c) Business Model(s)/Procurement Mechanism(s). Discuss your current business model hypothesis for bringing the technology to market. Describe plans to license, partner, or self-produce your product. How do you plan to generate revenue? Understanding NGA's goal of creating and sustaining a U.S. military advantage, describe how you intend to develop your product and supply chains to enable this differentiation.
    - d) Target Market. Describe the market and customer sets you propose to target, their size, their growth rate, and their key reasons they would consider procuring the technology. Describe competing technologies existent today on the market as well as those being developed in the lab.
    - e) Funding Requirements. Describe your company's funding history. How much external financing have you raised? Describe your plans for future funding sources (internal, loan, angel, venture capital, etc.).
    - f) Commercialization Risks. Describe the major technology, market and team risks associated with achieving successful transition of the NGA funded

technology. NGA is not afraid to take risks but we want to ensure that our awardees clearly understand the risks in front of them.

  - g) Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?

- **Format of Cost Volume (Volume 3):** The Cost Volume (and supporting documentation) DOES NOT count toward the page limit of the Technical Volume. Some items in the Cost Breakdown Guidance below may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. ALL proposed costs should be accompanied by documentation to substantiate how the cost was derived. For example, if you proposed travel cost to attend a project-related meeting or conference, and used a travel website to compare flight costs, include a screen shot of the comparison. Similarly, if you proposed to purchase materials or equipment, and used the internet to search for the best source, include your market research for those items. You do not necessarily have to propose the cheapest item or supplier, but you should explain your decision to choose one item or supplier over another. It’s important to provide enough information to allow contracting personnel to understand how the proposer plans to use the requested funds. If selected for award, failure to include the documentation with your proposal will delay contract negotiation, and the proposer will be asked to submit the necessary documentation to the Contracting Officer to substantiate costs (e.g., cost estimates for equipment, materials, and consultants or subcontractors). It is important to respond as quickly as possible to the Contracting Officer’s request for documentation. Cost Breakdown Guidance:
  - List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
  - Special tooling and test equipment and material cost may be included. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with NGA; unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by NGA.
  - Cost for travel funds must be justified and related to the needs of the project.
  - Cost sharing is permitted for proposals under this announcement; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.
  - All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regard to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal. The Supporting Documents Volume (Volume 5) may be used if additional space is needed. For more information about cost proposals and accounting standards, see the DCAA publication titled “Audit Process Overview – Information for Contractors” available at: http://www.dcaa.mil.
- **Company Commercialization Report (Volume 4):** See DoD SBIR Instructions on Company Commercialization Report. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.

- **Supporting Documents (Volume 5):** The vendor may submit supporting documents (Volume 5) but that material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation. Items that may go into, not all inclusive, are additional cost proposal information, Completed Form SF326, advocacy letters, etc.
- **Fraud, Waste and Abuse Training (Volume 6):** See DoD SBIR Instructions onFraud, Waste and Abuse Training. This material WILL NOT be reviewed by the evaluation team as part of the proposal evaluation.

Selection of Phase II proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA (refer to Section 6.0 of the BAA). As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?
(3) How much money will be needed to bring the technology to market, and how will that money be raised?
(4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
(5) Who are the proposing firm's competitors, and what is the price and/or quality advantage over those competitors?

Due to limited funding, the NGA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

NGA typically provides a firm fixed price contract as a Phase II award. The type of contract is at the discretion of the Contracting Officer.

Initial Phase II proposals shall be limited to $1,000,000 over a two-year period with a Period of Performance not exceeding 24 months. A work breakdown structure that shows the number of hours and labor category broken out by task and subtask, as well as the start and end dates for each task and subtask, shall be included.

Phase II contracts shall include a requirement to produce a monthly status and financial reports, an interim report not later than 12 months after contract award, a prototype demonstration not later than 23 months after contract award and a final report not later than 24 months after contract award. These reports shall include the following sections:

- A summary of the results of the Phase II research to date
- A summary of the Phase II tasks not yet completed with an estimate of the completion date for each task
- A statement of potential applications and benefits of the research.
- A summary of any risks or issues

The interim and final report shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The pages shall be numbered.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
NGA will not provide any TABA.

VERSION 3

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. Selection of Phase I proposals will be in accordance with the evaluation procedures and criteria discussed in this BAA. As part of subfactor c in the evaluation criteria, the vendor will be evaluated on how it addresses the following five questions on the overall commercialization strategy:

(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?
(3) How much money will be needed to bring the technology to market, and how will that money be raised?
(4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
(5) Who are the proposing firm's competitors, and what is the price and/or quality advantage over those competitors?

Proposals not conforming to the terms of this BAA, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

The NGA SBIR Program reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality in the judgment of the technical evaluation team will be funded. The offeror must be responsive to the topic requirements, as solicited.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the Government Contracting Officer/Specialist with their official notification of proposal selection or non-selection. The notices will be binned into 3 categories: (1) proposals selected for award, (2) proposals selected for award, if additional funding becomes available, and (3) proposals not selected for award. Proposals with the award designation of 'Award if Additional Funding Becomes Available' will receive consideration for award 12 months from the BAA close date. An unsuccessful offeror has 3 days after notification that its proposal was not selected to submit a written request for a debriefing to the Contracting Officer (CO). Those offerors who get their written request in within the allotted timeframe above will be provided a debriefing.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Viphalac Dickover at Viphalac.C.Dickover@nga.mil.

AWARD AND CONTRACT INFORMATION

Federally Funded Research and Development Contractors (FFRDC) and other government contractors, whom have signed Non-Disclosures Agreements, may be used in the evaluation of your proposal.
NGA typically provides a firm fixed price level of effort contract for Phase I awards. The type of contract is at the discretion of the Contracting Officer.

Phase I contracts will include a requirement to produce monthly status reports, a more detailed interim report not later than 7 months after award, a final report no later than 9 months after award and any software/algorithms/documentation from items developed in Phase I. These reports shall include the following sections:

- A summary of the results of the Phase I research to date
- A summary of the Phase I tasks not yet completed, with an estimated completion date for each task
- A statement of potential applications and benefits of the research.

- A summary of any risks or issues

The interim report (draft final report) and final report shall be prepared single spaced in 12 pitch Times New Roman font, with at least a one-inch margin on top, bottom, and sides, on 8½" by 11" paper. The pages shall be numbered.

ADDITIONAL INFORMATION
USE OF FOREIGN NATIONALS

Due to the nature of our business, only US Nationals are permitted to work on NGA topics, unless the vendor proposes the work as Fundamental Research and indicates it as such in the proposal. The use of non-US National on a NGA contract is PROHIBITTED, unless the work is scoped as Fundamental Research. If the effort is Fundamental Research, the PI must be a US National. ALL offerors proposing to use non-US Nationals (which has not been determined as Fundamental Research) on the effort will be ineligible for award. This includes the use at universities or any other subcontractor. In the event it is determined to be Fundamental Research, non-US Nationals will be ineligible to receive controlled unclassified information as described below.

CONTROLLED UNCLASSIFIED INFORMATION (CUI)
Controlled Unclassified Information (CUI) is information that requires safeguarding or dissemination controls pursuant to and consistent with applicable law, regulations, and government-wide policies but is not classified under Executive Order 13526 or the Atomic Energy Act, as amended.

Executive Order 13556 "Controlled Unclassified Information" (the Order), establishes a program for managing CUI across the Executive branch and designates the National Archives and Records Administration (NARA) as Executive Agent to implement the Order and oversee agency actions to ensure compliance. The Archivist of the United States delegated these responsibilities to the Information Security Oversight Office (ISOO).

32 CFR Part 2002 "Controlled Unclassified Information" was issued by ISOO to establish policy for agencies on designating, safeguarding, disseminating, marking, decontrolling, and disposing of CUI, self-inspection and oversight requirements, and other facets of the Program. The rule affects Federal executive branch agencies that handle CUI and all organizations (sources) that handle, possess, use, share, or receive CUI—or which operate, use, or have access to Federal information and information systems on behalf of an agency.

During performance of this contract, if the government provides the vendor a dataset that is not publically released, the vendor must be CUI Compliant to receive it. For more information on this compliance please see DFARS Clause 252.204-7012, NIST Special Publication SP 800-171 and the National Archives and Records Administration (NARA) website (https://www.archives.gov/cui/about).

INFORMATION HANDLING

Contractor personnel will comply with the NGA, DoD, and IC policies and regulations (to include, but not limited to, the CoNGA Security Classification Guide) to properly mark (to include portion marking) classified and unclassified documentation, media, etc.

Markings will be in accordance with the lowest security classification possible to ensure the confidentiality and integrity for the greatest release to partners in accordance with NGA and mission partner marking guides for classified information.

Information management will be in accordance with applicable security policy and regulations, and NGA compliance documents.

All Government-furnished information released to the Contractor or created in the performance of this contract will be destroyed or returned by the Contractor to NGA upon contract termination or when no longer required for contract performance. The determination to destroy or return will be at the direction of the NGA CO or COR.

CLASSIFIED WORK PERFORMANCE SECURITY REQUIREMENTS (Not applicable to UNCLASSFIED ONLY contracts)

Contractor personnel performing Top Secret/Sensitive Compartmented Information (TS/SCI) work on the XXX contract are required to have active TS/SCI clearances for access to NGA facilities, when performing duties within TS/SCI environments, and for access to TS/SCI NGA computer systems. Contractors are subject to a Counterintelligence Polygraph as requested by the Government. NGA will sponsor TS/SCI security clearances, NGA Badges, Common Access Cards (CAC) and other items (example: parking hangtag) for required contract personnel.

Contractors must abide by the DD Form 254 - Contract Security Classification Specification and applicable security policies and regulations.

Contractor personnel shall follow all applicable NGA, IC, and DoD information security and operational security policies and guidance when accessing and transmitting data over networks during performance of agreement requirements.

The contractor shall inform the Government when its employees no longer support the contract (see DD254). The Government desires notification prior to the day the individual no longer supports the contract, but requires notification no later than the day support ends. If contractor personnel will no longer be supporting NGA via an NGA contract, any debriefing paperwork, notifications, and/or requests for further direction from the COR or Industrial Security shall be turned into the NGA Workforce Support Center, NGA Site Security Office, or the COR. If contract personnel are unable to turn these items into the NGA Workforce Support Center, NGA Site Security Office, or COR then it is the contractor's security office's responsibility to collect the items from the individual. If the contractor debriefs the employee, the contractor shall send a copy of the debriefing statement, plus any Government items (i.e. NGA Badge, CAC, Courier Card, parking hangtags, etc.) within four (4) business days (timeline may be extended with authorized documented exceptions by NGA Security) to an NGA Site Security Office or the NGA Workforce Support Center.

All classified work performed at a non-NGA facility must be approved by the COR.

Cleared contractor personnel may be authorized to hand-carry contract-related classified information as authorized by the COR. Contract personnel will obtain NGA courier authorization prior to hand-carry of contract-related classified data. Contract personnel will be limited to hand-carry classified information between the contractor facilities and NGA facilities only.

Any classified work performed at collaborator sites must be performed in either an NGA accredited SCIF or an Other Government Agency (OGA) SCIF that has either a Memorandum of Agreement (MOA), Memorandum of Understanding (MOU), Joint Use Agreement or Co-Use Agreement with NGA for this contract.

Contract personnel are forbidden from bringing in prohibited, unauthorized, and/or Portable Electronic Devices (PEDs) items into any NGA installation or any office/working location covered under this agreement. A list of PEDs includes but is not limited to cell phones, cameras, two-way pagers, laptops, recorders (digital, tape, etc.), flash drives, or any other kind of removable media, without prior approval and approval paperwork from NGA. See NGA instructions/regulations/policy for a full list of prohibited and unauthorized items. Security violation repercussions will be determined on the severity of the violation.

CERTICATE PERTAINING TO FOREIGN INTERESTS
Offers must submit a SF-328 in Volume 5 in order to be considered for award. If after review of the form, the offeror may be found ineligible for award if the offerors foreign interest are found to be unacceptable. The form can be found at https://www.gsa.gov/forms-library/certificate-pertaining-foreign-interests.

DISCLOSURE OF INFORMATION

(a) The Contractor shall not release to anyone outside the Contractor's organization any unclassified information, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract, unless-

(1) The Contracting Officer has given prior written approval;
(2) The information is otherwise in the public domain before the date of release; or
(3) The information results from or arises during the performance of a project that involves no covered defense information (as defined in the clause at DFARS 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting) and **has been scoped and negotiated by the contracting activity with the contractor and research performer and determined in writing by the contracting officer to be fundamental research* (which by definition cannot involve any covered defense information)**, in accordance with National Security Decision Directive 189, National Policy on the Transfer of Scientific, Technical and Engineering Information, in effect on the date of contract award and the Under Secretary of Defense (Acquisition, Technology, and Logistics) memoranda on Fundamental Research, dated May 24, 2010, and on Contracted Fundamental Research, dated June 26, 2008 (available at DFARS PGI 204.4).

(b) Requests for approval under paragraph (a)(1) shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 10 business days before the proposed date for release.

(c) The Contractor agrees to include a similar requirement, including this paragraph (c), in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

***Note: This has to be negotiated prior to award of the contract. A request for determination after award will not be entertained and will result in the clause being pushed down to all subcontracts. Non-performance could result in cancelation of contract.**

5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION

(a) Except as provided in paragraph (b) of this clause, information pertaining to this contract shall not be released to the public unless authorized by the Contracting Officer in accordance with DFARS 252.204-7000, Disclosure of Information. Requests for approval to release information pertaining to this contract shall be submitted to the Contracting Officer by means of NGA Form 5230-1, National Geospatial-Intelligence Agency Request for Clearance for Public Release.

(b) The contractor may provide past performance information regarding this contract, without Contracting Officer approval, to the Office of the Director of National Intelligence (ODNI), the Central Intelligence Agency (CIA), the National Reconnaissance Office (NRO), the National Security Agency (NSA), the Defense Intelligence Agency (DIA), and NGA to support source selections at those agencies. The contractor is responsible for the proper classification and handling of such information and shall provide a copy of the information provided to the Contracting Officer.

5X52.227-9000 UNAUTHORIZED USE OF NGA NAME, SEAL AND INITIALS

(a) As provided in 10 U.S.C. Section 425, no person may, except with the written permission of the Director, National Geospatial-Intelligence Agency, knowingly use the words “National Geospatial-Intelligence Agency”, National Imagery and Mapping Agency” or “Defense Mapping Agency”, the initials “NGA”, “NIMA” or “DMA”, the seal of the National Geospatial-Intelligence Agency, National Imagery and Mapping Agency or the Defense Mapping Agency, or any colorable imitation of such words, initials, or seal in connection with any merchandise, retail product, impersonation, solicitation, or commercial activity in a manner reasonably calculated to convey the impression that such is approved, endorsed, or authorized by the Director, NGA.

(b) Whenever it appears to the U.S. Attorney General that any person is engaged or about to engage in an act or practice which constitutes or will constitute conduct prohibited by paragraph (a), the Attorney General may initiate a civil proceeding in a district court of the United States to enjoin such act or practice. Such court shall proceed as soon as practicable to hearing and determination of such action and may, at any time before such final determination, enter such restraining orders or prohibition, or take such other action as is warranted, to prevent injury to the United States, or to any person or class of persons whose protection the action is brought.

END

VERSION 3

NGA SBIR 22.2 Phase I Topic Index

VERSION 3

OSD222-001 [Topic Removed]

OSD222-D02 TITLE: Advanced Integrated CMOS Terahertz (THz) Focal Plane Arrays (FPA)

OUSD (R&E) MODERNIZATION PRIORITY: Microelectronics, AI/ML

TECHNOLOGY AREA(S): Information Systems, Modeling and Simulation Technology

OBJECTIVE: Develop advanced THz-FPA that offer large pixel count, high dynamic range, and high speed over a broad THz frequency range.

DESCRIPTION: Electromagnetic waves in the THz spectral band (roughly covering the 0.1 – 3 THz frequency range) offer unique properties for chemical identification, nondestructive imaging, and remote sensing. However, existing THz devices have not yet provided all the functionalities required to fulfill many of these applications. Although complementary metal–oxide–semiconductor (CMOS) technologies have been offering robust solutions below 1 THz, the high-frequency portion of the THz band still lacks mature devices. For example, most of the THz imaging and spectroscopy systems use single-pixel detectors, which results in a severe tradeoff between the measurement time and field of view. To address this problem, a large pixel count, high dynamic range, high speed, and broadband THz-FPA needs to be developed. The proposed THz-FPA can operate either as a frequency-tunable continuous-wave detector or a broadband-pulsed detector. It should be able to operate over a 1 – 3 THz frequency range while offering more than 30 decibel (dB) dynamic range per pixel. It should have more than 1,000 pixels and a frame rate of at least 1 hertz (Hz). Some anticipated features include developing THz-FPAs by exploring three-dimensional microstructures, smart readout integrated circuits, and processors that incorporate neuromorphic computing and ML to increase the data collection efficiency.

Direct Phase 2 Proposals—that is, proposals that skip Phase I—are being accepted under this topic. Such proposals should describe existing Thz technologies and their challenges, contrast with the proposed effort, and build a prototype with a long dynamic range. The effort should clearly justify the rational for a direct Phase II proposal and identify clear milestones. A direct Phase II proposal must include strong evidence of a verified standard FPA with comparable frequency range.

PHASE I: Demonstrate a proof-of-concept THz-FPA with at least 16 pixels. Show that each pixel of the THz-FPA meets the dynamic range and bandwidth requirements. Introduce a data readout method that can maintain the large dynamic range and broad bandwidth requirements for more than 1,000 pixels and a frame rate of at least 1 Hz. Develop a Phase II plan that includes technology integration, test, and validation with representative structures.

PHASE II: Realize the THz-FPA consisting of at least 1,000 pixels integrated with the read-out circuits. Demonstrate the functionality of the final prototype to take THz images with more than a 30dB dynamic range over a 1 – 3 THz bandwidth in less than 1 second. The prototype system will vary based on the proposed approach, but it may include hardware and software. Develop a technology transition plan and business case assessment.

PHASE III DUAL USE APPLICATIONS: Broadband THz imaging FPA enable sensors for detailed feature and frequency spectrum capture that support several DoD missions, including battlespace target assessment, remote sensing, surveillance in low-visibility conditions, nondestructive material quality control; law enforcement missions to detect illicit drugs and narcotics; and regulatory agencies for detecting toxins in drug, food, and agricultural products.

REFERENCES:

1. C. Posch, T. Serrano-Gotarredona, B. Linares-Barranco, T. Delbruck. Retinomorphic event-based vision sensors: Bioinspired cameras with spiking output. Proceedings of the IEEE 102, 10, 1470–1484, Oct. 2014, doi:10.1109/JPROC.2014.2346153.
2. K. Kito, T. Matsui, S. Kidera. Depth-adaptive object identification using terahertz time domain spectroscopic data. IEEE Transactions on Terahertz Science and Technology 11.5 (2021): 598–604.
3. B. Limbacher, S. Schoenhuber, M. Wenclawiak, M.A. Kainz, A.M. Andrews, G. Strasser, J. Darmo, K. Unterrainer. Terahertz optical machine learning for object recognition. APL Photonics 5, 126103 (2020). https://doi.org/10.1063/5.0029310.

KEYWORDS: Terahertz focal plane, imaging, optical machine learning, CMOS

UNITED STATES SPECIAL OPERATIONS COMMAND
22.2 Small Business Innovation Research (SBIR)
Phase I Proposal Submission Instructions

INTRODUCTION

The United States Special Operations Command (USSOCOM) seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces through the Department of Defense (DoD) SBIR 22.2 Program Broad Agency Announcement (BAA).

Offerors responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. USSOCOM requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below. A thorough reading of the "Department of Defense Small Business Innovation Research (SBIR) Program, SBIR 22.2 Program Broad Agency Announcement (BAA)", located at https://rt.cto.mil/rtl-small-business-resources/sbir-sttr/, prior to reading these USSOCOM instructions is highly recommended. The Offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of these instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

The USSOCOM SBIR/STTR Program Office will be hosting a virtual USSOCOM Industry Day on **27 April 2022** to further delineate requirements and stimulate small business/research institute partnership-building. Please visit **https://sofwerx.wufoo.com/forms/p1g2hq7v12gcm6l/** for more information.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Proposal Volumes are key in the qualification of the proposal. Offerors shall complete each of the following volumes. Those volume are (1) Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report, (5) Pitch Day Presentation, and (6) Fraud, Waste and Abuse Training.

Please Note:

1. It is the Offeror's responsibility to make sure all DoD and SOCOM instructions are followed, and proper documentations are submitted. The DSIP (DoD's SBIR/STTR proposal submission website) will NOT be able to ensure your submission is in accordance with both DoD and SOCOM instructions. The DSIP "100% submitted" means that the upload process is complete; It does NOT mean the proposal submission is in compliance with the stated instructions and that all required documentation is successfully uploaded.
2. SOCOM doesn't assist offerors with proposal preparation or review of proposals for completeness. We recommend you use your local and state resources for assistance. (See DoD Instructions for resources information.)
3. We have encountered issues while downloading proposals document titles, due to lengthy file names. The contractor shall not use more than 50 characters to include spaces in any of the proposal documents titles.

Cover Page (Volume 1) is created as part of the DoD Proposal Submissions process.

Technical Volume (Volume 2)
The technical volume is not to exceed 5 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Format of Technical Volume (Volume 2). If the Technical Volume exceeding five pages USSOCOM will only evaluate the first five pages of the Technical Volume. Additional pages will not be considered or evaluated.

Content of the Technical Volume
Required items are under the DoD SBIR Program BAA Phase I Technical Volume instructions stated in https://rt.cto.mil/rtl-small-business-resources/sbir-sttr/ under the paragraph titled "Content of the Technical Volume 2".

The identification of foreign national involvement in a USSOCOM SBIR topic is needed to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 of the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined section titled "Foreign Nationals" of the DoD SBIR Program BAA) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase I contract.

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $150,000.00. Costs must be identified on the Proposal Cover Sheet (Volume 1) and in Volume 3. Once the proposal is initiated you will have access to the required USSOCOM specific Cost Volume instructions and template.

A minimum of two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing firm. The percentage of work is measured by both direct and indirect costs as a percentage of the total contract cost.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by USSOCOM during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the documentation outlined in the DoD SBIR Program BAA, the following documents must also be included with Volume 5: (1) PowerPoint presentation, (2) Section K, and (3) Resumes.

(1) PowerPoint Presentation: Potential Offerors shall submit a slide deck **not to exceed 15 PowerPoint slides (inclusive of the cover sheet).** The presentation shall not have any videos or links to videos. There is no set format for this document. It is recommended (but not required) that more detailed information is included in the technical volume and higher-level information is included in the slide deck suitable for a possible presentation. Refer to the "Phase I Evaluations" Section of this instruction for more details.

(2) Section K: If Section K is not submitted with the proposal, the proposal will still be considered responsive, but the completed Section K shall be required at the time of award.

(3) Resumes: Include resumes as required.

Fraud, Waste and Abuse Training (Volume 6)

Fraud, Waste and Abuse (FWA) training is required for Phase I proposals. Please refer to the DoD SBIR Program BAA instructions for full details.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
USSOCOM does not provide Discretionary Technical and Business Assistance for Phase I awards.

INQUIRIES

During the Pre-release and Open Periods of the DoD SBIR Program BAA, all questions must be submitted to the online Defense SBIR/STTR Innovation Portal (DSIP) Topic Q&A. All questions and answers submitted to DSIP Topic Q&A will be released to the general public. USSOCOM does not allow inquirers to communicate directly in any manner to the topic authors (differs from the DoD SBIR Program BAA instructions). All inquiries must include the topic number in the subject line of the e-mail.

Consistent with DoD SBIR instructions, USSOCOM will not answer programmatic questions, such as who the technical point of contact is, the number of contracts to be awarded, the source of funding, transition strategy.

Site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR Program BAA.

EVALUATION AND SELECTION

All Offerors will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA, with the following exceptions:

1. Proposals missing any of the six stated volumes or those that do not comply with the requirement of two-thirds of the work conducted by the proposing firm will not be evaluated. Likewise, proposals that exceed the maximum price allowed as per Table 1 of these instructions will be considered non-responsive.

2. The technical evaluation will utilize the Evaluation Criteria provided in DoD SBIR Program BAA instructions. Refer to the “Phase I Evaluations” Section of this instruction for more details. The Technical Volume and slide deck will be reviewed holistically. The technical evaluation is performed in two parts:

   Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided of the DoD SBIR Program BAA. Once the evaluations are complete, all Offerors will be notified in a timely manner.

   Selected Offerors **may** receive an invitation to present their slide deck (30 minute presentation time / 30 minute Government question and answer period) to the USSOCOM technical evaluation team, using virtual teleconference. This will be a technical presentation of the proposed solution ONLY. The key personnel listed in the proposal should represent the presentation and responding to the questions of the evaluation team. This presentation is NOT intended for business development personnel, it is purely technical. Selected Offerors shall restrict their Pitch Day presentations to the 15-page

PowerPoint presentations ONLY that were submitted with their respective proposals. There will be no changes or updates to the presentations from what was proposed. All selected firms will be required to provide teleconference information for the presentation. This presentation will complete the evaluation of the proposal against the criteria listed in the DoD SBIR Program BAA. Notifications of selection/non-selection for Phase I award will be completed within a timely manner.

Part II: The Cost Volume award amount is set at a not to exceed (NTE) amount and a technical evaluation of the proposal cost will be completed to assess price fair and reasonableness. Proposals above the established NTE for the Phase I effort will not be considered for award. The team will assess the technical approach presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, subcontractors and consultants (scope of work, expertise, participation and proposed effort), and other direct cost as proposed.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. When appropriate, non-government advisors may have access to Offeror's proposals and may be utilized to objectively review a proposal in a particular functional area and provide comments and recommendations to the Government's decision makers. They may not establish final assessments of risk, rate or rank Offerors' proposals. All advisors shall comply with procurement Integrity Laws and shall sign Non-Disclosure and Rules of Conduct/ Conflict of Interest statements. The Government shall take into consideration requirements for avoiding conflicts of interest. Submission of a proposal in response to this request constitutes approval to release the proposal to Government support contractors.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA by the USSOCOM Contracting Office. This notification will come by e-mail to the Corporate Official identified by the Offeror during proposal submission. The Government will also notify the Offerors if their proposal is considered non-responsive (disqualified).

A non-selected Offeror can make a written request to the Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The Contracting Officer will provide informal feedback after receipt of an Offeror's written request rather than a debriefing as specified in the DoD SBIR Program BAA instructions.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: sbir@socom.mil.

AWARD AND CONTRACT INFORMATION

Table 1: Consolidated SBIR Topic Information

Topic	**Technical Volume (Vol 2)**	**Additional Info. (Vol 5)**	**Period of Performance**	**Award Amount**	**Contract Type**
Phase I SOCOM222-001	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	NTE $150,000.00	Firm-Fixed-Price

Phase I SOCOM222-002	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	NTE $150,000.00	Firm-Fixed-Price
Phase I SOCOM222-003	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 6 months	NTE $150,000.00	Firm-Fixed-Price

SBIR awards for topics SOCOM222-001, and SOCOM222-002 may be made under the authority of National Defense Authorization Act (NDAA) for Fiscal Year 2022, Section 841, MODIFICATION OF PILOT PROGRAM FOR DEVELOPMENT OF TECHNOLOGY- ENHANCED CAPABILITIES WITH PARTNERSHIP INTERMEDIARIES. USSOCOM may use a partnership intermediary to award SBIR contracts and agreements to small business concerns. SOCOM222-001, and SOCOM222-002 SBIR contract awards may be done through SOFWERX and result in a commercial contract between the firm and DEFENSEWERX. The Government will conduct evaluations and selections for award all for all SBIR Phase I topics listed in this BAA. SOCOM222-003 awards will be made by USSOCOM SBIR Contracting Office.

ADDITIONAL INFORMATION

Phase I proposals shall NOT include:

1) Any travel for Government meetings. All meetings with the Government will be conducted via electronic media.
2) Government furnished property or equipment.
3) Priced or Unpriced Options.
4) “Basic Research” (or “Fundamental Research”) defined as a “Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.”
5) Human or animal studies.
6) Discretionary Technical and Business Assistance

SOCOM SBIR 22.2 Phase I Topic Index

SOCOM222-001 TITLE: Solid State High Energy Desity Batteries

OUSD (R&E) MODERNIZATION PRIORITY: Microelectronics; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials; Electronics

OBJECTIVE: The objective of this topic is to develop applied research toward an innovative capability to enhance battery safety and enhance the energy capacity of batteries used in a maritime environment.

DESCRIPTION: The objective of this topic is to develop applied research toward an innovative capability to conduct the research, development, and assessment of a viable overall system design options with respective specifications detailed below.

Current lithium-ion battery systems are inherently unsafe. While they are the current technology that blends the attributes of affordability and energy capacity, they pose risks that can be detrimental to operating/stowage on maritime vessels, operating in an undersea environment, and operating while forward. Lithium batteries carry the risk of thermal runaway. Any lithium battery, when exposed to fire, can sympathetically ignite, which worsens the severity of a fire, thereby possibly igniting other lithium batteries nearby and releasing a toxic off-gas biproduct. SOCOM seeks to implement improved systems that allow for safe, efficient, and effective energy storage. Traditional batteries in inventory use vendor-specific means of using multiple 18650-based cells to produce the power and current levels needed unique to each system. The following attributes describe key characteristics that would be sustained and/or desirable in a battery system over current lithium battery systems:

1. More energy storage (longer duration of use at a fixed discharge rate) than an 18650-based battery.
2. Safe static storage (specifically, in a fire event, the battery does not contribute to additional severity of the fire).
3. Safe dynamic use in discharge (in use, the battery does not pose risk of fire, electric shock, nor release of toxic off-gas biproduct).
4. Maintain overall small size and weight for integration in a variety of maritime platforms. Improve performance over lithium 18650-based battery.
5. Faster charge than current lithium-ion batteries without detrimental effects (reference current Li-O battery charging speed) – performance improved over lithium 18650-based battery.
6. Able to integrate into a pressure system operating in an undersea environment up to 200 feet of seawater (fsw).

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”
The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (No more than a Technology Readiness Level 3) to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility

studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on a solid state high energy density battery.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where stable, safe battery power with high energy density is needed.

REFERENCES:
1. https://news.mit.edu/2021/designing-better-batteries-electric-vehicles-0816

KEYWORDS: lithium ion; lithium; battery; thermal runaway; graphene; energy storage

SOCOM222-D002 TITLE: Utilizing ML Algorithms to Track and Identify UAS Threats

OUSD (R&E) MODERNIZATION PRIORITY: Autonomy; Artificial Intelligence/Machine Learning; General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Sensors; Electronics; Information Systems

OBJECTIVE: The objective of this topic is to develop applied research toward an innovative capability to conduct the research, development, and assessment of a lidar based system utilizing Machine Learning (ML) algorithms to create electronic signatures for Unmanned Aerial System (UAS) identification and continuous surveillance of UAS threats.

DESCRIPTION: As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications for detection and identification of UAS that provide real-time alerts with geolocation of target objects in the air. The main features for technology development should include range maximization while maintaining accuracy of detection, integration with radar, integration with active mitigation measures, and development of algorithms to create a library of UAS profiles.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”
The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (not to exceed “Technology Readiness Level 3”) to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on the utilization of ML algorithms to track and identify UAS threats. Phase II should result in the proof of concept and prototype development of a lidar based system for UAS identification with a focus on performance, Size Weight and Power (SWaP) goals, and the refinement of the UAS profile library.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where the integration of a lidar based system with an operational radar provides accurate identification of different Type 1 and 2 UAS threats, lower false positives from UAS identification, improves UAS defense capability with integration with existing radar capabilities, and provides accurate ability to pinpoint UAS interception for single UAS and/or swarm threats.

REFERENCES:

1. “Target Classification by mmWave FMCW Radars Using Machine Learning on Range-Angle Images”, IEEE Sensors Journal - Volume: 21, Issue: 18, Sept 15, 2021 http://cds.iisc.ac.in/faculty/yalavarthy/Gupta_IEEESensors_2021.pdf.
2. “Dynamic Multi-LiDAR Based Multiple Object Detection and Tracking”, Multidisciplinary Digital Publishing Institute (MDPI) – Mar 26, 2019.
3. https://www.mdpi.com/1424-8220/19/6/1474/pdf

KEYWORDS: counter unmanned air systems; unmanned air systems; unmanned air vehicles; lidar; machine learning; artificial intelligence; detection; identification; tracking; radar integration; geolocation; drones; situational awareness; aerial systems; aerial vehicles; autonomous vehicles

SOCOM222-D003 TITLE: CO_2 Scrubber Material

OUSD (R&E) MODERNIZATION PRIORITY: General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: The objective of this topic is to develop applied research toward an innovative capability to enhance CO_2 scrubber material composition, duration, and technology. The proposed solution has the benefit of being regenerative and having a significantly greater surface area which will allow for a much higher volume of CO_2 to be captured per unit area. The introduction of this solution potentially enables a range of innovative new diving product designs offering equivalent performance in a smaller and lighter package, with reduced user maintenance. Moreover, it has the potential to significantly reduce the risk of CO_2 breakthrough due to improper filling of scrubber material into a canister.

DESCRIPTION: The diving industry's standard solution for the removal of exhaled carbon dioxide (CO_2) from the breathing loop is a cartridge containing soda lime; a unit commonly known as a CO_2 scrubber. Soda lime is a solid off-white mixture of calcium and sodium hydroxides used in rebreathers and other closed-circuit breathing environments to prevent the build-up of CO_2 gas. The diver's exhaled breath passes through the soda lime where the CO_2 chemically reacts with the soda lime where it is absorbed. This irreversible chemical reaction restricts subsea operations based on size and duration of the system. This current CO_2 absorbent technology cannot be recharged and therefore must be replenished / replaced after each use.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled "Objective" and "Description."
The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (not to exceed "Technology Readiness Level 3") to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on a CO_2 scrubber material.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where removing carbon dioxide within life support systems is required.

REFERENCES:

1. https://www.earth.com/news/co2-scrubbing-technology-scuba-gear/

KEYWORDS: oxygen rebreather; scrubber; scrubber canister; carbon dioxide; breathing loop; life support system; CO2 scrubber; CO2 scrubbing