

**DEPARTMENT OF DEFENSE**  
**SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM**  
**SBIR 23.3 Program Broad Agency Announcement (BAA)**

**August 23, 2023:** DoD BAA issued for pre-release

**September 20, 2023:** DoD begins accepting proposals

**October 18, 2023:** Deadline for receipt of proposals no later than **12:00 p.m. ET**

Participating DoD Components:

- Department of Navy (Navy)
- Department of Air Force (Air Force)
- Chemical and Biological Defense (CBD)
- Defense Health Agency (DHA)
- Defense Logistics Agency (DLA)
- Office of Secretary of Defense – Defense Human Resource Activity (OSD – DHRA)
- Office of Secretary of Defense – National Geospatial-Intelligence Agency (OSD – NGA)

**IMPORTANT**

This BAA incorporates **MANDATORY** foreign disclosure requirements and other important programmatic changes as required by the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). These updates can be found in sections 2.2, 2.5, 3.0, 4.2.e., 4.3, 6.0, 8.2, and Attachment 2. Proposals that do not include the completed Attachment 2 in Volume 5 **will be deemed noncompliant and will not receive an evaluation**. Small business concerns are highly encouraged to review the full BAA to remain apprised of any additional recent programmatic changes.

**Deadline for Receipt:** Complete proposals must be certified and submitted in DSIP no later than **12:00 PM ET on October 18, 2023**. 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. Proposing Small Business Concerns are required to register for a Login.gov account and link it to their DSIP account. See section 4.16 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 (BAA). The DoD SBIR/STTR Programs follow the policies and practices of the SBA SBIR/STTR Policy Directive, current version. 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 [HERE](#).

**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.

**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](mailto: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 4.15 for further information on where to direct questions regarding instructions and topics in this BAA.

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## 1.0 INTRODUCTION

Navy, Air Force, CBD, DHA, DLA, OSD – DHRA, and OSD – NGA, hereafter referred to as DoD Components, invite proposing small business concerns to submit proposals under this BAA for the Small Business Innovation Research (SBIR) Program. Proposing Small Business Concerns 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**. Navy, Air Force and DHA 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 proposing small business concerns 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 proposing small business concern 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 proposing small business concern before the issuance of any award. Proposals must conform to the terms of this announcement.

## 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 Due Diligence Program to Assess Security Risks

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. The full text of the SBIR and STTR Extension Act of 2022 is available at <https://www.congress.gov/117/plaws/publ183/PLAW-117publ183.pdf>.

As previously stated, the DoD SBIR/STTR Programs follow the policies and practices of the Small Business Administration (SBA) [SBIR/STTR Policy Directive](#). The Policy Directive was revised effective May 3, 2023, to incorporate requirements of the SBIR and STTR Extension Act of 2022. This revision is incorporated into this BAA, including the utilization of the Appendix III, Disclosure Questions, as Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries”. **Proposals that do not include the completed Attachment 2 in Volume 5 of the proposal submission will be deemed noncompliant and will not receive an evaluation.**

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The Department will use information provided by the small business concern in response to the Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the financial ties and obligations (which shall include surety, equity, and debt obligations) of the small business concern and employees of the small business concern to a foreign country, foreign person, or foreign entity. The Department will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13).

DoD has partnered with Project Spectrum to provide an online course on Understanding Foreign Ownership, Control, or Influence (FOCI). This course defines FOCI, explains what it means to be under FOCI, and details FOCI's effect on a company seeking initial or continued eligibility for access to a federally funded award. Small business concerns can register and access this course by following the instructions below:

1. Go to [projectspectrum.io](https://projectspectrum.io)
2. Click "Profile/Dashboard" in the top right and then click "Sign Up" from the dropdown menu.
3. Follow the instructions to sign up for an account. Descriptions of the account types are provided below each option.
4. Verify your email by entering the code sent to the email address you provided when signing up.
5. Log in to Project Spectrum by clicking "Profile/Dashboard > Login" in the top right.
6. Find the Training Course on "Understanding Foreign Ownership, Control, or Influence (FOCI)" by clicking "Courses > Training Courses"
7. Copy the provided password.
8. Click on the course and log in to Encite.io using your email address and the copied password.
9. Enroll in the course and click "Enter" to begin.

For assistance with registration or access to the Project Spectrum website, please contact [support@projectspectrum.io](mailto:support@projectspectrum.io).

### **2.3 OUSD(R&E) Critical Technology Areas**

Although each DoD Component develops SBIR and STTR topics that are mission-oriented to their programs, topics generally align with the OUSD(R&E) Critical Technology Areas. While many technologies may cross between these categories, these areas represent the broad and different approaches that are required to advance technologies crucial to the Department. By focusing efforts and investments into these critical technology areas, the Department will accelerate transitioning key capabilities to the Military Services and Combatant Commands.

OUSD(R&E) Critical Technology Areas:

- FutureG
- Trusted AI and Autonomy
- Biotechnology
- Advanced Computing and Software
- Integrated Sensing and Cyber
- Directed Energy (DE)
- Hypersonics
- Microelectronics
- Integrated Network Systems-of-Systems
- Quantum Science



(D) expand the ability for qualifying small business concerns to propose technology solutions to meet the needs of the Department of Defense.

Unlike conventional topics, which specify the desired technical objective and output, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities.

**A small business concern may only submit one (1) proposal to each open topic.** If more than one proposal from a small business concern is received for a single open topic, only the most recent proposal to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for the same open topic will be marked as nonresponsive and will not receive an evaluation.

Open topics released under this BAA will be clearly identified as such in the title and objective of the topic. Proposal preparation instructions for open topics may vary significantly across DoD Components. Proposing small business concerns are advised to carefully read and follow all instructions from the DoD Component for the open topic of interest. Unless specifically noted in the Component instructions, all requirements outlined in this BAA remain in effect for open topics.

### **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 small business concern.

#### **Covered Individual**

An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

## **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](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.

## **Federally Funded Award**

A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

## **Foreign Affiliation**

As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

## **Foreign Country of Concern**

As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People's Republic of China, the Democratic People's Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

## **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 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 contracts and other transaction authority (OTA) agreements will be used by DoD Components for 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).

## **Malign Foreign Talent Recruitment Program**

As defined in 42 U.S.C § 19237, the term “malign foreign talent recruitment program” means-

- (A) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-
  - (i) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;
  - (ii) being required to recruit trainees or researchers to enroll in such program, position, or activity;
  - (iii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;
  - (iv) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;
  - (v) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;
  - (vi) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;
  - (vii) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award,

- contrary to the institutional policies or standard terms and conditions of the Federal research and development award;
- (viii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or
- (ix) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and

(B) a program that is sponsored by-

- (i) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;
- (ii) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or
- (iii) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

### **Performance Benchmark Requirements**

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.

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations and increased performance standards for more experienced firms can be found at <https://www.sbir.gov/performance-benchmarks>.

### **Personal Conflict of Interest**

A situation in which an individual has a financial interest, personal activity, or relationship that could impair the employee's ability to act impartially and in the best interest of the Government when performing under the contract. (A de minimis interest that would not "impair the employee's ability to act impartially and in the best interest of the Government" is not covered under this definition.)

Among the sources of personal conflicts of interest are-

- (i) Financial interests of the covered employee, of close family members, or of other members of the covered employee's household;
- (ii) Other employment or financial relationships (including seeking or negotiating for prospective employment or business); and
- (iii) Gifts, including travel.

Financial interests referred to in paragraph (1) of this definition may arise from-

- (i) Compensation, including wages, salaries, commissions, professional fees, or fees for business referrals;
- (ii) Consulting relationships (including commercial and professional consulting and service arrangements, scientific and technical advisory board memberships, or serving as an expert witness in litigation);

- (iii) Services provided in exchange for honorariums or travel expense reimbursements;
- (iv) Research funding or other forms of research support;
- (v) Investment in the form of stock or bond ownership or partnership interest (excluding diversified mutual fund investments);
- (vi) Real estate investments;
- (vii) Patents, copyrights, and other intellectual property interests; or
- (viii) Business ownership and investment interests.

### **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 proposing 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 proposing small business concern 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 any information that a small business concern considers to be non-public information that is owned by the small business concern and is marked accordingly.

### **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. Proposing small business concerns 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](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](http://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 small business concern 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. DoD does not guarantee Direct to Phase II opportunities will be offered in future BAAs.

Each eligible topic requires that proposing small business concerns 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 proposing small business concern and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposing small business concern 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 proposing small business concern 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 Proposing Small Business Concern Eligibility and Performance Requirements

- a. Each proposing small business concern 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). Proposing small business concern must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702).
- b. A minimum of two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing small business concern. For Phase II, a minimum of one-half (50%) of the research

and/or analytical work must be performed by the proposing small business concern. The percentage of work is measured by both direct and indirect costs. Occasionally, deviations from these SBIR requirements may occur, and must be approved in writing by the Funding Agreement officer after consultation with the agency SBIR/STTR program manager/coordinator. For more information on the percentage of work calculation during proposal submission, refer to section 5.3.

- c. For both Phase I and II, the primary employment of the principal investigator must be with the proposing small business concern 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.** Proposing small business concern with prior SBIR/STTR awards must meet two performance benchmark requirements as determined by the Small Business Administration (SBA) on June 1 each year.
  - (1) Phase I to Phase II Transition Rate: For all proposing small business concerns 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 proposing small business concerns with greater than 15 Phase II awards over the last 10 fiscal years excluding the last two years, the proposing small business concern 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.

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations, increased performance standards for more experienced firms and consequence of failure to meet benchmarks can be found at <https://www.sbir.gov/performance-benchmarks>.

As defined by the SBIR/STTR Policy Directive, Department of the Army, Department of the Navy, and Department of the Air Force each constitute its own Federal agency, and the remaining DoD Components fall under the executive agency of the Department of Defense. Companies that fail to meet either of the benchmarks under the Increased Performance Standards for more Experienced Firms may not receive more than an overall total of 80 awards from DoD, as detailed in the breakdown below:

Army – 20 total Phase I and Direct to Phase II awards

Navy – 20 total Phase I and Direct to Phase II awards

Air Force – 20 total Phase I and Direct to Phase II awards

All other DoD Components - 20 Phase I and Direct to Phase II awards, combined

#### **4.3 Disclosures Regarding Ties to People’s Republic of China and Other Foreign Countries**

Each proposing small business concern is required to complete Attachment 2 of this BAA, “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” and upload the form to Volume 5, Supporting Documents. **Proposals that do not include the completed Attachment 2 in Volume 5 of the proposal submission will be deemed noncompliant and will not receive an evaluation.** The disclosure requires the following information:



- (A) the identity of all owners and covered individuals of the small business concern who are a party to any foreign talent recruitment program of any foreign country of concern, including the People's Republic of China;
- (B) the existence of any joint venture or subsidiary of the small business concern that is based in, funded by, or has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
- (C) any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;
- (D) whether the small business concern is wholly owned in the People's Republic of China or another foreign country of concern;
- (E) the percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
- (F) any technology licensing or intellectual property sales to a foreign country of concern, including the People's Republic of China, during the five-year period preceding submission of the proposal; and
- (G) any foreign entity, offshore entity, or entity outside the United States related to the small business concern.

After reviewing the above listed disclosures of the proposing small business concern, and if determined appropriate by the DoD, the Department may ask the small business concern may to provide true copies of any contractual or financial obligation or other agreement specific to a business arrangement or joint-venture like arrangement with an enterprise owned by a foreign state or any foreign entity in effect during the five-year period preceding submission of the proposal with respect to which the small business concern made the disclosures.

#### **4.4 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. Proposing small business concern must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies.

A small business joint venture entity must submit, with its proposal, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

- (A) Small business;
- (B) Service-disabled veteran-owned small business;
- (C) Women-owned small business (WOSB) under the WOSB Program;
- (D) Economically disadvantaged women-owned small business under the WOSB Program; or
- (E) Historically underutilized business zone small business.

These representations can be found as Attachment 3 to this BAA and must be uploaded to Volume 5, Supporting Documents of the proposal submission in DSIP, if applicable.

#### **4.5 Majority Ownership in Part by Multiple Venture Capital, Hedge Fund, and Private Equity Firms**

Unless otherwise noted in the participating Component instructions, proposing small business concerns 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 proposing small business concern that is owned, in whole in 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 proposing small business concern, whether such equity stake is directly or indirectly held. The proposing small business concern 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.

#### **4.6 Conflicts of Interest**

Contract awards to proposing small business concern 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.

#### **4.7 Organizational Conflicts of Interest (OCI)**

##### FAR 9.5 Requirements

In accordance with FAR 9.5, proposing small business concerns are required to identify and disclose all facts relevant to potential OCIs involving the proposing small business concern's organization and any proposed team member (sub-awardee, consultant). Under this Section, the proposing small business concern is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposing small business concern's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposing small business concern has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposing small business concern's judgment and to prevent the proposing small business concern 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. As part of the FAR 9.5 disclosure requirement above, a proposing small business concern must affirm whether the proposing small business concern 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 proposing small business concerns to provide additional information to assist the Government in evaluating the proposing small business concern'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.

#### **4.8 Classified Proposals**

Classified proposals will not be accepted under the DoD SBIR Program. If topics will require classified work during Phase II, the proposing small business concern 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/>.

#### **4.9 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. proposing small business concerns 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.**

#### **4.10 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.**

#### **4.11 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.

#### **4.12 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.

#### **4.13 Pre-Award and Post Award BAA Protests**

Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of this BAA must be served to:

Ms. Tara Randolph  
Contracting Officer

[tara.j.randolph.civ@us.navy.mil](mailto:tara.j.randolph.civ@us.navy.mil) & [osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil](mailto:osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil)

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 proposing small business concern may also be made to the Small Business Administration.

#### **4.14 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 each 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 negotiation and possible 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 proposing small business concerns 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 important for proposing small business concerns to review Component-specific instructions regarding award size.
- d. **Timing.** Proposing small business concerns 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. 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.

#### **4.15 Questions about this BAA and BAA Topics**

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

(1) **DSIP Support:**

Email DSIP Support at [DoDSBIRSupport@reisystems.com](mailto: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 small business concern, 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.  
Proposing small business concerns 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://www.defensesbirsttr.mil/>, 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 **August 23, 2023 – September 20, 2023**, 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 small business concerns 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 small business concerns 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 **September 20, 2023**, no further direct contact between proposing small business concerns and topic authors is allowed unless the Topic Author is responding to a question submitted during the pre-release period. Proposing small business concerns 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 small business concerns 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 **August 23, 2023**, and closes to new questions on **October 4, 2023, 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 small business concerns are advised to monitor Topic Q&A during the BAA period for questions and answers. Proposing small business concerns should also frequently monitor DSIP for updates and amendments to the topics.**

#### **4.16 Registrations and Certifications**

Individuals from proposing small business concerns must be registered in the Defense SBIR/STTR Innovation Portal (DSIP) in order to prepare and submit proposals. **The DSIP application is only accessible from within the United States, which is defined as 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.** All users are required to have an individual user account to access DSIP. As DSIP user accounts are authenticated by Login.gov, all users, who do not already have a Login.gov account, will be required to create one. 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, can be accessed here: <https://www.dodsbirsttr.mil/submissions/learning-support/training-materials>.

**Be advised that the sharing of accounts and passwords is a violation of the Terms of Use for Login.gov and DoD policy.**

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 UEI or 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 UEI or 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 UEI or 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.

**Users should complete their account registrations as soon as possible to avoid any delays in proposal submissions.**

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit [www.sam.gov](http://www.sam.gov). A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its 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 proposing small business concern 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 proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the small business concern profile with the UEI (SAM) as soon as possible.**

For new proposing small business concern 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 proposing small business concern'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 proposing small business concerns at time of award and during the award life cycle. Each proposing small business concern 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.

#### **4.17 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.

#### **4.18 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 negotiation for 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 5.3.c(11).

#### **4.19 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](mailto:hotline@dodig.mil).

#### **4.20 State and Other Assistance Available**

Many states have established programs to provide services to those proposing small business concerns 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#](https://www.sbir.gov/state_services?state=105813#) for further information. Small business concerns may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States.

#### **4.21 Discretionary Technical and Business Assistance (TAB A)**

DoD has not mandated the use of TAB A 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. The proposing small business concerns should carefully review individual component instructions to determine if TAB A is being offered and follow specific proposal requirements for requesting TAB A 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. Proposing small business concerns are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through this site for the first time will be asked to register. It is recommended that proposing small business concerns 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 small business concern'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) MANDATORY
- b. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) MANDATORY
- c. Verification of Eligibility of Small Business Joint Ventures (Attachment 3), if applicable
- d. Disclosure of Funding Sources (Attachment 4) MANDATORY
- e. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

**A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.**

Volume 6: Fraud, Waste and Abuse Training

All proposing small business concerns **must** complete the following:

- Volume 4: Company Commercialization Report (upload of CCR from SBIR.gov to DSIP is required for proposing small business concerns 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): Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
- Volume 5(c): Disclosure of Funding Sources (Attachment 4)
- 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 proposing small business concern 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 negotiation and possible award, the DoD Component program will contact the proposing small business concern for signatures prior to award.

## 5.2 Marking Proprietary Proposal Information

Proposing small business concerns 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 proposing small business concern 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. **Do not include proprietary or classified information in the Proposal Cover Sheet.** If your proposal is selected for negotiation and possible 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.

Effective January 2023, the amounts listed in the Percentage of Work (POW) certification question on the Proposal Cover Sheet are derived from information entered by the proposing small business concern in the Cost Volume (Volume 3). Details on the calculation can be viewed in DSIP during proposal submission.

If the POW calculations fall below eligibility requirements, a letter of explanation or approval by the Funding Agreement officer must be uploaded to the certification question to complete the submission. Some DoD Components will not accept any deviations from the POW minimum requirements. Please refer to the Component instructions regarding acceptance of deviations to the POW requirements.

**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 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.**
- (2) **Length:** It is the proposing small business concern'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 proposing small business concern 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 in the order given below:

- (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. If 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 the proper approvals have been obtained (see Sections 4.9 - 4.11). **Small Business Concerns 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 small business concern, 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 proposing small business concern'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 proposing small business concern'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 proposing small business concern 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. Proposing small business concerns 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. The proposal may be deemed nonresponsive if the requested information is not provided. The proposing small business concerns should report 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 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 small business concern, 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, proposing small business concerns 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. There is no need to provide information on each individual 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; 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 negotiation and possible 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.

The proposing small business concern 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 proposing small business concern 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 proposing small business concern 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 small business concern 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 proposing small business concern. 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 small business concern 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 small business concerns will have to recertify and resubmit such proposals. If a proposing small business concern does not recertify or resubmit such proposals, they will not be considered fully submitted and will not be evaluated.
- b. If the proposing small business concern 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 proposing small business concern 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 proposing small business concern 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 small business concern 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 small business concern will select NO. The CCR section of the proposal will be marked complete.

While all proposing small business concerns 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 proposing small business concerns to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

All proposing small business concerns 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)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
3. Disclosure of Funding Sources (Attachment 4)

**A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.**

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. Verification of Eligibility of Small Business Joint Ventures (Attachment 3)
8. 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 proposing small business concern's authorized proposing small business concern representative. The DFARS provisions and clause may be found in BAA Attachment 1. **These certifications must be signed by the authorized proposing small business concern 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 the proposing small business concern and any contractors that may be proposed as a part of the submission including research partners and suppliers. The proposing small business concerns 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. **Disclosures of Foreign Affiliations or Relationships to Foreign Countries**

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022 and the SBA SBIR/STTR Policy Directive, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. **Proposing small business concerns must complete Attachment 2: Disclosures of Foreign Affiliations or Relationships to Foreign Countries and upload to Volume 5. Proposals that do not include the completed Attachment 2 in Volume 5 will be deemed noncompliant and will not receive an evaluation.** For additional details, please refer to Section 2.2 and 4.3.

i. **Certification Regarding Disclosure of Funding Sources**

The proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, which requires that covered individuals:

- (A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
- (B) certify that the disclosure is current, accurate, and complete; and
- (C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award

Small business concerns must also certify that each covered individual who is employed by the small business and listed on the proposal has been made aware of the requirements listed above. **The disclosure and certification must be made by completing Attachment 4 of this**

**BAA and uploading to Volume 5, Supporting Documents of the proposal submission in DSIP.**

**j. 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 small business concern. 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 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 proposing small business concern.

**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, 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 proposing small business concern 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.

**Denial of Awards**

The DoD will not make an award under the SBIR program if it determines that—

- (A) the small business concern submitting the proposal –
  - (i) has an owner or covered individual that is party to a malign foreign talent recruitment program;
  - (ii) has a business entity, parent company, or subsidiary located in the People’s Republic of China or another foreign country of concern; or
  - (iii) has an owner or covered individual that has a foreign affiliation with a foreign entity located in the People’s Republic of China or another foreign country of concern; and
- (B) the relationships and commitments described in clauses (i) through (iii) of subparagraph (A)—
  - (i) interfere with the capacity for activities supported by the DoD to be carried out;
  - (ii) create duplication with activities supported by the DoD;

- (iii) present concerns about conflicts of interest;
- (iv) were not appropriately disclosed to the DoD;
- (v) violate Federal law or terms and conditions of contracts or other agreements awarded by the DoD; or
- (vi) pose a risk to national security.

## **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 negotiation for 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 proposing small business concern 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 proposing small business concern 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 proposing small business concern contain marketing expertise and, if not, how will that expertise be brought into the small business concern?
- (5) Who are the proposing small business concern'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 proposing small business concern 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**

To reduce risk to the small business and avoid potential contracting delays, 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 proposing small business concern 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 DoD SBIR/STTR Program 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-tech-transition@mail.mil](mailto:osd.ncr.ousd-r-e.mbx.sbir-sttr-tech-transition@mail.mil).

## 8.0 CONTRACTUAL REQUIREMENTS

### 8.1 Additional Contract Requirements

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 (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. 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 small business concern receiving an SBIR/STTR award is required to provide adequate cybersecurity on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. To learn about cybersecurity resources for your SBIR/STTR contract visit the Blue Cyber webpage: <https://www.safcn.af.mil/CISO/Small-Business-Cybersecurity-Information/>.
- 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](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.

## 8.2 Agency Recovery Authority and Ongoing Reporting

In accordance with Section 5 of the SBIR and STTR Extension Act of 2022, the DoD will –

- 1) require a small business concern receiving an award under its SBIR program to repay all amounts received from the Federal agency under the award if—
  - (A) the small business concern makes a material misstatement that the Federal agency determines poses a risk to national security; or
  - (B) there is a change in ownership, change to entity structure, or other substantial change in circumstances of the small business concern that the Federal agency determines poses a risk to national security; and
- 2) require a small business concern receiving an award under its SBIR program to regularly report to the Federal agency and the Administration throughout the duration of the award on—
  - (A) any change to a disclosure required under subparagraphs (A) through (G) of section 4.3 above;
  - (B) any material misstatement made under section 8.2 paragraph (A) above; and
  - (C) any change described in section 8.2 paragraph (B) above.

## 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 (NOV 2021)

- (a) **Definitions.** As used in this clause -



- (1) *Covered contractor information system* means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.
- (2) *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 websites) or simple transactional information, such as necessary to process payments.
- (3) *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).
- (4) *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).
- (5) *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 products or commercial services, 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.

(End of clause)

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

DFARS 252.225-7055, Representation Regarding Business Operations with the Maduro Regime, is incorporated into this solicitation. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from 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 the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

#### **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 concerns 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 U.S.C. § 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 Section 8.7, Invention Reporting.

## 8.7 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](http://www.iedison.gov) for those agencies participating in iEdison.

## 8.8 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 Government Purpose 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 proposing small business concern 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.

## 8.9 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 proposing small business concern in its Phase II proposal to report Phase I progress may also be used in the final report.

- (2) For each unclassified report, the proposing small business concern 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 2020-00007 (see Section 8.5, Technical Data Rights). The sponsoring DoD activity, after reviewing the proposing small business concern'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](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 2020-00007.

**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	
Small Business Concern 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**

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

**DISCLOSURES OF FOREIGN AFFILIATIONS OR  
RELATIONSHIPS TO FOREIGN COUNTRIES**

In accordance with the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) and the Small Business Administration (SBA) SBIR/STTR Policy Directive, small business concerns are required to disclose the information requested below about the small business’s investment and foreign ties.

Responses to disclosure questions may contain trade secrets or commercial or financial information that is privileged or confidential and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with an award between the submitter and the Government.

Relevant definitions can be found at the end of this document. An up-to-date list of countries determined to be countries of concern by the Secretary of State will be maintained and accessible on SBIR.gov.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

**The information provided in response to the Disclosure Questions listed below is certified to be accurate and complete. 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.**

Name of person authorized to sign: \_\_\_\_\_

Signature of person authorized: \_\_\_\_\_

Date: \_\_\_\_\_

## **Disclosure Questions**

1. Is any owner or covered individual of the applicant or awardee party to any malign foreign talent recruitment program?

Yes                       No

If yes, disclose the first and last name of each owner or covered individual, identify their role (i.e., owner or covered individual), and the malign foreign talent recruitment program.

2. Is there a parent company, joint venture, or subsidiary, of the applicant or awardee that is based in or receives funding from, any foreign country of concern?

Yes                       No

If yes, disclose the name, full address, applicant or awardee relationships (i.e., parent company, joint venture, or subsidiary) of each entity based in, or funded by, any foreign country of concern.

3. Does the applicant or awardee have any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity?

Yes                       No

If yes, disclose the name of each enterprise or foreign entity, type of obligation, agreement, or arrangement ( *i.e.*, contractual, financial, or other), description of obligation, agreement, or arrangement, and the foreign state(s) and/or the country of the foreign entity (or entities).

4. Is the applicant or awardee wholly owned in a foreign country?

Yes                       No

If yes, disclose the foreign country.

5. Does the applicant or awardee have any venture capital or institutional investment?

Yes                       No

If yes, proceed to question 5a. If no, proceed to question 6.

- 5a. Does the investing entity have a general partner or any other individual holding a leadership role who has a foreign affiliation with any foreign country of concern?

Yes                       No                       Unable to determine

If yes or unable to determine, disclose the venture capital or institutional investing entity's name, the percentage of ownership obtained by the investing entity, and the type of investment (i.e., equity, debt, or combination of equity and debt).

6. During the previous 5-year period, did the applicant or awardee have any technology licensing or intellectual property sales or transfers, to a foreign country of concern?

Yes                       No

If yes, disclose the name, address, and country, of the institution or entity that licensed, purchased, or received the technology or intellectual property.

7. Is there any foreign business entity, offshore entity, or entity outside the United States related to the applicant or awardee?

Yes                       No

If yes, disclose the entity name, relationship type (i.e., foreign business entity, offshore entity, entity outside the United States), description of the relationship to the applicant or awardee, and entity address and country.

8. Does the applicant or awardee have an owner, officer, or covered individual that has a foreign affiliation with a research institution located in a foreign country of concern?

Yes                       No

If yes, disclose the first and last name of each owner, officer, or covered individual that has a foreign affiliation with a foreign country of concern, identify their role (i.e., owner, officer, or covered individual), and the name of the foreign research institution and the foreign country of concern where it is located.

---

## Relevant Definitions

*Covered individual* — An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

*Federally funded award* — A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

*Foreign affiliation* — As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or

honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

*Foreign country of concern* — As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People’s Republic of China, the Democratic People’s Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

*Malign foreign talent recruitment program* — As defined in 42 U.S.C § 19237, the term “malign foreign talent recruitment program” means-

- (C) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-
  - (x) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;
  - (xi) being required to recruit trainees or researchers to enroll in such program, position, or activity;
  - (xii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;
  - (xiii) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;
  - (xiv) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;
  - (xv) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;
  - (xvi) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award, contrary to the institutional policies or standard terms and conditions of the Federal research and development award;
  - (xvii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or
  - (xviii) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and
- (D) a program that is sponsored by-
  - (iv) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;

- (v) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or
- (vi) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

**ATTACHMENT 3**

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

**Verification of Eligibility of Small Business Joint Ventures**

A small business joint venture offeror must submit, with its offer, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

- (A) Small business;
- (B) Service-disabled veteran-owned small business;
- (C) Women-owned small business (WOSB) under the WOSB Program;
- (D) Economically disadvantaged women-owned small business under the WOSB Program; or
- (E) Historically underutilized business zone small business

Contractor's Name	
Small Business Concern Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: \_\_\_\_\_

Signature of person authorized: \_\_\_\_\_

Date: \_\_\_\_\_

FAR Provision Incorporated in Full Text:

**52.219-1 Small Business Program Representations (Oct 2022)**

(a) *Definitions.* As used in this provision-

*Economically disadvantaged women-owned small business (EDWOSB) concern* means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management

and daily business operations of which are controlled by, one or more women who are citizens of the United States and who are economically disadvantaged in accordance with [13 CFR part 127](#), and the concern is certified by SBA or an approved third-party certifier in accordance with [13 CFR 127.300](#). It automatically qualifies as a women-owned small business concern eligible under the WOSB Program.

*Service-disabled veteran-owned small business concern-*

(1) Means a small business concern-

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) "Service-disabled veteran" means a veteran, as defined in [38 U.S.C.101\(2\)](#), with a disability that is service-connected, as defined in [38 U.S.C.101\(16\)](#).

*Small business concern—*

(1) Means a concern, including its affiliates, that is independently owned and operated, not dominant in its field of operation, and qualified as a small business under the criteria in [13 CFR part 121](#) and the size standard in paragraph (b) of this provision.

(2) *Affiliates*, as used in this definition, means business concerns, one of whom directly or indirectly controls or has the power to control the others, or a third party or parties control or have the power to control the others. In determining whether affiliation exists, consideration is given to all appropriate factors including common ownership, common management, and contractual relationships. SBA determines affiliation based on the factors set forth at 13 CFR 121.103.

*Small disadvantaged business concern*, consistent with 13 CFR 124.1002, means a small business concern under the size standard applicable to the acquisition, that-

(1) Is at least 51 percent unconditionally and directly owned (as defined at 13 CFR 124.105) by-

(i) One or more socially disadvantaged (as defined at 13 CFR 124.103) and economically disadvantaged (as defined at 13 CFR 124.104) individuals who are citizens of the United States, and

(ii) Each individual claiming economic disadvantage has a net worth not exceeding \$750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(2) The management and daily business operations of which are controlled (as defined at 13 CFR 124.106) by individuals who meet the criteria in paragraphs (1)(i) and (ii) of this definition.

*Veteran-owned small business concern* means a small business concern-



(1) Not less than 51 percent of which is owned by one or more veterans (as defined at [38 U.S.C.101\(2\)](#)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

*Women-owned small business concern* means a small business concern-

(1) That is at least 51 percent owned by one or more women; or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

*Women-owned small business (WOSB) concern eligible under the WOSB Program* (in accordance with [13 CFR part 127](#)) means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States, and the concern is certified by SBA or an approved third-party certifier in accordance with [13 CFR 127.300](#).

(b) (1) The North American Industry Classification System (NAICS) code for this acquisition is \_\_\_\_\_ [*insert NAICS code*].

(2) The small business size standard is \_\_\_\_\_ [*insert size standard*].

(3) The small business size standard for a concern that submits an offer, other than on a construction or service acquisition, but proposes to furnish an end item that it did not itself manufacture, process, or produce (*i.e.*, nonmanufacturer), is 500 employees if the acquisition—

(i) Is set aside for small business and has a value above the simplified acquisition threshold;

(ii) Uses the HUBZone price evaluation preference regardless of dollar value, unless the offeror waives the price evaluation preference; or

(iii) Is an 8(a), HUBZone, service-disabled veteran-owned, economically disadvantaged women-owned, or women-owned small business set-aside or sole-source award regardless of dollar value.

(c) *Representations.*

(1) The offeror represents as part of its offer that—

(i) it  is,  is not a small business concern; or

(ii) It  is,  is not a small business joint venture that complies with the requirements of [13 CFR 121.103\(h\)](#) and [13 CFR 125.8\(a\)](#) and (b). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture: \_\_.*]

(2) [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents that it  is,  is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents as part of its offer that it  is,  is not a women-owned small business concern.

(4) *Women-owned small business (WOSB) joint venture eligible under the WOSB Program.* The offeror represents as part of its offer that it  is,  is not a joint venture that complies with the requirements of [13 CFR 127.506\(a\)](#) through [\(c\)](#). [The offeror shall enter the name and unique entity identifier of each party to the joint venture: \_\_.]

(5) *Economically disadvantaged women-owned small business (EDWOSB) joint venture.* The offeror represents as part of its offer that it  is,  is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [The offeror shall enter the name and unique entity identifier of each party to the joint venture: \_\_.]

(6) [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents as part of its offer that it  is,  is not a veteran-owned small business concern.

(7) [Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (c)(6) of this provision.] The offeror represents as part of its offer that

(i) It  is,  is not a service-disabled veteran-owned small business concern; or

(ii) It  is,  is not a service-disabled veteran-owned joint venture that complies with the requirements of [13 CFR 125.18\(b\)\(1\)](#) and [\(2\)](#). [The offeror shall enter the name and unique entity identifier of each party to the joint venture: \_\_.] Each service-disabled veteran-owned small business concern participating in the joint venture shall provide representation of its service-disabled veteran-owned small business concern status.

(8) [Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.] The offeror represents, as part of its offer, that-

(i) It  is,  is not a HUBZone small business concern listed, on the date of this representation, as having been certified by SBA as a HUBZone small business concern in the Dynamic Small Business Search and SAM, and will attempt to maintain an employment rate of HUBZone residents of 35 percent of its employees during performance of a HUBZone contract (see [13 CFR 126.200\(e\)\(1\)](#)); and

(ii) It  is,  is not a HUBZone joint venture that complies with the requirements of [13 CFR 126.616\(a\)](#) through [\(c\)](#). [The offeror shall enter the name and unique entity identifier of each party to the joint venture: \_\_.] Each HUBZone small business concern participating in the HUBZone joint venture shall provide representation of its HUBZone status.

(d) *Notice.* Under [15 U.S.C.645\(d\)](#), any person who misrepresents a firm's status as a business concern that is small, HUBZone small, small disadvantaged, service-disabled veteran-owned small, economically disadvantaged women-owned small, or women-owned small eligible under the WOSB Program in order to obtain a contract to be awarded under the preference programs established pursuant to section 8, 9, 15, 31, and 36 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall-

- (1) Be punished by imposition of fine, imprisonment, or both;
- (2) Be subject to administrative remedies, including suspension and debarment; and
- (3) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

**Attachment 4**

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

**DISCLOSURE OF FUNDING SOURCES**

In accordance with Section 223 of the William M. (Mac) Thornberry National Defense Authorization Act (NDAA) for Fiscal Year 2021, DoD shall require, as part of any application for a research and development award—

- (1) that each covered individual listed on the application—
  - (A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
  - (B) certify that the disclosure is current, accurate, and complete; and
  - (C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award; and
- (2) that any entity applying for such award certify that each covered individual who is employed by the entity and listed on the application has been made aware of the requirements under paragraph (1).

Full text of Section 223 of the FY21 NDAA, including relevant definitions, can be found on pages 84-86: <https://www.congress.gov/116/plaws/publ283/PLAW-116publ283.pdf>.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

The SBC has been made aware of the requirements outlined in Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 and certifies that the disclosures provided below are current, accurate, and complete. The SBC further agrees to update such disclosure at the request of DoD prior to the award of support and at any subsequent time DoD determines appropriate during the term of the award.

Name of person authorized to sign: \_\_\_\_\_

Signature of person authorized: \_\_\_\_\_

Date: \_\_\_\_\_

Covered individuals have no current or pending research support to disclose in accordance with Section 223 of the FY21 NDAA, as described above.

**Disclosures**

Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	

[Additional space as needed]

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

**IMPORTANT**

- **The following instructions apply to topics:**
  - **N233-117 through N233-120**
- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
  - The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Select the tab for the appropriate BAA cycle.
  - Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.
- 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.**
- Proposing small business concerns 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 proposing small business concerns 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](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.
- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under “other competitive procedures”. The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

**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](http://www.navysbir.com). Additional information on DON’s mission can be found on the DON website at [www.navy.mil](http://www.navy.mil).

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	Navy SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a> or appropriate Program Manager listed 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 ( <a href="https://www.dodsbirsttr.mil/submissions">https://www.dodsbirsttr.mil/submissions</a> ) 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 <a href="mailto:dodsbirsupport@reisystems.com">dodsbirsupport@reisystems.com</a>
Navy-specific BAA instructions and forms	Always	DON SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a>

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

<u>Topic Numbers</u>	<u>Point of Contact</u>	<u>SYSCOM</u>	<u>Email</u>
N233-117 and N233-118	Mr. Timothy Petro and Ms. Gladis Aispuro	Naval Facilities Engineering Center (NAVFAC)	<a href="mailto:timothy.j.petro4.civ@us.navy.mil">timothy.j.petro4.civ@us.navy.mil</a> and <a href="mailto:gladis.g.aispuro.civ@us.navy.mil">gladis.g.aispuro.civ@us.navy.mil</a>
N233-119	Mr. Shadi Azoum	Naval Information Warfare Systems Command (NAVWAR)	<a href="mailto:info@navwarsbir.com">info@navwarsbir.com</a>
N233-120	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	<a href="mailto:usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil</a>

### **PHASE I SUBMISSION INSTRUCTIONS**

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

(NOTE: Proposing small business concerns 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).** Proposing small business concerns 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. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that small business concerns 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.

**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 ten (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 ten-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 proposing small business concerns use the Phase I proposal template, specific to DON topics, at [https://navysbir.com/links\\_forms.htm](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, proposing small business concerns 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 small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I. The percentage of work is measured by both

direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern 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.

- Proposing Small Business Concern Costs (included in numerator for calculation of the small business concern):
  - 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 small business concern.

- Subcontractor Costs (numerator for subcontractor calculation):
  - Total Subcontractor Costs (TSC)
- Total Cost (i.e., Total Cost before Profit Rate is applied, denominator for either calculation)

— **Cost Sharing: Cost sharing is not accepted on DON Phase I proposals.**

- 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 proposing small business concerns must review and submit the following items, as applicable:

- **Telecommunications Equipment Certification.** Required for all proposing small business concerns. 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 proposing small business concerns 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.

— **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:

- Program Description
- Proposal Fundamentals
- Phase I Proposal
- Attachment 2

— **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:

- Phase I Proposal
- Attachment 4

— **Majority Ownership in Part.** Proposing small business concerns 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.

o Additional information:

— Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at [https://navysbir.com/links\\_forms.htm](https://navysbir.com/links_forms.htm) to provide guidance on optional material the proposing small business concern 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) in Volume 5 (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, proposing small business concerns 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 proposing small business concern has met eligibility requirements and followed the instructions for the Proposal Cover Sheet as specified in the 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 proposing small business concern has met the following requirements or the proposal will be REJECTED:

- Not to exceed ten (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 proposing small business concern 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 small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I.
- **Cost Sharing: Cost sharing is not accepted on DON Phase I proposals.**
- **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 proposing small business concerns 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 proposing small business concern 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 proposing small business concerns to consider during proposal preparation and submission process.

**Due Diligence Program to Assess Security Risks.** The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally-funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns.

**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. Proposing small business concerns 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 proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. 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 small business concern 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 proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern 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 proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern 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 Navy 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 proposing small business concern 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 small business concern 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](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.** Proposing small business concerns 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 proposing small business concerns 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, small business concerns must register with the SBA Company Registry Database.
- b. The proposing small business concern 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](https://navysbir.com/links_forms.htm). Include the SBIR VC Certification in the Supporting Documents (Volume 5).
- c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern 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](https://navysbir.com/links_forms.htm).

**System for Award Management (SAM).** It is strongly encouraged that proposing small business concerns 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, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award **MUST** have an active SAM registration at the time of award or they will be considered ineligible.

**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 small business concern 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 proposing small business concern 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.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections>. 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 proposal of the proposing small business concern 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.** Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: [osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil](mailto:osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil). A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For



protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

**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 the proposing small business concern, 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 small business concern per topic. The maximum Phase I proposal/award amount including all options 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 (as stated in this BAA). The Phase I Final Report and Initial Phase II Proposal will be used to evaluate the small business concern's potential to progress to a workable prototype in Phase II and transition the 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 small business concerns (e.g., the Navy 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.

### **Navy SBIR 23.3 Phase I Topic Index**

N233-117	Defluorination of PFAS-impacted Matrices and Detection Methodologies
N233-118	Artificial Intelligence (AI) and Autonomy for Improved Operations and Modernization of Navy Shipyards
N233-119	Solid State Power Amplifier System for Very Low Frequency Communication
N233-120	Transparent and Back-Lit Liquid-Crystal Displays for Lensless Computational Imaging

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Sustainment

**OBJECTIVE:** This topic seeks to: (1) demonstrate the integration of new treatment technologies for Per- and Polyfluoroalkyl substances (PFAS) impacted matrices to enable complete on-site disposal/management of PFAS-containing wastewater and solid wastes; (2) demonstrate and validate a rapid field portable solution for PFAS detection in wastewater and solid waste; and (3) develop a standardized analytical approach to properly quantify microplastics in drinking water, wastewater, and solid matrices.

**DESCRIPTION:** The Department of the Navy (DON) installations vary significantly in their missions, industrial operations, and functions but common to all of them is the generation of wastewater streams. Ensuring proper treatment of these wastewater streams is critical to comply with the installations' permits and secure the availability of potable and non-potable water supplies to sustain missions. Currently, treatment of wastewater streams impacted by contaminants of emerging concern (CEC), such as Per- and Polyfluoroalkyl Substances (PFAS) and potential microplastics, present DON installations with an ongoing challenge.

With present interest in replacing aqueous film forming foam (AFFF) with fluorine-free foam (F3) alternatives, there is a need to dispose of AFFF stockpiles and to treat wastewater streams derived from cleaning fixed (hangars) and mobile (firetrucks) fire suppression systems to less than 70 parts per trillion (ppt.) before discharging into sewers [Refs 1-4]. Often these wastewater streams are treated via conventional methods that involve granular activated carbon (GAC) and ion-exchange (IX) resin—thus producing PFAS-impacted waste that requires off-site disposal. In addition, wastewater treatment plants (WWTP) owned by DON installations may produce PFAS-impacted sewage-sludge and biosolids as a result of processing PFAS-impacted wastewaters from households using products containing PFAS (e.g., cleaning/degreasing agents; water-resistant, stain resistant, and fire-resistant fabrics; non-sticky cookware; personal-care products, etc.). Treated sewage-sludge or biosolids are often applied to crops and fields to supply plant organic nutrients without the use of synthetic fertilizer. If biosolids are PFAS-impacted, they have the potential to become a direct source of PFAS release into the soil and groundwater. In a similar manner, microplastics may end up in soil and groundwater due to the application of treated sewage-sludge or biosolids derived from the processing of domestic wastewater streams containing personal care products (e.g., toiletries and cosmetics) and washing of synthetic textiles [Refs 5-6].

As such, there is a need for PFAS destruction technologies for wastewater and solid waste (e.g., PFAS-impacted wastewater, PFAS-laden GAC, PFAS-laden IX-resin, and PFAS-impacted biosolids) [Refs 6-11]. Prototype technologies must demonstrate the ability to mineralize total PFAS to benign products without producing toxic waste and/or by-products. Particular emphasis must be placed in the mineralization of the six PFAS compounds—perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX Chemicals), perfluorohexane sulfonic acid (PFHxS), and perfluorobutane sulfonic acid (PFBS)—for which the U.S. Environmental Protection Agency (USEPA) is set to establish maximum contaminant levels (MCLs) under the National Primary Drinking Water Regulation (NPDWR). Conversely, it is also critical to have a rapid field portable solution for PFAS detection in wastewater, solid waste and treated PFAS-impacted sources (i.e., wastewater and solid waste). The rapid field portable solution for PFAS detection must be capable of reading PFAS concentration levels for PFOA and PFOS as low as 4 ppt. whereas PFNA, GenX chemicals, PFHxS, and PFBS must attained a combined Hazard Index of 1 (unit less) as proposed by the USEPA [Ref 12]. The latter implies that individual concentrations for these 4 PFAS compounds may be as low as single digit ppt. to double-digit ppt. In the

case of microplastics, for which there is no USEPA health advisory and/or proposed federal regulations but are set to become the next major environmental concern in drinking water, wastewater, and solid waste, there is a need to first develop a standardized analytical approach to properly quantify microplastics in drinking water, wastewater, and solid matrices. Once the standardized analytical approach is reliable and consistent across testing, a strategy must be developed to quantify sources of microplastics entering WWTPs and their effectiveness in removing microplastics. If WWTPs are not capable of addressing the removal of microplastics, an explanation must be provided and potential prototype treatment solutions must be identified.

**PHASE I:** Determine the feasibility of utilizing an emerging PFAS destruction technology to process PFAS-impacted matrices (i.e., wastewater and solid waste) of relevance to DON stakeholders. Some PFAS-impacted matrices of interest include (i) spent granulated activated carbon (GAC), (ii) spent powdered activated carbon (PAC), (iii) spent ion exchange resins (IXR), and/or (iv) complex PFAS-impacted wastewaters (e.g., fire truck rinse out byproducts). Ensure that matrices must be treated using lab-scale systems. Evaluate treatment success through measuring PFAS destruction levels, assessing the fate of fluorine after treatment, and assessing the fate of co-contaminants and matrix constituents (e.g., the filter material) during treatment.

For the rapid field portable solution for PFAS detection, the solution must be practical and not cumbersome as it will be conducted by personnel with and without engineering or scientific backgrounds. In addition, the rapid field portable solution must provide reliable PFAS concentration readings in the presence of other contaminants that may be present in real-life samples provided by DON stakeholders. PFAS detection and concentration levels by the field portable solution must be double-checked by PFAS analytical methods such as USAEPA Methods 533, 537.1, and/or 1633. Information on the capabilities of the solution as well as its shortcomings must be explained. This will provide information as to what areas still need development and how realistic it is to bring a solution into Phase II.

In the case of the standardized analytical approach to properly quantify microplastics in drinking water, wastewater and solid matrices, define, develop, and identify analytical tools that are both microplastic selective (i.e., specific only for some types of microplastics) and inclusive (i.e., able to detect all types of microplastics with adequate recoveries). Ensure that the microplastics comprise a variety of sizes, colors, and chemical compositions to include fibers, fragments, pellets, flakes, sheets, or foams. Discuss the advantages and disadvantages based on analytical tools in a summary of results and provide the best approach for a path forward to improve analysis of microplastics in the aforementioned matrices. At the end of Phase I, include in the final deliverables information substantiated by results and a Phase II plan that includes a concept for the Phase II field test and demonstration.

**PHASE II:** Demonstrate the PFAS destruction technology at a DON installation by treating one of the PFAS-impacted matrices identified in Phase I. Based on the results of Phase I, use the demonstration to validate the PFAS destruction performance at a realistic field site, processing a real waste stream. Use demonstration results to assess the feasibility of integrating the proposed technology into longer-term waste management projects.

Demonstrate and validate the rapid field portable solution for PFAS detection at a DON installation that has different sources of PFAS-impacted matrices. Use the equipment in real-time in the field test and demonstration and have it validated with support from DON personnel. Field testing readings must be supported by PFAS analytical testing as indicated in Phase I. Assess ease of use and portability of solution by personnel in the field.

Develop and test a step-by-step protocol of the microplastics standardized analytical approach to standardize collection, extraction, quantification, and identification of microplastics in drinking water, wastewater, and solid matrices to improve reliability, consistency and comparability across testing.

PHASE III DUAL USE APPLICATIONS: Integrate the Phase II-demonstrated technology with full-scale waste disposal and compliance-related PFAS management efforts and coordinate with the Air Force Civil Engineer Center (AFCEC) and the U.S. Army Corps of Engineers (USACE) to transition the technology to tackle broader (not just DON) Department of Defense (DoD)-wide challenges around PFAS-impacted sites. Address non-DoD Governmental and commercial needs including remediation of PFAS-impacted airport and fire training facilities, industrial wastewater treatment, and waste disposal.

Work with USEPA regulators to qualify Phase II rapid field portable PFAS detection and microplastics standardized analytical approach in order to mainstream them. Use rapid field portable PFAS detection and microplastics standardized analysis to quantify sources entering WWTPs and their effectiveness in removing them. If WWTPs are not capable of addressing the removal of PFAS and/or microplastics, provide an explanation and identify potential prototype treatment solutions.

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**KEYWORDS:** Per- and polyfluoroalkyl substance; PFAS; PFAS destruction; Perfluorooctane sulfonic acid; PFOS; Perfluorooctanoic acid; PFOA; Aqueous film-forming foam; AFFF; Environmental Compliance; Environmental Restoration; AFFF-impacted media; Granular Activated Carbon; GAC; Ion Exchange Resin; Solid-derived Wastes; Rapid Field PFAS Detection; Portable PFAS Detection; PFAS Detection in Real-Time; Microplastics; Microfibers

N233-118

TITLE: Artificial Intelligence (AI) and Autonomy for Improved Operations and Modernization of Navy Shipyards

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces;Sustainment;Trusted AI and Autonomy

OBJECTIVE: Modernize Navy Shipyard facilities through three lines of effort: Drydocks, Infrastructure, and Industrial Plant Equipment. Digital technology to include digital twins, AI, and autonomy will bring these century old shipyards up to modern practices. Upgrading and modernizing shipyard operations and processes will expedite, reliably and safely, redeployment of DON assets back in the field as quickly as possible. Technologies for maintaining and sustaining ships, aircraft, and ground vehicles have advanced significantly in the past 50 years. Yet, the DON sustainment community has struggled to pilot, and integrate those same technological advances into public shipyards, fleet readiness centers, and ground vehicle depots. Executing this plan will improve the Navy Shipyards' productivity and increase their maintenance throughput to support the combat readiness of the Navy.

DESCRIPTION: The DON seeks to modernize its four public shipyards by fielding unmanned systems capabilities to improve efficiency and reduce cost without sacrificing safety or reliability. Remotely Operated Vehicles (ROVs), Unmanned Aerial Vehicles (UAVs), Unmanned Underwater Vehicles (UUVs), and materials handling equipment are actively being investigated to reduce exposure to hazardous conditions; reduce or avoid costs related to inspections, repairs, and surveying; and in general improve shipyard work processes. These added capabilities will fundamentally change the shipyard work environment, allowing for faster and more reliable forms of inspection, material delivery, work standardization, security, and condition reporting.

Technologies in the following focus areas are sought. Proposals can address one or multiple areas:

1. Improvement of Materials Handling Workflow Automating cranes and folk lifts; and improving logistics tracking in near real-time. Analytics, AI, and machine learning tools can be deployed to plan scheduling, enable continuous 24/7 operations, improve safety, and track and monitor all logistics to track inventory and identify workflow bottlenecks. These digital solutions serve as a force-multiplier, and not a replacement for the workforce, by maximizing operator talent and empowering faster, smarter decisions to increase safety and operator efficiency.
2. Autonomous 3D Precision Scanning (Command, Control, and Communications): Progress in 3D scanning continues to revolutionize multiple industries. The Navy desires the ability to autonomously 3D scan large platforms (e.g., aircraft carriers, airframes, vehicles) with the greatest precision possible. These scans will further improve digital twins as well as locate various structural issues that may otherwise be difficult to discern. This focus area is intended to advance (1) the digitization rate (including capture of environmental conditions as metadata), (2) precision from stand-off distances, and (3) rate of image rendering/stitching to create an interactive model.
3. Autonomous Non-Destructive Inspection (Autonomy and Microelectronics): Inspections of various structures (e.g., struts or stiffeners), pier facilities, and components (e.g., hatches or assemblies) of DON platforms are very labor intensive. The Navy desires to perform non-destructive inspections (NDI) of various geometries, sizes, and submerged assets through autonomous means. Existing NDI techniques including but not limited to penetrant testing, ultrasonic testing, and magnetic testing are sought to be placed in an autonomous solution.

PHASE I: Develop and demonstrate an initial functional prototype meeting one primary Focus Area of the three Focus Areas listed under the Description. Phase I submissions should provide sufficient



information on how the prototype to be developed and demonstrated during the Phase I will function in a relevant environment in a manner meeting the specified Focus Area. This information may include, but is not limited to, detailed designs, preliminary component or system laboratory testing, or a minimum viable product (MVP). At the end of Phase I, an initial functional prototype will be ready for demonstration and a detailed test plan for prototype testing will be provided to the Government.

**PHASE II: Develop and demonstrate a functional prototype. Perform a Prototype Demonstration of Viability that focuses on moving beyond proving basic achievement of meeting DON needs to meeting usability features required for integration and deployment. Work with actual end users and systems integration personnel to ensure that requirements beyond technological performance of the prototype are identified (e.g., Human System Interface, logistics, training, maintenance, installation). Use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to modify and adapt the prototype(s) to meet defense operational conditions and technical needs, Ensure that the prototype demonstrates operational and/or commercial viability. Recommend test procedures to demonstrate viability and an appropriate facility for the test.**

Perform Pilot Testing in an Operational Environment that includes meeting with DON command stakeholders and operational end users to conduct pilot tests of fully functional prototype(s) in an operational environment or military exercise. Coordinate testing with DON command and operational stakeholders. Provide the results of this testing to inform stakeholders on the capabilities of the developed technology and the probability for its deployment in an operational environment. Use feedback from DON users, systems integrators, and other potential defense and commercial beneficiaries and stakeholders to adapt the prototype(s) to optimize defense operational and technical benefits and to provide optimal dual-use commercial market fit. If required, support the contractor-conducted tests, but the operation of the prototypes in the test must be capable of being performed by the government.

**PHASE III DUAL USE APPLICATIONS: Support the transition to Navy use. Given the need for these capabilities at numerous sites, the Navy will coordinate funding to maximize return on investment at needed sites. Depending on financial estimates, a phased procurement may be required to reach full implementation at the necessary sites. Coordination between the Navy and the provider will be required during Phase III to ensure support and proper proficiency of the solution is in place. New guidance or standards may need to be generated to adopt these new technologies into operational processes. Standards and guidance may be adopted from commercial dual use cases. The Navy sees commercial development in autonomous systems in commercial logistics, inspection of facilities and commercial ships that can be leveraged to reduce development and transition costs.**

Finally, the Federal Government sees the development of these capabilities as benefiting industrial maintenance activities in partnership with the Navy at commercial shipyards. The ability to keep critical assets in operation is a common need for which the Navy is seeking willing commercial partners . Service and or maintenance contracts may be procurement alternatives to direct acquisition of equipment.

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**KEYWORDS:** Autonomy; Artificial Intelligence; AI; Inspection; shipyard; robotics; data analytics; construction; digital twin; digitization; 3D scanning

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Design and demonstrate the ability to provide a 1 megawatt (MW) solid state power amplifier system to integrate into existing very low frequency (VLF) communication equipment.

DESCRIPTION: PMW 770 is looking to develop and install an affordable solid state power amplifier system to replace obsolete vacuum tube amplifiers at VLF transmitter sites with minimal down time and operation impact.

The Navy is interested in verifying a 1 MW solid state power amplifier system that meets the following minimum specifications:

- should work in all weather conditions (e.g., rain, daylight, night, cold, hot, etc.);
- should maintain existing reliability rating;
- should have redundancy and overhead built into the system;
- should have built-in test (BIT) capabilities for fault indications;
- should have automatic and step-by-step (i.e., manual) operation;
- should be able to demonstrate 1 MW across the entire VLF frequency range;
- should be able to demonstrate that it works with arc and phase monitoring equipment;
- should be able to demonstrate that it works with a synchronous tuner and that it can be auto-tuned;
- should be able to integrate into the existing system with minimum downtime;
- should be able to demonstrate that it works with legacy NATO Interoperable Submarine Broadcast System (NISBS) and Low Band Universal Communications System (LBUCS) outputs at their different baud rates; and
- should maintain IEEE electronic standards.

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 Naval Information Warfare Systems Command (NAVWAR) 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: Conduct a study to determine the technical feasibility and initial design of an affordable 1 MW solid state power amplifier system that could replace the existing vacuum tube amplifier system with minimal downtime at a VLF Broadcast Transmitter Station (BTS). For the identified solution, develop the SBIR Phase II Project Plan to include a detailed schedule (in Gantt format), spend plan, performance objectives and specifications, and transition plan for the identified Program of Record (PoR).

PHASE II: Design, develop, demonstrate, and validate a 1 MW solid state power amplifier system prototype based on Phase I work that could be long term tested at a BTS VLF site. Develop life-cycle support strategies and concepts for the system. Develop a SBIR Phase III commercialization plan. Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Refine the prototype and if required, perform additional development to produce a Production Representative Article (PRA). Perform test and validation to certify and qualify components for Navy use. Support the Navy in transitioning the technology for Navy use. Investigate the dual use of the developed technologies for other DoD applications as well as commercial applications to include ground penetrating radar and communication.

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3. NAVY VLF site history: <https://apps.dtic.mil/sti/pdfs/ADA393998.pdf>

KEYWORDS: Very Low Frequency (VLF); solid state power amplifier; Naval Submarine Communications; Fixed Submarine Broadcast System (FSBS); NRTF Lualualei; undersea communications; high power communications

N233-120

TITLE: Transparent and Back-Lit Liquid-Crystal Displays for Lensless Computational Imaging

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Trusted AI and Autonomy

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: Research, develop, and fabricate micro-scale, high-resolution, high-refresh rate liquid-crystal-on-silicon (LCoS) micro-displays.

DESCRIPTION: The Office of Naval Research (ONR) is currently developing a range of lensless, optical-computing devices for applications in the areas of computer vision and computational photography. To create the next-generation versions of these devices, we are seeking proposals aimed at the design and fabrication of custom liquid-crystal micro-displays. We are interested in micro-scale, high-resolution liquid-crystal displays, with both transparent and back-lit versions under consideration under this SBIR topic. These displays would likely be similar to what is found in commercial virtual-reality headsets and augmented-reality headsets.

The micro-displays we need have several requirements not found in existing commercial offerings. Some additional research is hence needed. The micro-displays must be small (20 millimeter diagonal length or less) and high resolution (2048x1080 pixels or higher). The micro-displays should be grayscale-only and capable of supporting and implementing 8-bit grayscale values with the option to potentially support 16-bit values. A low response time (about 3 milliseconds or lower), and hence high frame rate (240 frames per second or higher), is needed to perform sensing and processing tasks at a level needed for realizing certain autonomy capabilities. The micro-displays should also come in back-lit and non-back-lit, transparent variations. In the latter case, the display should be made as transparent as possible so that light can travel through the liquid-crystal layer and be predominantly attenuated by the point-spread functions that will be shown on them. No strongly-occluding materials can be present behind the liquid-crystal layer for the transparent version of the display. Any electronics should be located at the periphery of the displays and incorporated into the baffling. Both the back-lit and non-back-lit transparent displays should interface with printed-circuit driver boards that will be developed and fabricated by the awardee as part of this SBIR topic.

Design Requirements:

We seek the design and fabrication of two displays. One display is assumed to be transparent and will not have a built-in backlight. The other will have a built-in backlight. Both displays should possess the following traits:

- Size:  $\leq 20$  millimeter diagonal length
- Resolution:  $\geq 1920 \times 1080$  pixels
- Display Color: Either Monochromatic or color (RGB), monochromatic preferred
- Refresh Rate:  $\geq 240$  frames per second
- Pixel Bit Depth:  $\geq 8$  Bits for monochromatic,  $\geq 24$  Bits for color display

- Cell Gap Uniformity:  $\leq 5\%$
- Back-lit Display Brightness:  $> 1000$  candela per square meter
- Interface(s): Multi-lane Mobile Industry Processor Interface (MIPI DSI) with High-Definition Multimedia Interface (HDMI) 2.1, or better, to provide inputs to the printed-circuit driver board. A custom Low-Voltage Differential Signaling (LVDS) solution is also acceptable.

The back-lit display should have the additional trait:

- Back-lit Display Brightness:  $> 1000$  candela per sq. meter.

Technical challenges: Ideally, the displays should be as low power as possible. The displays may be used for applications in harsh environments not currently considered by the acquisition program. A path forward for high-temperature operating conditions (greater than 70 degrees Celsius) should be established in the design stage, even if it is not implemented in the prototypes. The displays will not be used in environments where direct contact with water is expected. They will also not be used in environments with strong background radiation present.

Supporting incredibly high frame rates will not be feasible with present HDMI standards. Pre-buffering many image frames may not always be an option. The displays will hence, practically, be limited to the rates and resolution supported by the current HDMI 2.1/2.1a standard, which will be approximately 240 frames per second, during evaluation by the Navy. The designed displays will eventually be integrated with a custom application-specific integrated circuit (ASIC) chip to drive them at the highest frame rate offered by either a multi-lane MIPI connection or an LVDS connection. Potential performers should therefore advertise if their proposed solution can be run at higher frame rates and are limited only by the bandwidth offered by HDMI.

PHASE I: Produce a liquid crystal display design that satisfies the above criteria. Outline testing and evaluation criteria. If the design cannot meet the design objectives an analysis or discussion of the potential should be included in the Phase I report. Modeling, simulation, or comparison to similar developments should be used to justify design decisions.

PHASE II: Fabricate two to three prototype systems for evaluation. These systems should include both the displays and any circuit boards and other components needed to drive them. The prototype demonstration should achieve or show potential for meeting the design requirements. Perform detailed analysis on ruggedness and compatibility with Navy unmanned underwater vehicle handling, storage, and environmental operating conditions. Testing will be conducted by both the performer and by Navy personnel. Cost effectiveness and manufacturability feasibility should be addressed as part of the prototype test and evaluation. The appropriate acquisition program office will be consulted for any additional evaluation metrics needed for Phase III.

PHASE III DUAL USE APPLICATIONS: Build an advanced liquid crystal display prototype that meets appropriate technology readiness level (TRL) metrics set by the acquisition program office. Support the Navy for test and validation of the system for certified Navy use. Explore the potential to transfer the technology for commercial use. Commercial applications might include visual detection and tracking systems, low-power processing for commercial UxV systems, and large-scale supercomputing resources. Develop manufacturing plans to facilitate transition to a program of record.

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**KEYWORDS:** Liquid-Crystal Display, Liquid Crystal on Silicon Display, Optical Processing, Machine Learning, Computer Vision, Computational Photography

**DEPARTMENT OF THE NAVY (DON)**  
**23.3 Small Business Innovation Research (SBIR)**  
**Direct to Phase II (DP2) Announcement and Proposal Submission Instructions**

**IMPORTANT**

- **The following instructions apply to Direct to Phase II (DP2) SBIR topic only:**
  - **N233-D10**
- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
  - The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Select the tab for the appropriate BAA cycle.
  - Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.
- The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).
- Proposing small business concerns 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 proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.
- A DP2 Phase I Feasibility proposal template (for Volume 2), unique to DP2 topics, and a Supporting Documents template (Volume 5) are available at [https://www.navysbir.com/links\\_forms.htm](https://www.navysbir.com/links_forms.htm).
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under “other competitive procedures”. The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

## **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](http://www.navysbir.com). Additional information on DON’s mission can be found on the DON website at [www.navy.mil](http://www.navy.mil).



The Department of Defense (DoD), including the Department of the Navy (DON), may issue an SBIR award to a small business concern under Phase II, without regard to whether the small business concern received a Phase I award for such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the small business concern has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those proposing small business concerns that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

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	DON SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a> or appropriate Program Manager listed 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 ( <a href="https://www.dodsbirsttr.mil/submissions">https://www.dodsbirsttr.mil/submissions</a> ) 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 <a href="mailto:dodsbirsupport@reisystems.com">dodsbirsupport@reisystems.com</a>
Navy-specific BAA instructions and forms	Always	DON SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a>

**TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS**

Topic Numbers	Point of Contact	SYSCOM	Email
N233-D10	Mr. Shadi Azoum	Naval Information Warfare Systems Command (NAVWAR)	<a href="mailto:info@navwarsbir.com">info@navwarsbir.com</a>

Each DON SBIR DP2 topic requires documentation to determine that Phase I feasibility, described in the Phase I section of the topic, has been met.

The DON SBIR DP2 is a two-step process:

STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the proposing small business concern to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the proposing small business concern performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility documentation **MUST NOT** be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select small business concerns to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The small business concern must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.

STEP TWO: If selected, the cognizant SYSCOM Program Office will contact the small business concern directly to provide instructions on how to submit a Full DP2 Proposal.

DON SBIR reserves the right to make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposing small business concerns must read the topic requirements carefully. The Government is not responsible for expenditures by the proposing small business concern prior to award of a contract. For 23.3 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

## **DP2 PROPOSAL SUBMISSION REQUIREMENTS**

The following section details requirements for submitting a compliant DON SBIR DP2 Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns 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).** Proposing small business concerns 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. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that proposing small business concerns 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.

**Eligibility.** Each proposing small business concern must:

- Have demonstrated feasibility of Phase I-type R&D work
- Have submitted a Phase I Feasibility Proposal for evaluation
- Meet Offeror Eligibility and Performance Requirements as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA
- Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment with the small business concern at the time of award

and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the small business concern

- Register in the System for Award Management (SAM) as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA. To register, visit <https://sam.gov/>

**Proposal Volumes.** The following six volumes are required.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA.
- **Technical Volume (Volume 2).**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - 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
  - Additional information:
    - It is highly recommended that proposing small business concerns use the DP2 Phase I Feasibility proposal template at [https://navysbir.com/links\\_forms.htm](https://navysbir.com/links_forms.htm) to meet DP2 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, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.
- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at <https://www.dodsbirsttr.mil/submissions/>), however, proposing small business concerns DO NOT need to download and complete the separate cost volume template when submitting the DON SBIR Phase I Feasibility Proposal. Proposing small business concerns are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Snapshot of Proposed Phase II Effort portion of the Technical Volume (Volume 2). Please refer to Table 3 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

<b>Order of Magnitude Cost Estimate Table</b>			
<b>Line Item – Details</b>	<b>Estimated Base Amount</b>	<b>Estimated Option Amount</b>	<b>Total Estimated Amount Base + Option</b>
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			

Fee/Profit			
TABA (NTE \$25K, included in total amount)			
Total Estimated Costs			

**TABLE 3: COST & PERIOD OF PERFORMANCE**

Topic Number	Base		Option		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N233-D10	\$1,000,000	12 mos.	\$750,000	9 mos.	\$1,750,000

o Additional information:

For Phase II a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern 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 as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator. **NOTE:** G&A, if proposed, will only be attributed to the proposing small business concern.

- 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.

- **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 proposing small business concerns must review and submit the following items, as applicable:

- **Telecommunications Equipment Certification.** Required for all proposing small business concerns. 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 proposing small business concerns 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 proposing small business concerns must review to determine applicability. In accordance with DFARS provision 252.209-7002, a proposing small business concern is required to disclose any interest a foreign government has in the proposing small business concern when that interest constitutes control by foreign government. All proposing small business concerns must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized representative of the proposing small business concern 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.** Proposing small business concerns 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:
  - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at [https://navysbir.com/links\\_forms.htm](https://navysbir.com/links_forms.htm) to provide guidance on optional material the proposing small business concern 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, proposing small business concerns 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.

## **DP2 EVALUATION AND SELECTION**

The following section details how the DON SBIR/STTR Programs will evaluate Phase I Feasibility 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 proposing small business concern has met eligibility requirements and followed the instructions for Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.
- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I Feasibility 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 proposing small business concern has met the following requirements or the proposal will be REJECTED:

- Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
  - 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.
- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
    - Must not exceed values for the Base and Option (refer to Table 3).
    - Must meet minimum percentage of work; a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs.
  - **Company Commercialization Report (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 proposing small business concerns 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 proposing small

business concern has included items in accordance with the DP2 SUBMISSION INSTRUCTIONS section above.

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

### **ADDITIONAL SUBMISSION CONSIDERATIONS**

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

**Due Diligence Program to Assess Security Risks.** The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns.

**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. Proposing small business concerns may request, in their Cost Volume (Volume 3), to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. 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). The amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. 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 TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

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 proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern

- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern 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 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 II: A total of \$25,000 per award, not to exceed \$50,000 per Phase II project

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern 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 Navy 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 proposing small business concern 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 small business concern 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](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.** Proposing small business concerns 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 proposing small business concerns 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, proposing small business concerns must register with the SBA Company Registry Database.
- b. The proposing small business concern 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](https://navysbir.com/links_forms.htm). Include the SBIR VC Certification in the Supporting Documents (Volume 5).
- c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern 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](https://navysbir.com/links_forms.htm).

**System for Award Management (SAM).** It is strongly encouraged that proposing small business concerns 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, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

**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 small business concern 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.** If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: <https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections>. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

**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 proposal of the proposing small business concerns 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.** Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

**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 cost analysis, confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

**Contract Types.** 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.

**Contract Deliverables.** Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to <https://www.navysbirprogram.com/navydeliverables/>.

**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 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.

## **Navy SBIR 23.3 Direct to Phase II Topic Index**

N233-D10

**DIRECT TO PHASE II - Time Division Duplex (TDD) Radio Frequency (RF)  
Beamforming Chip for Active Electronically Scanned Array (AESA)**

N233-D10            TITLE: DIRECT TO PHASE II - Time Division Duplex (TDD) Radio Frequency (RF) Beamforming Chip for Active Electronically Scanned Array (AESA)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

OBJECTIVE: Design and demonstrate a Time Division Duplex (TDD) Radio Frequency (RF) beamforming chip that enables the ability to communicate with existing and future Non-Geostationary Orbit (NGSO) satellite constellations using a single Active Electronically Scanned Array (AESA) antenna for both receive and transmit.

DESCRIPTION: PMW 770 is looking to develop a highly integrated semiconductor-based Application-specific Integrated Circuit (ASIC) core TDD RF beamforming chip in order to leverage a single AESA antenna for use with both receive (Rx) and transmit (Tx) for Radio Frequency (RF) communications. The chip is needed to provide the requisite beam steering, polarization tracking, Rx low noise amplification, and Tx power amplification.

The Navy is interested in developing a TDD RF beamforming chip for AESA antennas that meets the following minimum specifications:

- Dual-Polarization antenna element support (Ref 5);
- Half-Duplex architecture to support both Rx and Tx on the same semiconductor beamforming chip;
- Ability to support a single steerable Rx beam (Threshold); ability to support two independently steerable Rx beams and incorporates an integrated power combiner so that the beamforming chip has a single antenna port for the two beams (Objective);
- Operational frequencies:
  - Rx: 10.7 to 12.7 GHz (Threshold), 3 to 40 GHz (Objective);
  - Tx: 14 to 14.5 GHz (Threshold), 3 to 40 GHz (Objective);
- Noise figure of 1.5 dB or better;
- 6-bits of phase control in both Rx and Tx RF signal paths;
- Greater than 25 dB of gain control in both Rx and Tx RF signal paths;
- Ability to support multiple antenna channels per beamforming chip;
- Tx performance requires greater than +16 dBm OP1dB per channel;
- Fast Beam Scan ability (stored beam states);
- A digital Serial Protocol Interface (SPI) to control each beamforming chip; and
- Supports a wide axial ratio circular polarized phased array architecture (example described in US Patent Number: US 11,539,146 B2).

PHASE I: Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. Demonstrating proof of feasibility is a requirement for a Direct to Phase II award.

For this Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort: conduct a study to determine the technical feasibility and initial design of an affordable TDD RF beamforming chip that enables the ability to communicate with existing and future NGSO satellite constellations using a single AESA antenna for both receive and transmit.

FEASIBILITY DOCUMENTATION: Offerors interested in proposing to this Direct to Phase II topic must include in their response Phase I feasibility documentation that substantiates the scientific and technical merit; proof that Phase I feasibility (described in Phase I above) has been met (i.e., the small business must have performed Phase I-type research and development related to this topic, but feasibility

documentation must not be solely based on work performed under prior or ongoing federally funded SBIR/STTR work; and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI).

PHASE II: Design, develop, demonstrate, and validate an affordable TDD RF beamforming chip that enables the ability to communicate with existing and future NGSO satellite constellations using a single AESA antenna for both receive and transmit. Develop a comprehensive interface control document that should be made available for both the Department of Defense (DoD) and Defense Contractors. Develop life-cycle support strategies and concepts for the system, per chip cost estimates, and a SBIR Phase III commercialization plan.

PHASE III DUAL USE APPLICATIONS: Refine the prototype and if required, perform additional development to produce a Production Representative Article (PRA). Perform test and validation to certify and qualify components for Navy use. Support the Navy in transitioning the chip for Navy use. Investigate the dual use of the developed technologies for other DoD applications as well as commercial applications to include satellite communication, cellular communication, and other commercial RF-based communication.

#### REFERENCES:

1. Minimum Viable Product (MVP): [https://en.wikipedia.org/wiki/Minimum\\_viable\\_product](https://en.wikipedia.org/wiki/Minimum_viable_product)
2. Technology Readiness Levels: <https://www.army.mil/e2/c/downloads/404585.pdf>
3. Active Electronically Scanned Array:  
[https://en.wikipedia.org/wiki/Active\\_electronically\\_scanned\\_array](https://en.wikipedia.org/wiki/Active_electronically_scanned_array)
4. Time Division Duplex: [https://en.wikipedia.org/wiki/Duplex\\_\(telecommunications\)](https://en.wikipedia.org/wiki/Duplex_(telecommunications))
5. S. Das et al., "A Flat-Panel 8×8 Wideband K–/Ka–Band Dual Circularly Polarized Phased Array Antenna for CubeSat Communications," in IEEE Transactions on Antennas and Propagation, 2023: <https://ieeexplore.ieee.org/document/10071999/>
6. US Patent Number: US 11,539,146 B2: <https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/11539146>

KEYWORDS: Time Division Duplex (TDD); Low Earth Orbit (LEO); Medium Earth Orbit (MEO); Non-Geostationary Orbit (NGSO); Phased Array; Active Electronically Scanned Array (AESA); Naval Submarine Communications; Super High Frequency (SHF) Communications

**DEPARTMENT OF THE AIR FORCE**  
**23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PHASE I**  
**PROPOSAL SUBMISSION INSTRUCTIONS**  
**AMENDMENT 2**

This Amendment adds language to the **AIR FORCE PROPOSAL EVALUATIONS** section of these Component-specific instructions:

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

All other terms and provisions remain unchanged as a result of this Amendment.

**DEPARTMENT OF THE AIR FORCE**  
**23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PHASE I**  
**PROPOSAL SUBMISSION INSTRUCTIONS**  
**AMENDMENT 1**

This Amendment modifies several of the topics associated with the DAF SBIR Phase I offering. Topic numbers that are highlighted have been updated. That includes the following topics:

<b>Topic Number</b>	<b>Topic Name</b>
SF233-0001	Digital Flatsat
AF233-0002	Power Efficient Digital Binocular Night Vision Imaging System (PEDBNVIS)
SF233-0003	Revolutionary SmallSat Power Enhancement
AF233-0004	Hybrid Turbo-Electric Propulsion Design and Optimization
SF233-0005	High Fidelity Sporadic E Model
AF233-0006	Machine Learning Algorithms for Infrared Search and Track Applications
SF233-0007	On-Orbit Intent Estimation of Close-Proximity Space Objects
AF233-0008	Compact Midwave Infrared Hyperspectral Imager for Attributable Platforms
SF233-0009	Sporadic E Predictive Model
AF233-0010	Dual-purpose laser range finder and lidar sensor
SF233-0011	Flexible Satellite Terminals for Multi-Tenancy Applications
AF233-0012	Multi-Spectral Infrared Focal Plane Arrays
SF233-0019	Suborbital Hover Vehicle-Reusable Rocket
AF233-0020	Mapping Mesostructures to Hypersonics for Improved Manufacturability and Performance

All other terms and provisions remain unchanged as a result of this Amendment.

**DEPARTMENT OF THE AIR FORCE**  
**23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) PHASE I**  
**PROPOSAL SUBMISSION INSTRUCTIONS**

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein.

**Offerors must ensure proposals meet all requirements of the SBIR 23.3 BAA posted on the Defense SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirstr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirstr.mil/submissions/login>.

Complete proposals **must** be prepared and submitted via <https://www.dodsbirstr.mil/submissions/> (DSIP) on or before the date published in the DoD SBIR 23.3 BAA. Applicants are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

The DAF 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 DAF 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 DAF 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.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF 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 DAF. **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, “23.3 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@afsbirstr.us](mailto:usaf.team@afsbirstr.us).
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at [dodsbirsupport@reisystems.com](mailto:dodsbirsupport@reisystems.com).
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD SBIR 23.3 BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
  - Mr. Daniel J. Brewer, [Daniel.Brewer.13@us.af.mil](mailto: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](http://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.

### **PHASE I PROPOSAL SUBMISSION**

The DoD SBIR 23.3 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.

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.**

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit [www.sam.gov](http://www.sam.gov). A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its 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 proposing small business concerns 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 proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the Small business concern profile with the UEI (SAM) as soon as possible.

For new proposing small business concern 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 Small business concern's profile on the DSIP at <https://www.dodsbirsttr.mil/submissions/>.

### **PHASE I PROPOSAL FORMAT**

Complete proposals must include all of the following:

**Volume 1:** DoD Proposal Cover Sheet

Note: 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 this section.

**Volume 2:** Technical Volume

**Volume 3:** Cost Volume

**Volume 4:** Company Commercialization Report

**Volume 5:** Supporting Documents

**Volume 6:** Fraud, Waste, and Abuse Training

### **DoD PROPOSAL COVER SHEET (VOLUME 1)**

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.

## **TECHNICAL VOLUME (VOLUME 2):**

The Technical Volume should include all graphics and attachments but should not include the Cover Sheet, which is completed separately as Volume 1. The Phase I technical volume (uploaded in Volume 2) shall contain the required elements found below. Ensure that all graphics are distinguishable in black and white.

The Phase I Technical Volume page/slide limits identified for the topics 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.

**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. **Note:** Do not upload information such as Permanent Resident Cards (Green Cards), birth certificates, Social Security Numbers, or other PII to the DSIP system.

## **Phase I Work Plan Outline**

NOTE: The DAF 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**

## **COST VOLUME (VOLUME 3)**

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.-g. below) regarding funds use. The DSIP Cost Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing also may be submitted in Volume 5 under the "Other" dropdown option.

a. **Direct Cost Materials:** Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, prices and where appropriate, purpose. Material costs may include the costs of such items as raw materials, parts, subassemblies, components, and manufacturing supplies.

b. **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 v. purchase justification.

c. **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 for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.

d. **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.

e. **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 (do not include profit in the calculation), 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.

f. **Special Tooling, Special 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 special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include items such as innovative instrumentation and/or automatic test equipment.

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.

#### **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 23.3 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

#### **SUPPORTING DOCUMENTS VOLUME (VOLUME 5)**

**The following documents are required for all proposal submissions:**

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1 to the DOD SBIR 23.3 BAA)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2 to the DOD SBIR 23.3 BAA)
3. Disclosure of Funding Sources (Attachment 4 to the DOD SBIR 23.3 BAA)

**The following documents may be required if applicable to your proposal:**

1. 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/DD2315Instructions.aspx>. DD Form 2345 approval will be required if proposal is selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 23.3 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

**FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)**

Note that 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.

**DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TAB A)**

The Air Force does not participate in the Discretionary Technical and Business Assistance (TAB A) Program. Proposals submitted in response to DAF topics shall not include TAB A.

**AIR FORCE PROPOSAL EVALUATIONS**

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 23.3 BAA.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

**DAF USE OF SUPPORT CONTRACTORS**

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, Montech, 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 CO Daniel J. Brewer ([Daniel.Brewer.13@us.af.mil](mailto:Daniel.Brewer.13@us.af.mil)) with concerns.

### **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.

Automated feedback will be provided for Phase I proposals designated Not Selected. Additional feedback may be provided at the sole discretion of the DAF.

**IMPORTANT:** Proposals submitted to the DAF are received and evaluated by different organizations, handled 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.

The Air Force anticipates that all 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 J. Brewer, [Daniel.Brewer.13@us.af.mil](mailto:Daniel.Brewer.13@us.af.mil).

### **AIR FORCE SUBMISSION OF FINAL REPORTS**

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

### **PHASE II PROPOSAL SUBMISSIONS**

DAF organizations may request Phase II proposals while technical performance is ongoing. This decision will be based on the contractor's technical progress, as determined by an DAF Technical Point of Contact review using the Phase II review criteria outlined above.

Phase II is the demonstration of the technology found feasible in Phase I. Only Phase I awardees are eligible to submit a Phase II proposal. All Phase I awardees will be sent a notification with the Phase II proposal submittal date and detailed Phase II proposal preparation instructions. If the physical or email addresses or firm points of contact have changed since submission of the Phase I proposal, correct information shall be sent to the DAF SBIR/STTR One Help Desk. Phase II dollar values, performance periods, and proposal content will be specified in the Phase II request for proposal.

NOTE: The DAF primarily makes SBIR Phase I and II awards as Firm-Fixed-Price contracts. 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, including award of Cost-Reimbursement types of contracts. 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/STTR PROGRAM MANAGEMENT IMPROVEMENTS**

The DAF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees will be notified. The DAF also reserves the right to change any administrative procedures that will improve management of the DAF SBIR/STTR Program at any time.

### Air Force SBIR 23.3 Phase I Topic Index

<b>Topic Number</b>	<b>Topic Name</b>	<b>Maximum Value*</b>	<b>Maximum Duration* *</b>	<b>Technical Volume Page Limit***</b>
SF233-0001	Digital Flatsat	\$190,000.00	6	20
AF233-0002	Power Efficient Digital Binocular Night Vision Imaging System (PEDBNVIS)	\$180,000.00	6	20
SF233-0003	Revolutionary SmallSat Power Enhancement	\$190,000.00	6	20
AF233-0004	Hybrid Turbo-Electric Propulsion Design and Optimization	\$180,000.00	6	20
SF233-0005	High Fidelity Sporadic E Model	\$150,000.00	6	20
AF233-0006	Machine Learning Algorithms for Infrared Search and Track Applications	\$180,000.00	6	20
SF233-0007	On-Orbit Intent Estimation of Close-Proximity Space Objects	\$150,000.00	6	20
AF233-0008	Compact Midwave Infrared Hyperspectral Imager for Attributable Platforms	\$180,000.00	6	20
SF233-0009	Sporadic E Predictive Model	\$150,000.00	6	20
AF233-0010	Dual-purpose laser range finder and lidar sensor	\$180,000.00	6	20
SF233-0011	Flexible Satellite Terminals for Multi-Tenancy Applications	\$150,000.00	6	20
AF233-0012	Multi-Spectral Infrared Focal Plane Arrays	\$180,000.00	6	20
AF233-0013	Wafer scale Zinc Selenide (ZnSe) single crystals	\$180,000.00	6	20
SF233-0014	Multi-Object Behavior Modeling of Space Systems	\$190,000.00	6	20
AF233-0015	Multi-int Multi-look 3D features Image Fusion with Machine Learning	\$180,000.00	6	20
SF233-0016	Evaluation of Space-Enabled Kill-Webs	\$190,000.00	6	20
AF233-0017	Passively Augmented LiDAR	\$180,000.00	6	20
SF233-0018	Mobile RAVEN Observatory	\$190,000.00	6	20
SF233-0019	Suborbital Hover Vehicle-Reusable Rocket	\$190,000.00	6	20
AF233-0020	Mapping Mesostructures to Hypersonics for Improved Manufacturability and Performance	\$180,000.00	6	20
AF233-0021	Operations & Logistics Susceptibility due to Publicly Available Information (PAI)	\$180,000.00	6	20

SF233-0022	Rapid ASCENT propellant loading operations	\$190,000.00	6	20
AF233-0023	High energy, multi-component, optical isolator for 2 $\hat{P}$ /4m fiber lasers	\$180,000.00	6	20
AF233-0024	Optical Fiber Combiner for Combining MWIR Quantum Cascade Laser Beams	\$180,000.00	6	20
AF233-0025	High bandwidth, low latency wavefront sensing for airborne directed energy applications	\$180,000.00	6	20
AF233-0026	Compact High Power Microwave Antenna	\$180,000.00	6	20
AF233-0027	Combiner Architectures for Maximum Brightness Fiber Laser Amplifier Pumping	\$180,000.00	6	20
AF233-0028	L-Band Buncher/Modulator for X-Band Accelerator	\$180,000.00	6	20
AF233-0030	Energy-Aware Autonomy for Air Vehicles	\$180,000.00	6	20
AF233-0032	Design AF DCGS Next Gen Enterprise IT systems using 5G Technology for Low to Zero Maintenance	\$180,000.00	6	20
AF233-0033	Synthetic Weather Environment Injection	\$180,000.00	6	20
AF233-0034	Creating a digital twin of legacy aircraft	\$180,000.00	6	20
AF233-0035	Readiness Spares Package (RSP) Optimization	\$180,000.00	6	20
AF233-0036	Commercial Technologies for EMP Hardening and Electrical System Protection	\$180,000.00	6	20
AF233-0037	Measuring Ground-to-Air Atmospheric Path Transmission	\$180,000.00	6	20

**\*Proposals that exceed this amount will be disqualified**

**\*\* Proposals that exceed this duration will be disqualified**

**\*\*\*Pages in excess of this count will not be considered during evaluations**



SF233-0001

TITLE: Digital Flatsat

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System-of-Systems

OBJECTIVE: A fully functioning Flatsat via a rapidly produced, easily maintained, cloud-resident Digital Twin model that allows full mission emulation of SDA mission features and allows test of new bus, payload, network and mission commands prior to upload to vehicles on orbit. Solutions should minimize hardware and emphasize massless payload deployment. Resulting flatsats would be expected to fulfill the same mission requirements as traditional hardware/software flatsats – ground test of commands prior to upload, operator training, etc. – but would be instantiated only as cloud-based software solutions.

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PHASE I: Phase I feasibility will be demonstrated by a computer model and simulation tool that shows the basic interfaces for a digital FlatSat that supports future system development.

PHASE II: Phase II applicants will be expected to provide a fully operable digital FlatSat that allows the user to create and provide a simulation model that will interface with existing SDA FlatSat hardware, as well as emulate it and allow it to be replicated online.

PHASE III DUAL USE APPLICATIONS: SDA, Space Development Agency is working to provide spiral development of smallsats that allow continue improvement and the ability to add new technology. A Digital FlatSat would provide a model that supports development and integration of new systems that can be added in with a digital twin model instead of having to build and integrate hardware, allowing for more options to be evaluated and compared. A successful Phase III would be used to evaluate design trades for future SDA tranches and would reduce engineering design time, while increasing the deployment of novel and innovative technology required to keep ahead of near peer competitors in space system design.

#### REFERENCES:

1. Shangguan, Duansen, A Digital Twin-Based Approach for the Fault Diagnosis and Health Monitoring of a Complex Satellite System, Symmetry 2020

KEYWORDS: Satellite Digital Twin; Satellite Digital Engineering; Computer Aided Design; Satellite Product Lifecycle Management; Satellite Model-Based Systems Engineering; Satellite Digital Thread

AF233-0002

TITLE: Power Efficient Digital Binocular Night Vision Imaging System (PEDBNVIS)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Human-Machine Interfaces;Advanced Materials;Advanced Computing and Software

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 digital binocular night vision system having the imaging performance of analog goggles in the reflective infrared bands with power and mass properties consistent with long-term helmet-worn use. System must integrate visual situational awareness

**DESCRIPTION:** Analog binocular night vision goggle (NVG) sets remain ubiquitously fielded to enable combat operations by aviators and ground operators because an acceptable digital replacement has not emerged over the past 20 years. As a result, higher-performance white-phosphor (HPWP) image intensifier (II) tubes are currently being retrofitted into the AN/AVS-9 and other NVG housings as an improvement over lower-performance green-phosphor tubes fielded in the 1990s. Attempts to optically overlay digital information over analog night scenes in aviator binocular NVG sets via a clip-on device to the objective or ocular optics – including a digital eyepiece (DEP) for the AN/AVS-9 and Night Vision Color Display (NVCD) for the AN/AVS-10) – have failed due to their unacceptable human machine interface (HMI) performance, including dramatically and unacceptably increased power, neck-born mass properties (weight, moment-arm), and image latency. Similarly, attempts to completely replace the functionalities performed by analog tubes – which run on 0.50 W while generating visible representations of near infrared (NIR) scenes with 0.6 ms latency at 20/23 Snellen acuity under quarter-moon illumination over a 40° circular field-of-view (FoV) – with various assemblies of digital devices have failed for similar reasons. Pilots and ground special operators need a digital helmet mounted visualization system that enables night/day/adverse weather operations. The currently fielded analog night and digital day vision helmet systems are not integrated. The opportunity now exists to replace these two separate pilot helmet systems—one for night, another for day—with one, hybrid system leveraging emerging technologies including metaoptics, advanced vacuum electronics-based infrared II designs and materials, power efficient algorithms and processors optimized for human foveal visual perception (e.g neuromorphic, neural-net optimized pipeline), and complementary metal oxide semiconductor (CMOS) digital visual-band sensors and microdisplays developed for the ultrahigh definition television (UHD TV) and computer gaming/metaverse industries. The Air Force has a mission need for a digital binocular night vision goggle operating in a reflective band. Reflective bands of interest include near infrared (NIR, 700-1100 nm), shortwave infrared (SWIR, 900-1700 nm), some visible (VIS), 400-700 nm), or a combination (VNIR, NSWIR, VNIRSWIR). Architectures of interest include 1:1 overlapped left/right channels, each inline with eyes, with the high resolution reflective band sensor-processor-display device chain providing a visible representation of the scene sensed in infrared with interfaces for conformal symbol overlay, external video source display, and native helmet-view transmission off-helmet to other battlespace participants. The power, mass properties, and volume must be minimized sufficiently to achieve end-user acceptance, to avoid neck injuries over years of use and minimize probability of head lock during high g maneuvers. The device must be comfortable for wearing under combat conditions for hours and be usable as a vision aid during night (including overcast starlight), day, and all-weather operations. The power efficient digital binocular night vision imaging system (PEDBNVIS) sought

must have an organic helmet mounted battery and an interface to off-helmet power and an image generator for symbology/imagery. PEDNVIS housing, helmet mounting system, and controls must be simple, intuitive, operable with gloved hands, and similar to those for AN/AVS-9 sets. Performance metric threshold (objective) levels sought in the Phase II PEDBNVIS prototypes include: reflective band sensor NIR (VNIRSWIR); spatial image resolution 2000x2000 px (7680x4320 px); field-of-view 40x40 deg. (128x72 deg.); acuity 1.3 arcmin (1.0 arcmin) under quarter moon illumination; frame rate 60 Hz (240 Hz); latency from objective-to-eye, 17 ms (1 ms); head-born mass 2 kg (1 kg); head-born moment arm 0.1 kg-m (0.05 kg-m); power 12W (1W); volume 2000 cc (1400 cc); and head-mounted battery time 4 hr (8 hr) at 22°C. Volume and weight metrics include the digital goggle with its helmet mount and conformal battery pack. No government furnished materials, equipment, data, or facilities will be provided.

**PHASE I:** Design PEDBNVIS having size, weight, and power (SWaP) consistent with helmet-worn implementation. Justify all design performance metrics (listed in Topic Description) via laboratory experiments and analyses. Explain any estimated performance less than the thresholds described in the topic description and state why a warfighter would accept/select it for combat use over their currently fielded analog NVG set. Develop a system architecture for PEDBNVIS integration (a) with standard helmets (e.g. HGU-55/P, USAF Future Fixed Wing Helmet, or special operations) and (b) with aircraft cockpits or special warfare kit. Develop a System Implementation Plan (SIP) for evaluating PEDNVIS operating performance in combat environments, including producibility and supportability. Describe components and fabrication processes required to build prototypes.

**PHASE II:** Fabricate and deliver Qty(2) PEDBNVIS prototypes at TRL6 whose performance meets or exceeds thresholds for all metrics simultaneously. Incorporate mechanical, electrical, and software interfaces required for integration into fielded cockpit helmet systems or special warfare operations kits. Support operator testing, provide special test equipment, and refine prototype performance based on feedback. Performance metric threshold (objective) levels sought in the Phase II PEDBNVIS prototypes include: reflective band sensor NIR (VNIRSWIR); spatial image resolution 2000x2000 px (7680x4320 px); field-of-view 40x40 deg. (128x72 deg.); acuity 1.3 arcmin (1.0 arcmin) under quarter moon illumination; frame rate 60 Hz (240 Hz); latency from objective-to-eye, 17 ms (1 ms); head-born mass 2 kg (1 kg); head-born moment arm 0.1 kg-m (0.05 kg-m); power 12W (1W); volume 2000 cc (1400 cc); and head-mounted battery time 4 hr (8 hr). Volume and weight metrics include the digital goggle with its helmet mount and conformal battery pack. Deliver prototype optimized for weight, power, HVS compatibility, reliability, and ruggedization consistent combat operations. Develop and deliver prototype user/maintainer/training manuals. Finalize and deliver a Bill of Materials describing each component with details including its vendor, TRL and MRL. Create roadmap to mature technology to TRL8/MRL8.

**PHASE III DUAL USE APPLICATIONS:** Develop, fabricate, and deliver Qty(6) PEDBNVIS production configuration units at TRL8/MRL8 with interfaces to the fielded cockpit helmets systems or special warfare kits. Support field test and evaluation activities to demonstrate end-user acceptance. Update BoM and establish PEDBNVIS production performance specification with tolerances for each component. By the end of Phase III, the PEDBNVIS should be capable of all-weather operation worldwide. Finalize commercialization plan. Evaluate PEDBNVIS and its subsystems for other USAF, USSF, and DoD operational applications such as expeditionary base security police and lunar night space suites. Develop and deliver quantitative estimates of addressable market by industrial segments including defense, non-defense federal and state agencies, civil and commercial aviation, outdoor recreation (e.g. hunting, camping), and consumer electronics (e.g. computer gaming, metaverse).

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1. Darrel G. Hopper, Alternative Night/Day Imaging Technologies (ANIT), Association of Night Vision Manufacturers (ANVM), 35pp (1 Dec 2022), [www.nightvisionassociation.org](http://www.nightvisionassociation.org) ; Darrel G.

- Hopper, AFRL alternative night/day imaging technologies (ANIT) program, in Proceedings of SPIE Vol. 10642, Degraded Environments, Sensing, Processing, and Display 2018, 1064208 (14 May 2018) [www.spiedigitallibrary.org](http://www.spiedigitallibrary.org); David G. Curry, Gary Martinsen, and Darrel G. Hopper, Capability of the human visual system, in Cockpit Displays X, Proceedings of SPIE Vol. 5080, 58-69 (2003);
2. Metalens technology: M. Khorasaninejad, W.T. Chen, R.C. Devlin, J. Oh, A. Y. Zhu, F. Capasso, "Metalenses at visible wavelengths: Diffraction-limited focusing and subwavelength resolution imaging," *Science* 352 (6290), pp 1190-4 (3 Jun 2016); William A. Schulz, "Staking a Claim on the Next Best Thing Since Glass," *Photonic Focus*, Jan/Feb 2023, pp26-29; Metalenz, Leadoptik fiber-thin 3D imaging probes, other startups; "Novel liquid crystal metalens offers electric zoom," *ScienceDaily* (10 Jun 2021) <https://www.sciencedaily.com/releases/2021/06/210610162353.htm> ; DARPA/DSO ENVision Program, [www.darpa.mil/program/envision](http://www.darpa.mil/program/envision) ;
  3. Sensor technologies including: (a) image intensifier technologies from L3Harris [www.l3harris.com](http://www.l3harris.com) , Elbit [www.elbitamerica.com](http://www.elbitamerica.com) , Photonis Inc. [www.photonis.com](http://www.photonis.com) ; (b) electron-bombarded active pixel sensor (EBAPS) technologies from [www.eotechinc.com](http://www.eotechinc.com) ; (c) SWIR technologies from Sensors Unlimited, [www.sensorsunlimited.com](http://www.sensorsunlimited.com) ; (d) CMOS image sensors from STMicroelectronics [www.st.com](http://www.st.com) , SiOnyx LLC [www.sionyx.com](http://www.sionyx.com) ; (e) Jason McPhate et al., Noiseless, kilohertz-frame-rate, imaging detector based on micro-channel plates readout with the Medipix2 CMOS pixel chip, in *Proc. SPIE* 5881 (2005), 10.1117/12.618861;
  4. prior digital night vision development attempts including: (a) Multispectral Adaptive Networked Tactical Imaging System (MANTIS), <https://www.afcea.org/signal-media/us-recoups-nighttime-primacy> ; (b) Enhanced Visual Acuity (EVA) <http://www.collinsaerospace.com/news/news/2020/06/collins-helps-us-navy-marine-corps-pilots-fly-more-safely-new-enhanced-visual-acuity> ; (c) Integrated Visual Augmentation System (IVAS) [https://www.army.mil/article/264773/ivas\\_campaign\\_of\\_learning\\_ensures\\_development\\_products\\_on\\_and\\_fielding\\_remain\\_on\\_track](https://www.army.mil/article/264773/ivas_campaign_of_learning_ensures_development_products_on_and_fielding_remain_on_track) ; (d) Wesley Sheridan, Binocular Multispectral Adaptive Imaging System (BMAIS), DTIC AD1033984 (2010), <https://apps.dtic.mil/sti/citations/AD1033984> .

**KEYWORDS:** Power Efficient Digital Binocular Night Vision Imaging System; PEDBNVIS; pilot augmented reality system; PARS; augmented reality; AR; low latency; digital visual interface; human vision system; HVS; nanooptics; image intensifier; CMOS imagers, metaoptics

SF233-0003

TITLE: Revolutionary SmallSat Power Enhancement

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology; Integrated Network System-of-Systems

OBJECTIVE: Using novel technology to dramatically (at least double) increase available on-orbit power in an ESPA or ESPA Grande class vehicle. Considerations could include enhancing on board processing power efficiency, reducing power requirements of significant power consumption devices or improved power generation, all while maintaining overall commoditized size, weight and cost points currently available

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PHASE I: Phase 1 feasibility will demonstrate a product or power management control system that effectively improves power operation or conserves power use.

A.) Novel systems that includes more efficient batteries, higher yielding solar arrays, or lower power consuming devices show a good way forward and further development will support a lower power system on orbit

B.) Effective power management is essential and power control and power management systems that have potential to reduce the need for power consumption or that demonstrate a more effective way to manage power use on orbits should be explored

PHASE II: Phase II will demonstrate a more effective power enhancement system, which could be providing more power, reducing power consumption or more effectively managing the existing power systems. A working model, either virtual or that is integrated with several pieces of hardware, will demonstrate power enhancement that either provides more power or reduces power consumption. Demonstration of that will provide the way forward for novel SmallSat power enhancement.

PHASE III DUAL USE APPLICATIONS: As more and more satellites are in orbit, especially in a proliferated LEO constellation, they will have multiple tasks which will require varied and different power consumption. Finding effective SmallSat Power Enhancement will be essential to providing those new technologies and allowing them to either provide more power, or manage the existing power more effectively. Specific topics include effective power management, novel power generation, autonomous power control systems, and power monitoring systems.

#### REFERENCES:

1. Mostacciuolo, Elisa, Iannelli, Luigi, et al., "Modeling and power management of a LEO small satellite electrical power system," 2018 European Control Conference (ECC) Tuschida, Kwamoto, Kato, et al., "Efficient Power Control for Satellite-Borne Batteries Using Q-Learning in Low-Earth-Orbit Satellite Constellations" IEEE Wireless Communications Letters ( Volume: 9, Issue: 6, June 2020)

KEYWORDS: Small Satellite Power Management; On Orbit Power Efficiency; Improved Satellite Power Control Systems; Novel Battery systems on orbit; Novel battery satellite systems

AF233-0004

TITLE: Hybrid Turbo-Electric Propulsion Design and Optimization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Renewable Energy Generation and Storage; Trusted AI and Autonomy

OBJECTIVE: Conventional turbines and hybrid powertrains have been seen to limit the operational parameters of advanced VTOL and CTOL aircraft and there is strong evidence to believe novel hybrid turbine propulsion architecture can provide enhanced capabilities to provide expanded mission sets beyond what is currently possible in the Air Force. The technology space for hybrid turbine propulsion is growing and the Air Force would like to better understand the feasibility of existing models to meet or exceed current industry standards for turbines, conduct trade space analysis to increase performance characteristics, and develop a prototype to demonstrate performance. The purpose of this topic is to demonstrate that a hybrid turbine propulsion architecture can achieve greater mission performance in key critical phases of flight over conventional turbines. The effort will feed requirements generation and future concept evaluation by AFWERX Prime for electrified aircraft by proving the feasibility, maturity, and mission impact of hybrid turbine propulsion architectures while providing mission relevant capability such as enabling vertical take-off of otherwise overly complicated configurations, maintaining power at high altitude or boosting power for dash phases and exporting power for payloads during cruise. The Agility Prime program has seen the benefit of hybrid powertrains that utilize electric motors for propulsion and hypothesizes that this benefit not only transfers to turbines but will be relevant to a number of existing and future aircraft.

DESCRIPTION: Conventional turbines have typical performance designed towards a peak thrust required for takeoff and an efficient cruise for longer range. AFWERX Prime is interested in the performance enhancement potential of hybrid turbine propulsion architectures which directly link electric machines to turbomachinery input/output shafts. These architectures of "turbo-electric" machines are then able to leverage multiple energy sources (electrical and chemical) and aerodynamic work outputs (fan blades) to produce thrust in novel combinations which are better optimized for various phases of flight. This could be leveraged to better optimize for specific mission profiles such as Vertical Take off and Landing, high altitude loft, fuel efficient cruise, high speed dash, or payload power draw. The architectures are not limited in sizing, maturity, or architecture at this stage; however, it is necessary to investigate and produce a report on their design to achieve greater performance than comparable conventional turbines in one or more of the key mission areas above. A key metric for this topic is to collect and analyze performance data from existing physical prototypes (small scale turbo-electric machines) to inform the design trade space of future systems. It is expected that a company will work collaboratively with AFWERX and other invested DoD stakeholders throughout the full period of performance to inform the tradespace and evaluate potentials. Companies should be mindful during their analysis and design efforts, to identify significant changes in required maintenance and or operational burden and cost. While there is a need to enhance performance in the areas mentioned, a cost benefit balance to the overall system should be maintained. Of note, as a SBIR Topic it is required that proposals are received by SBCs, but companies are allowed to collaborate with academia and partners if need be and AFWERX Prime is interested in all relationship dynamics as long as they adhere to SBIR regulations.

PHASE I: The Phase I effort should consist of a feasibility study and analysis showing that a company's current technology can, currently or with further innovation, exceed the performance characteristics of conventional turbines to achieve one or more of the following use case/mission parameters: 1. Increased endurance 2. VTOL capability 3. Electrical power output to payloads 4. Increased Altitude Ceiling 5. Increased Maximum Speed The feasibility study is expected to be fed from analysis of current models or prototypes and should include, but not be limited to the following content: a) Tradespace analysis conducted by your team to converge on current design(s) b) Limiting factors to reach maximum performance and potential to overcome c) Technical recommendation or prioritization of alternative

solutions. Deviations in use case and characteristic improvements not mentioned herein may be explored with coordination with AFWERX Prime and its partner Stakeholders. Success criteria for Phase I is an analysis of trade space and a recommended path forward that describes the design's technical feasibility and a description of work required.

**PHASE II:** Phase II should pick up where the Phase I left off and will focus on the maturation of a Customer approved design. It is expected that, based on the Phase I results one design or development aspect will be chosen for Phase II development and maturation. The effort should focus on refining the technology such that the performance characteristics proposed in Phase I can be verified through prototyping or demonstration. Phase II should result in a demonstration or prototype test and report that validates the capabilities proposed out of Phase I. Additional phase II work efforts include, but are not limited to: Improve and refine the digital models developed in phase 1 throughout prototype integration and testing process, explore supplier options for hybrid power and thermal management architectures and key components to identify key technology gaps, and quantify technology metric goals, required to enable significant capability improvements.

**PHASE III DUAL USE APPLICATIONS:** Phase III potential exists both in the commercial sector and within the DAF ecosystem. This work will be transitioned and scaled to support Agility Prime efforts. There are opportunities to flight demo and test within the Prime program construct while also exploring and extending the use cases to additional AF interested parties.

**REFERENCES:**

1. <https://docs.google.com/document/d/1HCcDdPDPdaM9s4OvmVp2kWTenNhnIn2RwA1snnhhj-E/edit?usp=sharing>

**KEYWORDS:** electric; hybrid; turbine; turbo; turbofan; turbojet; turboshaft; turboprop; parallel hybrid; series; electric motor; propulsion

SF233-0005

TITLE: High Fidelity Sporadic E Model

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Integrated Network System-of-Systems;Space Technology

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 project would be to develop and integrate and high fidelity sporadic E model that is useful to currently accepted and deployed ionospheric modeling and ray tracing tools. High fidelity in the context of this model is one that is spacially and temporally on the order of the development of the key features of sporadic E. This model should be 3 dimensional in nature and capture correctly the features seen by high fidelity measures by Incoherent Scatter Radar. This model would then be used to develop and update ionospheric propagation codes used by the Space Force in modeling and tracking ISR performance and communication performance currently in use by operational user.

**DESCRIPTION:** This model will be developed using existing 2 dimensional Magneto-Hydro-Dynamic codes coupled to existing neutral atmosphere fluid dynamic codes. These codes are already developed and tested on HPC systems, but would be required to extend to a 3 dimensional code. This code would be run for a variety of 3 dimensional cases exploring relevant ionospheric conditions, both across the globe and through a variety of solar conditions. The output of these code will be an extremely high fidelity electron density map which can be compared and validated against existing ISR coverage of sporadic E to ensure that the code produces qualitatively and quantitatively similar results to the highest fidelity observations available. Once validated, the resulting electron density models would be integrated into existing ionospheric propagation code bases to determine the effects of this phenomena on relevant RF military systems. The code would also provide a validation of the resulting codes at the SSC and operational level.

**PHASE I:** For this topic a phase I is not necessary as the technology and literature review has been conducted as well as relevant code explored and understood. If required Phase 1 would be used to develop a software framework compatible with expected transition agents as well as doing an evaluation of relevant use cases and their particular requirements.

**PHASE II:** The goal of the Phase II will be to produce representative magneto-hydro-dynamic output and validate that output against existing incoherent scatter radar data. This will be an iterative process to ensure that the relevant underlying physics is understood and that the magneto-hydro-dynamic code captures all sporadic E phenomena. This will likely be run on High Performance Computing systems, utilizing massively parallelizable code. The end point of the Phase II will be a complete, validated sporadic E model.

**PHASE III DUAL USE APPLICATIONS:** The Phase III of this project will be to produce sporadic E models for a variety of locations and conditions within the ionosphere. This will provide a baseline through which currently existing RF propagation codes can be used with the determine the appropriate effects that sporadic E has on RF propagation. These effects will then be integrated into operationally relevant RF propagation models, after which the models will be validated against the high fidelity models and ISR data.



**REFERENCES:**

1. 1. Werne, Joe & Fritts, David & Wang, Ling & Lund, Thomas & Wan, Kam. (2008). High-Resolution Simulations and Atmospheric Turbulence Forecasting. 262 - 266. 10.1109/DoD.HPCMP.UGC.2008.82.;

**KEYWORDS:** For this topic a phase I is not necessary as the technology and literature review has been conducted as well as relevant code explored and understood. If required Phase 1 would be used to develop a software framework compatible with expected transition agents as well as doing an evaluation of relevant use cases and their particular requirements.

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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**OBJECTIVE:** Develop machine learning algorithms that can be implemented on low cost, size, weight and power processing hardware to aid detection and tracking processing for infrared search and track (IRST) applications.

**DESCRIPTION:** The United States Air Force needs an extended range passive air-to-air surveillance capability for contested environments where solutions based on active emissions and/or radar returns may not be available or are ineffective. Detection and tracking algorithms have demonstrated great capability when paired with IRST sensors. However, common statistically-based detection and tracking algorithms are computationally expensive and require large compute resources to operate real-time, leading to compromises in execution methodologies and performance. In addition, required processing resources limit the ability to deploy such IRST systems on platforms with stringent cost, size, weight and power (C-SWaP) constraints and/or may significantly reduce platform endurance and associated mission effectiveness. As such, alternative algorithms must be developed with similar, if not improved, performance but requiring significantly less computational resources. Machine learning (ML) algorithms offer a possible solution to this challenge. ML algorithms have been explored and developed for various detection and tracking applications [1 - 5]. However, they have not specifically been developed for use in IRST applications with very low contrast targets imbedded in diverse background clutter including sensor-induced artifacts. In this application, the targets are unresolved with their signatures and motion characteristics differing significantly from other tracking scenarios. Here unresolved does not mean the system generates single-pixel targets, but rather the spatial shape is dictated by the impulse response of the imaging system and sampling at the focal plane array. In addition, the specific type of sensor implementation for IRST may dictate methodologies employed. Ultimately, an optimal algorithm/processing solution might be a combination of a conventional approaches with ML techniques applied to a specific aspect of the problem. In order to be effective, robust and generalizable to a variety of environments and different IRST sensor instances, the ML methods should not rely solely on training data collected by the respective sensors themselves. The effort should not be based on blind application of numerous ML methods and evaluating the results. It should instead focus on the entirety of the detection and tracking process and determine where and how ML should be specifically applied. This effort should explore and demonstrate the ability to train the ML algorithm using properly simulated target signatures and clutter plus noise and interference effects, and achieve comparable detection performance to baseline algorithms. In addition, the ML approach should take into account of limitations of truth data for real world IRST data that could be used for the ML training and should be able to overcome this limitation. For this effort, the government will provide 1) Limited real-world IRST data with relevant targets and truth for testing and validation 2) Modeled target signatures 3) IRST sensor characteristics. It is expected the Offeror will incorporate physical phenomenology, radiometry, and realistic focal plane characteristics within the structure of the algorithm. The Offeror must also demonstrate knowledge of conventional IRST algorithms and processing products in order to understand the problem space. Offerors must have the ability to process and store classified data up to Secret//Collateral.

PHASE I: Develop a modular machine learning architecture optimized within a detection and track processing framework for IRST. Clearly identify the areas where ML would apply or integrate into a detection and track processing pipeline.

PHASE II: Develop and refine the architecture in described in Phase 1. Demonstrate the ability to train the ML algorithm using a combination of synthetic and real-world data. Apply the ML-enhanced algorithm to real-world government furnished data with relevant targets and associated truth. Compare detection and false track performance of the ML-enhanced algorithm with baseline algorithms. The ML-enhanced algorithm performance should be evaluated against the truth data and should achieve a specified threshold of False Positive rate (or False Alarm) and False Negative rate. Compare computation time/resources via demonstration and/or timing studies of the ML-enhanced algorithm with baseline algorithms.

PHASE III DUAL USE APPLICATIONS: Implement the ML-enhanced IRST detection and tracking algorithm in a ruggedized low SWaP processor to meet the provided platform requirements including Open Mission Systems (OMS), integrate with IRST system(s), and demonstrate performance and capability through mountaintop and/or flight testing.

#### REFERENCES:

1. Hu, Y, Xiao, M, Zhang, and K, Wang, "Aerial Infrared Target Tracking in Complex Background Based on Combined Tracking and Detecting", *Mathematical Problems in Engineering*, vol. 2019, Article ID 2419579, 17 pages, 2019;
2. Wang, T, Qin, R, Chen, Y, et al., "A reinforcement learning approach for UAV target searching and tracking." *Multimed Tools Appl*, 78, 4347–4364 (2019);
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5. Ryu, J and Kim, S, "Small infrared target detection by data-driven proposal and deep learning-based classification," *Proc. SPIE*, Vol. 10624, *Infrared Technology and Applications XLIV*, 106241J (2018).

KEYWORDS: Machine Learning; AI/ML; Infrared Detection and Tracking; Infrared Search and Track; IRST sensor; low SWaP; real-time processing; RT processing; low contrast targets; electro-optical/infrared; EO/IR; passive EO/IR

SF233-0007

TITLE: On-Orbit Intent Estimation of Close-Proximity Space Objects

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 work is the development of techniques that will enable the estimation of a space object's behavior/intent in close-proximity scenarios. Space domain awareness (SDA) is often described as the characterization of available information in the space environment in a meaningful way. For instance, measurements of an object in the space environment may yield a "state estimate" of that object (e.g. some position, velocity, and attitude all with some corresponding uncertainty). The belief state of this object, via orbital dynamics knowledge, can then be further propagated into the future. This actionable knowledge enables decision-making in the space domain, such as a collision-avoidance maneuver or a reorientation of a high-valued asset. Conventionally, these belief states represent the core of SDA. However, it is becoming necessary to analyze the available data in the space domain at a higher level - not only where an object is/going, but why it is there/maneuvering. With the assumption that there is some agency behind the control of a space object, what tools and algorithms can be developed on available data that will enable the precise estimation of that object's intent? The ability to estimate both an object's intent and its state simultaneously will enable more-informed decision-making in the space domain. Furthermore, we seek solutions that enable these methods to be implemented on-board a spacecraft, enhancing its autonomous capabilities.

**DESCRIPTION:** Although there does not yet exist a collectively-agreed upon definition of autonomy amongst academic circles, the core idea is often some variation on the following: a machine-driven system that (i) receives data, (ii) interprets that data into some form of knowledge representation, and (iii) uses that knowledge representation to make decisions and accomplish some predefined task without human input. As the space domain becomes increasingly contested and congested with a rapidly-growing population of space objects there is a need to improve the on-board autonomous capabilities of high-valued assets. A promising avenue to do this is through informed decision-making based on the state and intent estimates of nearby objects. While state estimation techniques have been studied for decades, intent estimation is a relatively unexplored area. The ultimate aim is to infer the intent of an agent from available data (e.g. sensor observations, process dynamics, historical patterns of behavior). There are many open research questions regarding this topic - what types of uncertainty (aleatory, epistemic) are most applicable to intent characterization? Given that many forms of space-based data offer ambiguous interpretations of intent, i.e. available evidence may point to multiple mutually-exclusive hypotheses simultaneously, how can this be leveraged with current mathematical frameworks, such as Kolmogorov's axioms of modern probability or belief function theory? What information theoretic (e.g. Kullback-Leibler divergence, Mahalanobis distance, etc...) can be utilized to yield intent estimation metrics? Thus, the objective of this SBIR is to investigate these research problems and develop mathematically-rigorous algorithms that supply intent estimates of nearby space objects. Offerors should specify in their proposals what government-furnished property and/or data is required to conduct this effort.

**PHASE I:** Conduct a comprehensive comparative assessment and trade-off study of various intent estimation approaches. Define metrics that indicate the precision/success of intent estimation techniques

and acknowledge the computational complexity of employing investigated techniques on-board space-grade hardware. Investigate the effects of intent estimation for on-board autonomous decision making.

PHASE II: Improve and iterate upon the most promising and effective intent estimation method. Conduct performance analyses on available space asset data and test on-board algorithms on space-grade hardware in the AFRL/RV laboratory environment.

PHASE III DUAL USE APPLICATIONS: Develop flight-ready intent-estimation software that can be employed into future AFRL or government space missions and experiments.

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2. Lai, Y., Paul, G., Cui, Y. et al. (2022), "User Intent Estimation During Robot Learning Using Physical Human Robot Interaction Primitives." Autonomous Robotics 46;
3. Cramer M., Cramer J., Kellens K., Demeester E., (2018), "Towards Robust Intention Estimation Based on Object Affordance Enabling Natural Human-Robot Collaboration in Assembly Tasks," Procedia CIRP, Volume 78, Pages 255-260, ISSN 2212-8271

KEYWORDS: Autonomy; Intent Estimation; Statistical Inference; Data-Driven Decision-Making

AF233-0008

TITLE: Compact Midwave Infrared Hyperspectral Imager for Attritable Platforms

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System-of-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: Develop a midwave infrared (MWIR) hyperspectral imager (HSI) capable of covering a 3-5 um with at least 250 spectral bands.

DESCRIPTION: Hyperspectral imaging (HSI) has demonstrated utility for material classification and target detection/identification as well as gas detection and quantification. [1] Most HSI sensors work in either the visible through shortwave infrared (V-SWIR) or longwave infrared (LWIR.) V-SWIR sensors rely on solar illumination limited their use to daytime applications. LWIR sensors rely on the emitted radiance from targets meaning they can operate during day or night but cameras and often optics must be cooled to cryogenic temperatures to avoid near field radiance swamping any target signal thus increasing cost, size, weight, and power (C-SWaP.) MWIR HSI has traditionally received less attention because both solar reflection and self-emission affect the target signature complicating target detection. As non-linear detection algorithms such as neural networks gain prominence these complications become less of a concern. Largely because of these processing issues development of MWIR HSI sensors over the last 20 years has been extremely limited. As such existing MWIR HSI sensors such as Aerospace's MAHI have SWaPs (>10ft<sup>3</sup> and >100lbs) that far exceed those needed for attritable platforms. [2] Low-SWaP MWIR options such as Telops's MWIR Hypercam [3] rely on long integration times to get sufficient SNR which makes detection of transient events such as gas releases or moving targets extremely difficult. MWIR FPA and other component technologies have continued to advance during this time making it possible to design a sensor that meets the SWaP constraints of attritable platforms. MWIR HSI sensor can also potentially balance the limitations of V-SWIR and LWIR sensors allowing for day-night operation but at reduced C-SWaP compared to LWIR systems. Although the use of MWIR HSI has been limited it has demonstrated success in greenhouse gas detection and quantification, [4] camouflage detection, [5] and explosives detection [6] as well as other applications. As camouflages become more sophisticated in reducing SWIR and LWIR features additional wavebands such as MWIR will become more valuable. Additionally, several combustions products such as CO<sub>2</sub>, CO, H<sub>2</sub>O, and N<sub>2</sub>O have strong features in the MWIR that can be used to determine whether an engine is running and/or characterize different types of engines (i.e. diesel vs gas.) These applications would directly support AF Operational Imperative 3 by both detecting critical targets and distinguishing targets from decoys. The proposed system should have at least 250 bands with an objective of 600 bands and cover the full wavelength range from 3-5 um (T) or 2.9-5.5um (O). The sensor should have a GSD of no more than 3m (T), 1.5m (O) from when viewing nadir from an altitude of 20kft. NESR should not exceed 2 u-flicks (T) 1 u-flick (O) averaged across all bands between 4.5 and 5 um when viewing a 300K blackbody. There are no SWaP constraints for Phase I and II design and prototype but a design path forward should be presented for the sensor to fit in a volume of 5ft<sup>3</sup>(T)/2ft<sup>3</sup>(O), weigh less than 80lbs(T)/20lbs(O), and draw less than 500W(T)/100W(O) power. Prototype designs closer to meeting these specifications will be given preference, but the system performance metrics will take precedence.

PHASE I: Develop plans and concept designs and identify component options to demonstrate viability.

PHASE II: Develop and refine concept outlined in Phase I to include thermal and mechanical modeling, stray light analysis, and optical design tolerancing. Develop breadboard lab prototype (T) or ruggedized ground-based (O) sensor system.

PHASE III DUAL USE APPLICATIONS: Adapt existing design to meet C-SWaP requirements of an attritable platform, exact platform is to-be-determined but should be roughly what is outlined in the description. Ruggedize design for flight environment up to 70kft and conduct flight testing.

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1. M.T. Eismann, Hyperspectral Remote Sensing, SPIE press, Bellingham, WA (2012)
2. Tratt, David M., et al. "MAHI: An airborne mid-infrared imaging spectrometer for industrial emissions monitoring." *IEEE Transactions on Geoscience and Remote Sensing* 55.8 (2017): 4558-4566.
3. Gagnon, Marc-André, et al. "Standoff midwave infrared hyperspectral imaging of ship plumes." 2015 7th Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS). IEEE, 2015.
4. Casey I. Honniball, Rob Wright, and Paul G. Lucey "MWIR hyperspectral imaging with the MIDAS instrument", *Proc. SPIE 10177, Infrared Technology and Applications XLIII*, 101770J (9 May 2017)
5. Kumar, Vinay, and Jayanta Kumar Ghosh. "Camouflage detection using mwir hyperspectral images." *Journal of the Indian Society of Remote Sensing* 45 (2017): 139-145.
6. K. Ruxton, G. Robertson, W. Miller, G.P. A. Malcolm, and G. T. Maker "Mid-infrared hyperspectral imaging for the detection of explosive compounds", *Proc. SPIE 8546, Optics and Photonics for Counterterrorism, Crime Fighting, and Defence VIII*, 85460V (30 October 2012)

KEYWORDS: Hyperspectral; Midwave Infrared; Low SWaP

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 project is to deliver a predictive model of sporadic E occurrence. The model would allow the user to see a "weather" forecast for sporadic E statistics for a given time and place. The forecast would run out hours, days, weeks, or even months into the future with uncertainty increasing with forecast length. Sporadic E statistics might include percent of day (or other time unit) with blanketing or sporadic E as a function of frequency. The model could also provide information on the expected peak frequency of Sporadic E. Other parameters, such as a yet to be defined "severity" metric could also be provided. The model should be data-assimilative and global. Possible data sources included ionograms, radio occultation measurements, high altitude wind measurements, and sporadic E seed population data. Other data sources are also possible.

**DESCRIPTION:** Historically, Earth's ionosphere is separated into 3 distinct layers, namely the D (50-90 km), E (90 – 150 km), and F (150 – 500 km) layers. It is well known that the plasma in these layers impacts propagation at radio frequencies (RF). When the ionosphere is smoothly and slowly varying, it is generally straight forward to model these impacts. The ionosphere, however, is not always in a behaved and well-defined state. Irregular ionospheric structures severely alter RF propagation or produce scintillation. Numerous mechanisms exist that cause irregular structure in the ionosphere. One such mechanism is Sporadic E, which can be described as an unusually dense E layer that sporadically appears for relatively short periods of time. Sporadic E can sometime be so dense that it completely blocks skywave propagation to and from the F layer. When this blocking occurs, the phenomenon is often referred to as blanketing E. It is generally accepted that Sporadic E forms when long lasting meteoritic ions are pushed into a thin, dense layer due to wind shear interactions and the geomagnetic field. Sporadic E occurrence is modulated on timescales from years to hours. Annually, sporadic E occurs much more frequently in the summer. Daily, it is modulated by the semi-diurnal tides, which trigger a descending horizontal wind shear in the thermosphere twice a day. These descending wind shears have been observed in wind measurements as well in measurements of descending sporadic E layers. Additionally, it has been shown that Sporadic E is modulated by quasi-periodic planetary waves with periods ranging from a few days to a few weeks (Haldoupis and Pancheva 2002). It is not exactly known how the planetary waves produce the sporadic E modulation, but the effects are easy to measure. Ionosondes, which measure the electron density as a function of altitude, are the primary tool used for detecting sporadic E. In fact, the term sporadic E is a descriptive term used to describe ionograms (ionosonde measurements) that are affected by the overly dense E layer phenomenon. Since sporadic E is such a thin layer, the only two measured characteristics are the height and peak plasma frequency. These two parameters could then be input into a RF propagation model to determine the geometric impacts. Based on recent observations, the length scales of dense sporadic E structures are on the order of 10s to 100s of km, depending on the orientation. The goal of this topic, however, is not to characterize the exact morphology of sporadic E, rather we intend to predict the occurrence rate and characteristics of sporadic E at any point on Earth. Since it is difficult to globally monitor the drivers of sporadic E (thermospheric winds and meteoritic seed populations), a physics-based forecast model may be impractical. The impacts of sporadic E, however, are



regularly observed by numerous instruments, including ionosonde networks and GNSS radio occultation (RO) capable satellite constellations. Since Sporadic E is subject to global weather patterns, spatial and temporal correlation functions could adequately describe future occurrence. For instance, observations in western US today could predict observations in eastern US tomorrow, and Europe a week later. Existing global sensor networks likely provide the necessary tools to build an empirical, predictive model. Such a model currently does not exist. We seek a global forecast model that leverages existing data sources. Preference is given to publicly available data but exceptions can be made. The model should act like a weather forecast for scattered thunderstorms, where the product is a percent probability of occurrence and overall severity. The model should focus on the characteristics of Sporadic E that impact high frequency (HF; 3-30 MHz) propagation but other aspects (e.g. scintillation) can be considered as well. The model will be validated by the performer and customer by comparing predicted Sporadic E levels at Ionosonde sites or other instrument sites with actual measurements.

**PHASE I:** Phase I will demonstrate the feasibility of using existing data sources for use in a Sporadic E forecast model. Specifically the demonstration would include a global Sporadic E occurrence/severity study using available Ionosonde data and possibly other data sources. The feasibility of a potential model will be determined by the measured temporal and spatial correlations between stations. If a strong enough correlation exists on planetary wave size scales then the model will likely be deemed feasible by the TPOC.

**PHASE II:** Develop a data-assimilative forecast model based on the results of phase I. The model should be similar to a weather forecast model where the user can get the percent chance for Sporadic E for a given place. The forecast would stretch out days to weeks depending on how far in advance the information is statistically meaningful. The forecast model should be validated using existing data sources. New data sources through AFRL may also become available for validation. The model will be compared to median climatology estimates to determine its usefulness as a forecast tool.

**PHASE III DUAL USE APPLICATIONS:** There are a number of government and private organizations that rely on accurate predictions of RF interactions with the space environment. Furthermore, the proposed model has potential use within the US Space Force Space Systems Command as well as Air Combat Command, the US Navy, and other DoD and Title 50 organizations.

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2. Tang, Q., Zhao, J., Yu, Z., et al. (2021) Occurrence and Variations of Middle and Low Latitude Sporadic E Layer Investigated With Longitudinal and Latitudinal Chains of Ionosondes, *Space Weather*, 19, 2;
3. Shinagawa, H., Tao, C., Jin, H. et al. (2021) Numerical prediction of sporadic E layer occurrence using GAIA, *Earth Planets and Space*, 73, 28

**KEYWORDS:** Sporadic E; ionospheric model; ionosonde

AF233-0010

TITLE: Dual-purpose laser range finder and lidar sensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber;Trusted AI and Autonomy

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:** This topic seeks to develop a dual-purpose sensor which can operate as a laser range finder (LRF) at long ranges (defined as range detection of a standard 2.3-m x 2.3-m NATO target; multi-pulse processing is allowed) and secondarily as a lidar system which can generate small-scale, 3D point clouds at ranges within approximately 10 kilometers. The sensor should be able to seamlessly switch between either mode while being suitable for operation from an airborne platform.

**DESCRIPTION:** Digital range finding technology offers many advantageous capabilities to airborne Intelligence, Surveillance, and Reconnaissance (ISR) missions. Many object tracking applications require precise knowledge of the object location, which can be found in real-time using a precision laser range finder in conjunction with some other cueing sensor [1]. The inclusion of a laser system on a sensor platform also invites the opportunity to perform target identification missions using the laser in conjunction with an optically resolved imaging system to create accurate 3D point clouds of targets [2]. Such a dual-purpose sensor will likely require real-time reconfigurable camera and laser settings to switch between the two missions. The goal of this effort is to demonstrate a product with a compact and lightweight design and with standard interfaces that achieves the basic specifications outlined here. The sensor should operate at an eye-safe wavelength of 1.55  $\mu\text{m}$  or longer. The 3D lidar mode should offer a pixel format and/or scanning solution to provide approximately a 256x256 or larger image providing both angular and range resolution. The pixels can be digitally combined into larger macro-pixels and the laser pulse repetition frequency and pulse duration can all be reconfigurable to facilitate the laser range finding mode. In the LRF mode, the range resolution should be less than 50-m with an accuracy of  $\pm 5$  m out to maximum ranges. The sensitivity and range can be increased through longer dwell times and multi-pulse processing. The solution should fit within size, weight and power constraints of 1 cu ft, 40lbs, 100W, not including the beam steering mechanism. For both modes, some small angle scanning ( $\pm 0.5$  degrees) to fine tune the pointing towards targets in field of view should be developed to be used conjunction with a larger, coarse steering mechanism such as a gimbal or turning mirror. The end-product for this effort need not include the coarse beam steering mechanism.

**PHASE I:** In this initial phase, device concepts will be developed, evaluated, and computer modelled. Design challenges and trade-offs will be tabulated and areas in need of additional R&D will be identified. Critical factors for the LRF include the maximum operating range, the range accuracy, and overall volume. For the secondary objective of the lidar, critical factors include the resolution and field of view, and reconfigurability between the two modes.

**PHASE II:** Prototype devices will be constructed and tested for relevant specifications. Tests will be performed against relevant metrics. A final packaged system will be produced that meets the specifications and is suitable for Technology Readiness Level 4. Preliminary designs will be made for a Phase III device.

PHASE III DUAL USE APPLICATIONS: A flight ready version of the design will be built from a compact and lightweight design and with standard interfaces. Manufacturing process will be evaluated and refined to improve yield while reducing cost.

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1. <https://www.l3harris.com/all-capabilities/dp-elrf-v-diode-pumped-eye-safe-laser-range-finder>;
2. P. McManamon, LiDAR Technologies and Systems, SPIE Press, Bellingham, WA (2019)

KEYWORDS: lidar; laser range finder; ISR; point clouds

SF233-0011

TITLE: Flexible Satellite Terminals for Multi-Tenancy Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Integrated Network System-of-Systems;Space Technology

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**OBJECTIVE:** Develop proper interfaces, digital Intermediate Frequency (IF) services and virtualized digital IF modem terminals with utilization efficiency, maximum flexibility and full automation needed to support fighting SATCOM's reliability, growth, and cybersecurity

**DESCRIPTION:** The Air Force has identified digital intermediate frequency (IF) technology as one of the key enablers for the digital transformation of space, satellite and related industries as its interoperability and performance standards offer the advantage of load balancing and mission planning flexibility that could replace analog IF signals and help prevent vendor lock-in. This topic explores the current state-of-the-art related to digital IF groundwork, digital IF dividers and combiners, digital IF multi-carrier modem, and integrated modem and terminal in enhancing controls to service providers (e.g., network service providers, application service providers, etc.) with expected benefits of path resilience, baseband aggregation, and radio frequency (RF) disaggregation. Specifically, there is also much interest in pursuing innovative solutions on how digital IF services and virtual digital IF modems based on software-defined, flexible, and extensible virtual platforms, could potentially enhance future digital IF operations of satellite communication gateway infrastructure and satellite terminals as well as emergent deployments of enterprise-to-site management automation, full failover capacity and automation. In addition, proposed solutions should take into account of other technical challenges, e.g., i) multi-tenancy at satellite terminals so that multiple end-users and customers could be attached to the same satellite terminal but still have customized access network services, ii) elastic provisioning based on the underlying network access resources specifically for multi-tenants to achieve service isolation and offering seamless communications services, and iii) transformation potentials of satellite terminals into virtualization-capable remote head-ends, and thus, serving a wide range of services.

**PHASE I:** Develop necessary digital IF systems engineering plans and concept designs for on-demand satellite terminals capable of handling satellite broadband access services with end-users and customers to be able to dynamically request and acquire bandwidth, quality of service, and quality of experience in flexible and transparent manners. Conceptualize the support of multi-tenancy in satellite terminals to offer satellite access to multiple customers connected to the same satellite terminal. Develop reference solutions of virtualized baseband subsystems composed of return links for satellite access and transmission that efficiently provide adaptive waveforms virtualized on the fly in conjunction of digital IF services, transient on-demand bandwidth allocation, handover, power control, fading mitigation, etc. without affecting normal operation of other users.

**PHASE II:** Demonstrate the utility of an engineering development unit for flexibility in the provisioning, configuration and customization of multi-tenant satellite terminals with reduced (if any) intervention by satellite network operators and network access operators owning the satellite ground segment platforms. Evaluate operational and business support services by multi-tenants with considerations of promptly setup

times and resource elasticity. By the end of Phase II, a proof of concept for an agile deployment of flexible satellite terminals that keep pace with the rapid growth, cost, virtualization, and Commercial-Off-The-Shelf implementation pertaining to customer density and demand shall be demonstrated.

#### PHASE III DUAL USE APPLICATIONS:

#### REFERENCES:

1. FAA, "Concept of Operations v2.0",  
<https://www.faa.gov/researchdevelopment/trafficmanagement/utm-concept-operations-version-20-utm-conops-v20>
2. FAA, <https://www.faa.gov/uas>

**KEYWORDS:** Digital Intermediate Frequency (IF); Digital IF Multicarrier Modem; Virtual Digital IF Modem; Multi-Tenant Satellite Terminal; Virtualization on Commercial-Off-The-Shelf (COTS) Implementation; Elastic Provisioning; Virtualized Waveforms

AF233-0012

TITLE: Multi-Spectral Infrared Focal Plane Arrays

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Space Technology

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 commercial supplier of infrared detector materials, readout integrated circuits (ROICs), and/or focal plane arrays (FPAs) optimized for multi-spectral-band operation. Designs should be constrained to operate through the infrared atmospheric transmission windows, specifically short-wave infrared (SWIR, 1-2.7  $\mu\text{m}$ ), mid-wave infrared (MWIR, 3-5  $\mu\text{m}$ ), or long-wave infrared (LWIR, 8-16  $\mu\text{m}$ ). Materials and ROIC designs should be optimized specifically for multi-band operation (2 - 4 spectral bands in one or more atmospheric windows), with an emphasis on temporally simultaneous and/or spatially co-registered data capture. Additional consideration will be made for approaches that engineer radiation tolerance into the multi-band design to support both Air and Space Force applications. Solutions can include specific spectral-band combinations that serve a well-defined application (e.g. missile warning, target ID, gas sensing), or a modular product that can be adapted to a variety of multi-band applications.

**DESCRIPTION:** The commercial infrared imaging industry has grown tremendously in recent years, but all of the available commercial off-the-shelf infrared cameras are single band or color. Many industries currently utilizing single-band infrared imaging technology could benefit from a multi-band product that would generally provide improved discrimination and added functionality. For example, industrial manufacturers use single-color MWIR infrared cameras for imaging gas leaks. These cameras can be integrated with an optical filter designed to enhance contrast of a specific gas, but are limited in sensitivity by the environmental clutter of the scene and are blind to other gases. A two-color camera could dramatically improve the minimum detectable concentration of the gas, reduce false leak alarms, and provide improved visual fidelity of the gas by providing both a reference wavelength and gas-tuned wavelength. A three or four color camera could additionally detect and distinguish two or three different gasses all in a single camera. Similar cases can be made for industries such as defense, pharmaceuticals, health care, manufacturing etc. While dual-band FPAs have been demonstrated in the DoD, e.g. MWIR/MWIR and MWIR/LWIR, this was achieved using ROICs with two-color bias polarity switching. This approach utilizes alternating frames of each band and has several limitations: limited to two colors; detector array must be an epitaxial-grown stacked design; data capture is not temporally simultaneous; and generally works for broad-band channels with similar charge-handling requirements. For some applications, high quality identification/discrimination requires relatively narrow spectral bands (e.g. gas sensing), which is not easily realizable with the stacked design. Furthermore, many of these two-color ROICs use an analog pixel input with limited charge handling. This creates issues if bands have disparate charge handling requirements (e.g. SWIR with MWIR, or broad filter with narrow filter). Additionally, the detector designs and materials have not been optimized for multi-band imaging, which would ideally feature high absorption coefficients and sharp band edges to minimize optical cross-talk. Another recent technological growth area is in heterogeneous integration using vias, which have not been adequately explored in the context of multi-band FPAs. Solutions to this objective should be focused on providing a commercial supplier of enabling multi-spectral-band components (e.g. infrared detector materials, ROICs, integrated filter assemblies, or FPAs). The solutions should clearly define the innovation that makes the

product particularly suitable for multi-band applications, and should be optimized for this purpose. While the main focus could be on optimizing detector materials or ROICs, for example, later phases of the program should include fabrication of full FPAs and/or cameras for demonstration purposes. Because innovations in multi-band imaging have utility for high-altitude and space-based applications, innovations that include some level of radiation hardness or tolerance will be given extra consideration. For proposals focused on ROIC design, there should be an emphasis on flexibility and functionality. As required, designs should consider the disparity in current handling requirements for both bias switched and/or super-pixel arrangements. This may require bias, integration time, and amplifier gain flexibility at the pixel and/or super-pixel level. Another consideration might be ROIC input layouts that accommodate detector arrays with spatially co-registered and simultaneous capture using via contacts. Solutions focused on back-end processing, such as integrated filter assemblies, must consider the current standard FPA manufacturing procedures and limitations to ensure product integration is effective, feasible, and not cost prohibitive. Because dual-band bias switched FPAs have been previously demonstrated, proposals that utilize this approach should also feature something that improves upon the design in a clearly innovative way.

**PHASE I:** Develop an innovative enabling component that improves state-of-the-art multi-spectral-band imaging capability. Identify applications for the enabling component, and use these applications to define performance metrics and requirements. Model the expected performance, yield/operability, and assess the commercial viability of the product. Determine expected challenges in fabrication/integration and provide mitigation approaches where appropriate. Start basic fabrication or other feasibility demonstration.

**PHASE II:** Produce and begin optimization of prototype component(s). Assess the operability and yield at this stage. Integrate with FPA and produce test data. Analyze the key performance metrics as defined in Phase I, and compare with current state-of-the-art. Identify partner(s) to develop a prototype demonstration camera utilizing the component for Phase III.

**PHASE III DUAL USE APPLICATIONS:** Refine the manufacturing process, optimize performance, and maximize operability/yield of the component. Build a prototype camera to demonstrate the functionality and performance of the component in a demonstration system. Compare performance to similar single color cameras with single optical filter and two-color bias switched designs. Focus on identifying interested FPA manufacturers and/or camera and systems integrators to transition the technology.

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4. Carrasco, Rigo A., et al. "Proton irradiation effects on InGaAs/InAsSb mid-wave barrier infrared detectors." *Journal of Applied Physics* 130.11 (2021): 114501;

**KEYWORDS:** Infrared; Focal Plane Array; FPA, Image Sensor; Multi-Spectral; Multi-Band; Photodetector; Radiation Hard; ROIC; Readout Integrated Circuits;

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE);Advanced 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:** Develop a commercial single crystal growth process for 50mm diameter zinc selenide (ZnSe) wafers

**DESCRIPTION:** The need for high-brightness, compact infrared lasers operating in the mid-wave infrared (MWIR) through far infrared has long been established in the Global Strike Operational Imperative to address infrared missile threats. Beyond infrared countermeasures (IRCM), such frequencies have applications in spectroscopy, and imaging, for both military and commercial users. Frequency conversion devices based on quasi-phase matching (QPM) have been very successful with PPLN and the more recent development of orientation patterned (OP) GaAs. However, due to the intrinsic absorption losses in PPLN its usefulness is limited to wavelengths shorter than 4  $\mu\text{m}$ . These limitations combined with the need for MWIR to far IR fueled the development of OP-GaAs. As with PPLN there are intrinsic material properties that limit OP-GaAs as a high brightness source for MWIR to far IR radiation. The two primary limitations are the 1.42 eV direct band gap at room temperature and strong absorption at wavelengths longer than 15  $\mu\text{m}$ . GaAs's band gap leads to strong two photon absorption at wavelengths shorter than 1.75  $\mu\text{m}$  limiting the available pump sources. Zinc Selenide has a wider band gap, a modest nonlinear coefficient, and a wide transparency which are attractive for infrared countermeasure applications. The major obstacle to producing OP-ZnSe has been the lack of high quality wafer scale single crystal substrates, which are required for fabrication of OP-ZnSe templates. To date, single crystals of ZnSe have been grown by vapor phase, melt, and solution growth techniques, but the desired sizes and quality have not been achieved. In order to realize OP-ZnSe IR frequency conversion devices, large single crystals of ZnSe must be produced for fabrication of ZnSe OP-templates. This SBIR call is seeking the development of a crystal growth technique to provide high quality, optically clear ZnSe crystals 50mm in diameter.

**PHASE I:** Develop a scalable ZnSe growth process and then demonstrate a single crystal of ZnSe with a (100) orientation with at least 10x10x1mm dimensions.

**PHASE II:** Using the growth process established in Phase I, demonstrate and deliver a single crystal of ZnSe with a (100) orientation with at least 25mm in diameter and a 1mm thickness. Dicing and polishing the 25mm wafers with a scratch dig of 40-20.

**PHASE III DUAL USE APPLICATIONS:** Demonstrate and deliver a single crystal of ZnSe with a (100) orientation with at least 50mm in diameter and a 1mm thickness. Dicing and polishing the 50mm wafers with a scratch dig of 20-10.

**REFERENCES:**

1. Singh et al., Journal of Crystal Growth 312 (2010) 1142–1145.
2. Kolb, et al., Journal of Crystal Growth 7 (1970) 199-202.
3. Hum et al., C. R. Physique 8 (2007) 180-198.



KEYWORDS: Zinc Selenide; Crystal Growth; Infrared; Wafer; Single Crystal

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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**OBJECTIVE:** Investigate and develop tactical-speed analytical capabilities for space multi-threat, multi-object characterization and assessment.

**DESCRIPTION:** A fundamental component of ensuring freedom of operation in space is space battle management and command and control (SBMC2), with a core tenet therein being the ability to conduct real-time analysis of the risk to mission. This is necessary to allow action to be taken accurately, knowledgeably, and on appropriate timelines. This concept requires having knowledge. Collected data can be used to provide information to form hypotheses, but these hypotheses must have meaningful and critical context for BMC2 decision-making. Thus, accurate characterization on mission-relevant timelines must determine not only the behavior of a space-based threat but also the potential impact to the mission. In the increasingly complex space domain, analyses should look beyond single-object, single-event occurrences. Traditional approaches to modeling multi-object and/or campaign-level activities is time consuming and labor intensive, carries high levels of bias risk, and does not easily accommodate iteration for comparative and/or “what-if” analysis. Improved and new capabilities must support more complex analyses on tactically-relevant timelines and enable a robust risk assessment to include likelihood and consequence of events. The technology to be developed should consider multiple behavioral and physics inputs, perform threat and impact analysis beyond single object and event actions, and present assessment results in mission-time for critical decision making.

**PHASE I:** Awardees for Phase I will conduct a feasibility study on candidate technologies and develop an architecture that addresses the needs described in the topic description. This feasibility study should include assessments of computational methods for autonomously processing large amounts of space data. The feasibility study should be supported with preliminary analysis and results to demonstrate the viability of the approach.

**PHASE II:** Phase II efforts will design, develop, and implement a prototype based on the architecture developed in Phase I, focused on multi-object engagements within a single orbital regime with flexibility and scalability to expand into other regimes. The Phase II prototype shall generate situational awareness and risk to mission calculations using synthetic, representative, data.

**PHASE III DUAL USE APPLICATIONS:** Phase III efforts would involve enhanced performance capabilities of the prototype architecture implementation. They will demonstrate autonomous assessment capabilities as part of military exercises and other representative operational environments. Working with transition partners, they will identify and evaluate opportunities for implementation/integration in DoD and/or civilian applications requiring timely data for situational awareness.

**REFERENCES:**

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2. Furfaro, R., Linares, R.; Gaylor, D., Jah, M., Walls, R., Resident Space Object Characterization and Behavior Understanding via Machine Learning and Ontology-based Bayesian Networks, Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference, Maui, HI, 2016.
3. DeMars, K., Frueh, C., Jah, M, Erwin, R., Multiple-Object Space Surveillance Tracking Using Finite-Set Statistics. Journal of Guidance, Control, and Dynamics, 2020, doi:10.2514/1.G000987.

KEYWORDS: Space domain awareness; machine learning; AI, space command control

AF233-0015 TITLE: Multi-int Multi-look 3D features Image Fusion with Machine Learning

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Advanced Computing and Software

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 novel, more computationally efficient multi-int and multi-look fusion algorithms to improve detection, classification, and recognition of uncooperative low resolution and occluded objects in urban and other complex terrains using advantages and capabilities of modern sensors and machine learning algorithms.

**DESCRIPTION:** To develop novel, more computationally efficient multi-int and multi-look fusion algorithms to improve detection, classification, and recognition of uncooperative low resolution and occluded objects in urban and other complex terrains using advantages and capabilities of modern sensors and machine learning algorithms.

**PHASE I:** Investigate state of the art solutions in simple feature extraction and object level probability of Detection/identification methods that reduce the need for human oversight and the computational complexities of the fusion methods. Develop an architecture design concept of the Phase II detection/classification algorithms. The Phase I report should provide a complete description of the proposed algorithms that includes demonstration of electro-optic, infrared, or radar data processing and low level feature fusion from image data. It is desirable that algorithms be computationally efficient to provide near real-time capabilities. Any data needs and assumptions required by the concept should be clearly outlined and explained. Source code of the final demo is a required deliverable.

**PHASE II:** Develop and demonstrate a functional algorithmic suite and operator interface using realistic electro-optic, infrared, or radar imagery sensor data. Validate measures of performance established in Phase I. Other tasks include documenting and delivering a report, interim and final source code, including all users' needs assessments, methodologies, algorithms, and any data structures or software products necessary to support transition of the work to Air Force applications. Imagery and other multi-int data may be provided to the awardees. Extend Phase I approach to include additional sensor modalities and operating conditions. Sensor operating constraints shall also be addressed. The final report should document progress made and include requirements to sensors (range, spectra, timing, minimal amount of multi-look angles/images, and other operational constraints). Final delivery should include source code and data sets for all techniques developed under the contract. To streamline transition of the Phase II products to AF applications, a business model for compensation of the developers' SBIR data rights must be provided.

**PHASE III DUAL USE APPLICATIONS:** This system could be used in a broad range of military and civilian security applications where real-time information fusion and target detection/recognition is required: for example, in military operations in urban and complex terrain, in search and rescue, firefighting, drug interdiction, law enforcement, counter terrorism operations in urban structures, border tunnels, industrial facilities, etc. Commercial Application: Technologies developed under this effort can

be applied to remote sensing, industrial development and operations, traffic analysis, and environmental monitoring.

#### REFERENCES:

1. Igor Ternovskiy, "Scene Understanding Based on Mapping Singularities and New Primitives Generation" 2005 IEEE International Conference on Integration of Knowledge Intensive Multi-Agent Systems KIMAS'05 Boston MA, USA 18 – 21 April, 2005 Workshop on Sapiient Systems Editors: Rene V. Mayorga & Leonid I. Perlovsky
2. I. Ternovskiy, et. al., "Is catastrophe analysis the basis for visual perception?," chapter in Three-Dimensional Holographic Imaging, C.J. Kuo, M.H. Tsai (Eds.), John Wiley and Sons, Inc., 2002. ISBN: 0-471-35894-0
3. I.V. Ternovskiy, T.P. Jansson, "Rotational invariant visual object extraction and understanding," Proc. SPIE, Signal Processing, Sensor Fusion, and Target Recognition IX, I. Kadar (Ed.), Vol. 4052, pp. 85-93, August 2000.
4. T.P. Jansson, I.V. Ternovskiy, "Data reduction for multispectral and hyperspectral imagery based on application of catastrophe theory," Proc. SPIE, Applications and Science of Neural Networks, Fuzzy Systems, and Evolutionary Computation III, B. Bosacchi, D.B. Fogel, J.C. Bezdek (Eds.), Vol. 4120, pp. 110-119, October 2000.

KEYWORDS: Machine Learning; electro-optic, infrared, radar sensors; multi-phenomenology fusion; ISR; multi-look

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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**OBJECTIVE:** Develop modeling and simulation capabilities which highlight the interaction between space systems and aggregations of terrestrial (air, land, sea) systems coordinating to deliver effects in multi-domain operations scenarios.

**DESCRIPTION:** The USSF Commander's Campaign Support Plan (CSP) outlines the United States Space Force (USSF) will support Geographic Combatant Commands (GCCs) by organizing, training, equipping, and presenting a ready Space Force with an eye towards collaborative partnerships that yield decisive operational capabilities. Modern force design is moving towards concepts of "Mosaic Warfare" and distributed and connected groups of force components collaborating in new ways. As these force designs evolve terrestrially, so too will the way in which they are supported by space services. Enabling modeling and simulation engines to explore the multi-dimensional graphs structures which arise when analyzing connected and collaborating groups of agents (aka digital twins) while evaluating the utility of the delivered effects is an area of ongoing and rapidly evolving research. This topic explores the integration of model-based systems engineering (MBSE) system representation in systems modeling language (SysML) with agent-based modeling and simulation frameworks to enable high fidelity analytical representations of the connections between system design decisions, and the impact of the increase in space service performance on the utility of the service-dependent platforms in the fight.

**PHASE I:** Define and develop a concept for a workable prototype or design to address at a minimum the basic capabilities of the stated objective. Define uses cases and specific application for a new capability. Demonstrate technical feasibility to meet the capabilities of the stated objective for one use case.

**PHASE II:** The solution for this topic will employ multiple modeling and simulation frameworks for the representation of systems in their respective domains and integrate methods for the representation of these systems in SysML such that responsive models may be generated by the system representations as input. Further, multi-dimensional graph visualization and processing tools will be integrated to enable means to explain the complex relationships between interacting and collaborating agents in multi-domain scenarios. Evaluation of the kill-webs will be carried out to a point where, via the use of concrete performance metrics or measures of expected capability equivalent across domains, space-enabled kill-webs can be meaningfully compared to kill-webs that are not space-enabled.

**PHASE III DUAL USE APPLICATIONS:** Develop a strategy to transition prototype residual capabilities and incremental proliferation based on USAF/USSF requirements.

**REFERENCES:**

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2. Tobin, Josh, Rachel Fong, Alex Ray, Jonas Schneider, Wojciech Zaremba, and Pieter Abbeel. "Domain randomization for transferring deep neural networks from simulation to the real world." In 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 23-30. IEEE, 2017;
3. Fernandez, Nicolas F., Gregory W. Gundersen, Adeeb Rahman, Mark L. Grimes, Klarisa Rikova, Peter Hornbeck, and Avi Ma'ayan. "Clustergrammer, a web-based heatmap visualization and analysis tool for high-dimensional biological data." *Scientific data* 4 (2017)

**KEYWORDS:** model-based systems engineering (MBSE); agent-based modeling and simulation; digital twin engineering; Advanced Framework for Simulation

OUS (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber

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:** Investigate and prototype passive imager and laser beam scanners for a Passively Augmented LiDAR (PAL) architecture that can be used for autonomously detecting, recognizing, and identifying objects that may be obscured by background clutter. The USAF needs improved munitions and other airborne system sensing and target discrimination capabilities to perform against contested landscapes and deception techniques. Using this imaging architecture, USAF systems are expected to be able to precisely detect, recognize, and identify hidden targets on the battlefield with high confidence. The PAL architecture is based on a hybrid system consisting of a multi-kilometer range LiDAR and a passive imager. The goal of the hybrid system is for the active and passive sensors to complement one another by producing a sensor having the strengths of both, but not limited by the weaknesses of either individual system. To that end the passive imager provides high frame rate, high resolution, wide Field of Regard (FOR) imaging. The passive imager will be capable of producing image quality sufficient for target ID through shape-based template matching. In the event there are obscured targets, and the system is unable to ID targets, the passive imagery will be used for anomaly detection indicating the potential presence of hidden targets. The anomaly coordinates will be transferred to the LiDAR system for detailed interrogation over a narrow region. Although various types of passive imagers could be employed, we anticipate the initial imager will be a longwave passive polarimetric imager. It will be desirable for the LiDAR system to incorporate advanced material identification modalities including multiple spectral wavelengths and/or optical polarization. The LiDAR may be a conventional 3D imaging LiDAR or a spectropolarimetric LiDAR. In both cases the LiDAR will be capable of providing 3D imagery of the narrow FOR. For the spectropolarimetric LiDAR, the system will also provide the spectropolarimetric properties of objects in the narrow FOR. LiDAR imaging technology does not exist in any current US weapon seeker in inventory. Therefore, state-of-the-art imaging seekers do not include lidar capabilities such as 3D point cloud imaging, foliage penetration, and active spectropolarimetric material classification. The PAL concept overcomes the primary limitation of lidar imaging: scanning large areas in short time durations. However, the PAL concept of quickly scanning small regions within a large FOR is not conventional for lidar systems and requires a novel scanning system to enable lidar on weapon seekers for the first time.

**DESCRIPTION:** In depth investigation of a PAL system is needed in order to more completely understand the system trade-offs necessary to optimize the ability to detect and identify hidden targets. A compelling PAL system for Air Force applications in remote sensing may utilize a high frame rate passive imager to rapidly scan a large field of view, detect potential regions of interest, and pass location data to a LiDAR imager to obtain spatial, spectral, and/or spectropolarimetric information on the region of interest. Other than target identification in a battlefield, this technology may be useful in geologic, urban, or agricultural aerial surveys. It can also be applied for military or non-military search and rescue missions where hidden targets are commonly involved. In the notional system, the passive imager may be able to detect/ID unobstructed targets as it identifies scene anomalies, then cues the higher resolution foliage



penetrating LiDAR to scan small regions at the anomalies and perform more advance material identification. Images from passive systems can contain a mixture of multiple potential surfaces of interest on each image pixel due to finite pixel sizes, finite fields of view, and large imaging distances. This adds to the complexity of target detection and the need for a more sophisticated investigation for a potential passive imager on the PAL system. Therefore, a passive imager may need to employ unique anomaly detection (AD) methods that can include contrast enhancement, global RX detectors, and automatic thresholding to successfully analyze and detect anomalies within a complex heterogenous image. Due to the time constraints in a contested battlefield, the techniques for AD of a passive imager may also need to rank high anomaly regions and flawlessly cue the LiDAR system to scan these regions by priority to quickly enable target identification. Scene anomalies detected by a passive imager may include manmade objects obstructed by natural foliage, which may be missed by an unpolarized or non-multispectral imaging system. Therefore, having both a passive imager and a LiDAR in a system such as PAL is expected to result in higher detection rates of hidden targets. Additionally, the LiDAR system may make use of more advanced operational modes including but not limited to simultaneous operation at multiple wavelengths, and/or sensitivity to optical polarization. Polarization depends on a variety of factors including object geometry, surface material, and observation angles. At one extreme, vegetation tends to have a weak polarization signal compared to manmade objects because of surface roughness and nonuniform composition. On the other hand, manmade objects with flat surfaces and uniform composition can lead to a higher degree of polarization. Polarimetric signatures of numerous materials are described in pBRDF databases.

**PHASE I:** Investigate literature for background information on a PAL system and perform system design and analysis. This includes Field of View (FOV) steering for the passive imager and LiDAR scanners. It is desired to understand the complex system trade-offs involved in incorporating a passive imaging system with a LiDAR scanner; additionally, understanding the potential performance enhancements enabled by advanced LiDAR including multiple simultaneous spectral wavelengths and/or optical polarization sensitivity is desired. Study should identify scanner designs for phase II.

**PHASE II:** Procure hardware to build and characterize prototype scanning systems (1-3 from above) for passively augmented LiDAR system. This includes the development and delivery of hardware. It is desirable that the prototype system be capable of operation outdoors to enable field data collection, but it would be acceptable to develop a compelling tabletop system enabling indoor data collection. If the system is limited to indoor operation, then a path to outdoor operation should be clearly defined. Scan imaging frame rate, field of view, and operational range are metrics of interest.

**PHASE III DUAL USE APPLICATIONS:** Develop full system prototype and demonstrate in relevant field environment. Mature the prototype PAL system to perform real-time LiDAR scanning and data acquisition. The completed system shall locate anomalies and cue the novel LiDAR scanner to interrogate small regions. The system shall consist of government furnished or procured laser, detector, and infrared imaging components, completely integrated with the scanner technology developed in Phase II. The fully integrated PAL system will be tested outdoors for foliage penetration and material classification. System performance metrics include frame rate, laser scan rate, power requirements, maximum range, and processing time.

#### REFERENCES:

1. Hybrid passive polarimetric imager and lidar combination for material classification, Jarrod P. Brown, Rodney G. Roberts, Darrell C. Card, Christian L. Saludez, and Christian K. Keyser, Opt. Eng. Aug. 2020;
2. Detection of Hidden Objects Using Passive Polarimetric Infrared Imaging, J. Brown, D. Card, C. Welsh, C. Saludez, C. Keyser, R. Roberts, " IEEE Transactions on Geoscience and Remote Sensing, submitted Aug. 2019;

3. LADAR System and Algorithm Design for Spectropolarimetric Scene Characterization, Richard K. Martin, Christian Keyser, Luke Ausley, and Michael Steinke, IEEE Transactions on Geoscience and Remote Sensing, vol. 56, no. 7, pp. 3735-3746, July 2018;
4. "Single-Pulse Mueller Matrix LiDAR Polarimeter: Modeling and Demonstration, Christian K. Keyser, Richard K. Martin, P. Khanh Nguyen, and Arielle M. Adams, " IEEE Transactions on Geoscience and Remote Sensing, vol. 57, no. 6, pp. 3296-3307, June 2019;
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**KEYWORDS:** LiDAR; passive imagery; autonomy; anomaly detection; material classification; polarimetric imagery; multispectral imagery

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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 goal is to develop a transportable/mobile optical telescope observatory using a Raven-class telescope (aperture of 0.4 to 1.2 meters in size) that can be relocated to remote locations over paved/gravel/dirt roads. The system will be fully functional and autonomous in remote locations, which includes network access (WiFi/StarLink/etc.) and self-contained power source. The observatory should be easily deployed/set-up (1-2 person crew) and optimized for autonomous observations.

**DESCRIPTION:** The USSF has a need for a telescope system that can be relocated to support one-time observation events, just-in-time requirements in a specific geographic location, or to fill temporary coverage gaps. As a result, a mobile telescope system could best provide the required observations without a human present for collection. The mobile system must have the same capability as its fixed location counterparts (Raven network). To effectively accomplish its mission, it must consist of a dome/cover, telescope, mount, camera, filter wheel, and various satellite characterization filters. Additionally, it must contain compute resources for observatory control, telescope control, image processing, analysis, and data distribution. It must be transportable using its own power, or using a government standard vehicle such as a car or pickup truck. Lastly, the system should be designed to be easily deployable with minimal crew and capable of autonomous collection capability.

**PHASE I:** Phase I awardees will develop a mobile Raven Observatory design and perform finite element analysis to demonstrate the system's ability to survive transport over various terrains (asphalt, gravel, and dirt roads). The system should be equipped with a vibration suppression/shock absorption system to protect the telescope and its associated optics. The observatory must also be able to determine its location and perform any self-alignment required by the mount before operating. The observatory must have the ability to operate remotely and autonomously.

**PHASE II:** In Phase II, awardees will construct a prototype of their Phase 1 design. This prototype will be tested to confirm the finite element analysis performed in Phase 1. The autonomy of the observatory will be demonstrated and validated along with a checkout of the optical system after vibration/shock testing. Additionally, the system will be tested to determine measurement accuracy.

**PHASE III DUAL USE APPLICATIONS:** In Phase III, the awardee will deliver a fully functional Mobile Raven Observatory that can serve as a functional replacement for any of the in-service, fixed Raven observatories while also providing the option for easy relocation.

**REFERENCES:**

1. <https://amostech.com/TechnicalPapers/2009/Poster/Kervin.pdf>

**KEYWORDS:** mobile optical telescope observatory; raven telescope; commercial off the shelf telescope

SF233-0019

TITLE: Suborbital Hover Vehicle-Reusable Rocket

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Hypersonics

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 innovative concept, manufacturing implementation, and system hardware for a Suborbital Hover Vehicle-Reusable Rocket (SHVRR). Demonstrate multiple tethered vertical hover flights (or equivalent) of delivered propulsion pathfinder airframe using Government Furnished Equipment (GFE) of a flight weight Rotating Detonation Rocket Engine and engine controller. The delivered pathfinder vehicle under this topic consists of structure, propellant tanks, feedlines, pressurant, communications, control, and electrical power systems to test propellant fill/drain, engine ignition, vertical transition to hover, landing, engine shutdown, and safety system operations sufficient at a selected test facility at the completion of a Phase II award.

**DESCRIPTION:** Rotating Detonation Rocket Engines (RDRE) are a disruptive new rocket engine technology under development by the Air Force Research Laboratory's Aerospace Systems Directorate Rocket Propulsion Division at Edwards AFB California since 2017. The technology has the potential to significantly improve the size, performance, stability, and unit cost of liquid rocket engines over the existing state of the art constant pressure rocket engine technology in use throughout the space industry. To quickly mature the Technology Readiness Level (TRL) of RDREs, development of an innovative minimally viable propulsion system pathfinder is desired. The pathfinder mitigates propulsion development risk for a follow-on full flight demonstration of RDREs for several DoD applications, including, but not limited to: 1) Tactically Responsive Space Access (TRSA) orbital launch, 2) TRSA small point-to-point delivery, and 3) rocket-powered Hypersonic Testbed Vehicles. Mitigating the key propulsion system risks for this engine technology requires repeated testing of a flight weight RDRE in a representative environment for the range of intended DoD capabilities 1-3 above. Addressing the key technical challenges can best be evaluated at reasonable cost to the government using a tethered propulsion pathfinder capable of physically constrained vertical hover/throttling.

Tasks required include:

- Assess technical merit of hover pathfinder for at  $\geq$  two (2) of three (3) TRSA/Hypersonic Testbed capabilities listed above.
- Report budget/schedule feasibility of completing pathfinder design/manufacture/test under SBIR Phase II constraints.
- Complete workplan/schedule/budget.
- Evaluate candidate DoD/non-DoD hover test sites; Rank top two (2) sites with justification.
- In coordination with customer, perform assessment of all safety/flight test/airworthiness requirements for recommended test sites.
- Complete design of pathfinder systems meeting baseline requirements.
- Manufacture pathfinder.
- Complete pathfinder/engine Interface Control Document (ICD).
- Document Pathfinder Hover Test plan.
- Conduct Pathfinder Hover Tests.
- Complete conceptual/preliminary design of Phase III suborbital RDRE flight test vehicle.

- Complete reporting. Key Performance Parameters (KPP) include Parameter / Threshold Goal / Objective Goal Propellant Feed cycle / Pressure-fed / Pump-fed RDRE Chamber Pressure (Pc) /  $\geq 300$  psi /  $\geq 400$  psi Propellant Tank Pressurization / Blowdown / Regulated pressurant RDRE Thrust (F) /  $\geq 1000$  lbf /  $\geq 5000$  lbf Thrust Vector Control ( $\Theta$ TVC) / none /  $\geq 5$  degrees Fuel / Liquid hydrocarbon / RP-2 Oxidizer / Liquid O<sub>2</sub> / Liquid O<sub>2</sub> RDRE min operation time (tb) /  $\geq 10$  seconds /  $\geq 10$  seconds RDRE min specific impulse (Isp) /  $\geq 215$  seconds /  $\geq 215$  seconds RDRE min throttle /

PHASE I: Phase I efforts shall document the scientific/technical suitability and merit of a SHVRR propulsion pathfinder for at least 2/3 of the proposed DoD TRSA/Hypersonic Testbed capabilities as well as assess the feasibility of completing the design, manufacture, and testing of SHVRR within the budget/schedule of a SBIR Phase I/II. If completion of the baseline requirements under Phase II constraints is judged as infeasible, then recommendations shall be made on how the customer can modify baseline requirements or provide additional specific pathfinder systems, beyond the RDRE, as Government Furnished Equipment (GFE) to allow completion under a Phase II.

Specific deliverables under a Phase I include:

- Assess technical merit of hover pathfinder for at  $\geq$  two (2) of three (3) TRSA/Hypersonic Testbed capabilities listed above.
- Report budget/schedule feasibility of completing pathfinder design/manufacture/test under SBIR Phase II constraints.
- Complete preliminary workplan/schedule/budget.
- Complete conceptual design of pathfinder systems meeting baseline requirements.
- Evaluate candidate DoD/non-DoD hover test sites; Rank top two (2) sites with justification.
- In coordination with customer, perform assessment of safety/flight test/airworthiness requirements for recommended test sites.
- Finalize propulsion pathfinder Hover Test plan.
- Draft propulsion pathfinder/engine Interface Control Document (ICD).
- Complete conceptual design of Phase III Prototype Flight Mothership-Reusable Rocket and its traceability to SHVRR design.
- Complete reporting/documentation.

PHASE II: Phase II work should include completion of the design, manufacture, test planning, and test operations of the SHVRR pathfinder using the GFE provided RDRE.

Task during Phase II include:

- Complete final workplan/schedule/budget/requirements.
- Complete preliminary/critical design of pathfinder systems meeting final requirements.
- Finalize pathfinder/engine Interface Control Document (ICD).
- Manufacture SHVRR propulsion pathfinder and integrate GFE RDRE systems.
- Complete safety & test requirements for selected test site.
- Finalize propulsion pathfinder Hover Test plan.
- Complete preliminary design of Phase III Prototype Flight Mothership-Reusable Rocket.
- Conduct SHVRR Hover Test operations.
- Complete reporting/documentation.

PHASE III DUAL USE APPLICATIONS: Phase III consists of conducting the military utility analysis, design, manufacture, and testing of an integrated capability Prototype Flight Mothership-Reusable Rocket for one of the specified DoD TRSA or Hypersonic Testbed capabilities discussed in the Topic Description above. Manufacture and flight test of the integrated capability prototype may be executed under a SBIR Phase III, Other Transactional Authority (OTA), AFRL S&T Seedling for Disruptive Capabilities program (SDCP), or other flight funding mechanism. It's expected that RDRE propulsion system will be at a TRL=6 at entry into a Phase III effort. A successful completion of Phase II of this topic is envisioned to allow the technology to be included in the trade space for a follow-on for either a TRSA upper/high

energy orbit insertion launch program of record, or a prototype program for hypersonic testbed vehicle or TRSA point-to-point delivery.

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2. <https://doi.org/10.2514/6.2023-0358> ;
3. <http://doi.org/10.2514/6.2020-3873> ;
4. <https://doi.org/10.2514/6.2021-3682> ;
5. AFRLi-61-601 AFRL Airworthiness;
6. AFRLi 61-103 vol 1 AFRL Flight Test and Evaluation;
7. <https://www.nasa.gov/centers/marshall/feature/nasa-validates-revolutionary-propulsion-design-for-deep-space-missions>;
8. AFRLi 61-103 vol 1 AFRL Flight Test and Evaluation;
9. AFRLi 61-601 AFRL Airworthiness;
10. AFi 62-601 USAF Airworthiness

KEYWORDS: RDRE; VTVL; Hoveroc; Delta Clipper;

AF233-0020

TITLE:

Mapping Mesostructures to Hypersonics for Improved Manufacturability and Performance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics

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 research is to design hypersonic components and systems using mesostructures to improve manufacturability, maneuverability, speed, and range

**DESCRIPTION:** With emerging manufacturing technologies, engineering design is no longer limited by traditional component manufacturing processes and intrinsic material properties that arise from crystal microstructures. Rather, complex small structures, i.e., mesostructures, may be produced by additive manufacturing (AM) to reduce weight by up to 90% (Deng), integrate components and functionality, and tune effective material properties. A variety of mesostructures have been created using AM technologies including truss structures, triply periodic minimal surfaces (TPMS), and honeycomb structures. With mesostructures, engineers can tune material properties, essentially creating new materials, metamaterials or engineered materials. The properties of the engineered materials with mesostructures can be described at the macroscale using effective material properties and can vary by orders of magnitude from the base material's properties. Therefore, mesostructures are revolutionizing engineering design and are particularly suitable for weight critical industries including hypersonics. In addition to the weight reduction due to the partial density, system weight is also decreased by component integration, multifunctional materials, and property and topology optimization with mesostructures. Engineered materials and AM technology with mesostructures simultaneously improve munitions readiness and effectiveness. There are many complex challenges in the characterization and subsequent modeling of mesostructures. Many of the simplifying assumptions used to model the behavior of fully dense materials including isotropy, symmetry, and linearity are no longer valid for materials engineered with mesostructures. For example, most polycrystalline materials are isotropic, meaning they behave the same way in every direction. In contrast, most mesostructures are highly anisotropic. Effective material properties vary by orders of magnitude with rotation of the mesostructure. This anisotropy could result in catastrophic failures if not described in the analysis using advanced material models with tensor properties. Anisotropy is incredibly useful to optimize designs and tune material properties utilizing these advanced material models and tensor properties. For example, layered insulation with anisotropic thermal conductivity allows heat to flow from the leading edge along the outer lamina of hypersonic aeroshells while protecting the internal cavity and underlying sensitive components. Current engineering design and analysis techniques, tools, and software were not developed for multifunctional components and systems with variable, tensor material property fields enabled by mesostructures. In state-of-the-art design and finite element analysis (FEA), intrinsic material properties are assigned to entire components, boundary conditions are applied, the analysis is executed, and the thermomechanical response is output. Often entire systems are reinforced, redesigned, or even rejected because the FEA reveals a point failure at a load concentration. The tools required to navigate the burgeoning design space with mesostructures and advanced composites are in development. To inform this development, we must explore the design space, understand the tradeoffs, identify multi-objective optimization functions, develop advanced material models with effective tensor properties, and ultimately map the mesostructures to the hypersonic

systems. Therefore, the current challenge in AFRL/RW is to apply mesostructures to a variety of novel hypersonic designs to improve manufacturability and performance in a parallel approach. Exploration of the design space requires the evaluation of the system for opportunities to integrate functionality, reduce component interfaces, distribute loads, reduce weight, and/or otherwise improve system level designs with the application of mesostructures. In the design process, many different variables should be considered for the trade study including but not limited to: anisotropic and multi-physics effective material properties, various base materials and material combinations, mesostructure refinement and density, manufacturability, deformation and distortion of mesostructures, and various types of mesostructures and transition structures. Finally, mesostructures will be mapped to the hypersonic system using advanced models to create fields of tensor material properties for improved manufacturability or performance of representative hypersonic systems. Effective material properties of particular interest include: stiffness, fracture toughness, thermal conductivity, specific heat, density, impact resistance, surface roughness, maximum service temperature, creep, and strength. Manufacturability of mesostructures continues to challenge the AM community. If the engineered materials are not currently manufacturable, manufacturing limitations and progress will be explored in-depth. If the engineered materials are manufacturable, the materials will be characterized to understand the tensor properties, validate advanced material models, and demonstrate mapping, deformed and transition structures, the variable property fields.

**PHASE I:** During phase I, awardees will select a commercial or government-of-the-shelf (GOTS) FEA solver for implementation. Extensive literature surveys and prior research highlighting the advantages and limitations of the chosen approach is required. The firm will then select a representative hypersonic system, subsystem, or geometry for redesign with mesostructures. The objective performance and/or manufacturing improvements and trade space will be defined. The technical approach including design optimization scheme, advanced material models, and mapping functions will be identified. Effective tensor properties for the materials engineered with mesostructures will be collected from the literature and supplemented with FEA analysis, as required. Manufacturing limitations and progress will be identified

**PHASE II:** During phase II, the hypersonic system, subsystem, or geometry redesigned with mesostructures will be completed, modeled using the FEA solver selected in Phase I, and analyzed to demonstrate through modeling and simulation the improved maneuverability, speed, and/or manufacture. Mesostructures and engineered materials will be manufactured and characterized to validate advanced material models and demonstrate tunable tensor properties. Documentation of the implementation including user manuals, theory manuals, validation cases, examples, and source code with U.S. government data rights is required.

**PHASE III DUAL USE APPLICATIONS:** Following successful and innovative applications of mesostructures into hypersonic systems and design, analysis, and optimization tools within Phase I and II, Phase III funding will be available from 6.2 funding for the Advanced Manufacturing Enabled Technologies for Aerodynamics (Advanced META). The contract vehicle is currently being explored with the transition partner, Boeing BRD&T, for integration into developmental hypersonic, high-speed and weight critical systems using the developmental tools.

#### REFERENCES:

1. Deng, Biwei. Lightweight Mechanical Metamaterials Based on Hollow Lattices and Triply Periodic Minimal Surfaces. 2019.
2. Purdue University, PhD Dissertation; Yang, Lei. Continuous Graded Gyroid Cellular Structures Fabricated by Selective Laser Melting: Design, Manufacturing and Mechanical Properties. *Materials and Design*. 162, 2019, p. 394-404;

**KEYWORDS:** Mesostructures; Metamaterial; Hypersonic; Design Optimization; Maneuverability;



## Engineered Materials

AF233-0021 TITLE: Operations & Logistics Susceptibility due to Publicly Available Information (PAI)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Trusted AI and Autonomy

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:** Research and identify the Publicly Available Information (PAI) military units leave behind as a result of using commercial entities to support military operations. Assess if a potential adversary could use that information to target military units to delay, disrupt or degrade US military capabilities and intentions. Unclassified data includes locations & details of military assets, capabilities, & plans for upcoming operations. While this information may not be classified, it can still be used by adversaries to gain an advantage, such as by preparing for an attack or developing countermeasures to US military capabilities. PAI as a result of dependencies on contracted commercial entities generates a significant amount of unclassified information.

**DESCRIPTION:** Since the mid-1990s the US military has become increasingly reliant on contracted support from commercial entities with Operation Desert Storm being the last major military operation with a predominance of support from military units. The DoD projects that contractors will provide most of the support to future major military operations. Coordination for this support requires communication and transmission of militarily relevant information on unclassified commercial systems and this represents a potential military vulnerability. Joint doctrine directs planners to consider contractors as “forces available” for military operations and in some cases supplanting military logistics forces. This can relieve the US strategic transportation system of the burden of transporting military logistic units into a theater of operations in lieu of combat forces. If planners can expect to contract for heavy equipment transport trucks in theater, then they can plan to move more combat units into theater earlier in the plan. In addition, contractors are often used to fill gaps in military capabilities, provide additional expertise, or to augment the military's capacity to respond to emerging threats. Contractors provide a wide range of support services, such as logistics, transportation, construction, and maintenance, as well as technical and professional services, such as engineering, IT, and intelligence support. They also provide support for functions such as catering, laundry, and other services that are required to sustain military personnel in an operational environment. These activities occur alongside military personnel executing classified missions. Even if the contractor had no knowledge the actual military mission, their presence, and the signals they generate in the environment could provide a discernable pattern that an innovative adversary could use to derive the capabilities and intentions of the US military. This research intends to determine the feasibility of developing a capability for military units to assess the type of pattern that their Publicly Available Information (PAI) creates and if it represents a risk to military operations.

**PHASE I:** Period of performance objectives are: 1. Conduct a thorough analysis of the types of Publicly Available Information (PAI) generated by military units in receiving support from commercial entities. Include a review of existing datasets, software solutions and technical requirements. 2. Developing a detailed software design document that outlines the architecture, features, and functionality of a proposed solution. 3. Describe a proof-of-concept prototype of the software, which could include a minimum viable

product (MVP) or a demo version of the software. 4. Develop a plan for conducting user testing and gathering feedback on the prototype to evaluate its usability and identify areas for improvement. 5. Develop a plan to conduct market research to assess the potential demand for the software, identify potential customers and competitors, and estimate the size of the target market. USE CASES to analyze feasibility, a proof of concept will eventually be able to demonstrate these capabilities, using real or “realistic” fictitious data.

1. UNIVERSAL INTROSPECTION: a commander with sufficient role-based access, should be able to traverse data in the system to understand time, location, co-location, disposition, etc, of their people & assets ... a) Doctrinal: does the adversary know our staging location preferences per a type of, or specific objective? b) Plan: does the adversary know our primary COA for placement of assets? c) Execution: our adversary’s able to detect friendly locations in real-time d) Report: our adversary knows our own friendly account of where an asset was e) Lessons Learned: the adversary’s perception of our measure of success f) Rewrite: our adversary’s estimation on our plans to change based on past

2. OPSEC VISUALIZATION: Military operations are increasingly vulnerable to adversary detection due to exploitation of publicly available and open-source data. Currently the military has very few if any tools to allow military units to “see themselves” in the PAI and OSINT environment, especially as it applies to the use of contracted commercial entities. In 2020 a US Army opposing force (OPFOR) commander gave a US Army Brigade Combat Team (BCT) a visualization of their electronic signature on a simulated battlefield, as shown in “This is What Ground Forces Look Like to an Electronic Warfare System” (<https://www.thedrive.com/the-war-zone/33401/this-is-what-ground-forces-look-like-to-an-electronic-warfare-system-and-why-its-a-big-deal>) The BCT conducting the training was conducting its operations as intended by US Army doctrine and policy. The unit was camouflaged per standard operating procedure and in a tactical posture to avoid detection from the known means of adversary collection. Even so, the BCT was lit up like a Christmas tree in the electronic spectrum and thereby detectable to an adversary with the capability to collect in that spectrum. The signals from the BCT were attributed to unit equipment with modern features required to survive in the operational environment. They were also attributed to active radars and communications systems required to operate a brigade headquarters. Even so, the very equipment necessary for a decisive battlefield advantage also had a significant and heretofore previously unknown or unappreciated downside. Likewise, and because of the dependency on contracted commercial entities, military units may be emitting a signature in the PAI and OSINT environments that is equally detectable by an innovative adversary. These same military units may not be aware of these signatures even though they are utilizing their contracted commercial support in accordance with doctrine and policy. This research intends to relook OPSEC paradigms and investigate the potential for novel data-system design and operationalize OPSEC by allowing military units to see their signatures in the PAI and OSINT environments.

3. BIG DATA ANALYSIS: This call is for a system that not only looks inward for a rich detailed friendly force picture but provides the full range of user functions surrounding the lifecycle of that data: from doctrinal templates, to plans, execution, reporting, lessons learned, & semi-automatically implementing numerical tweaks to doctrinal templates based on the deficiency findings in lessons learned. This is a functional big data approach to providing streamlining automations on internal data. Big data analysis of external data classically requires faulty human analysis. A corresponding match of all-encompassing consolidated internal data, combined with external data & analytic models, provides widely accessible & interactive OPSEC cueing.

PHASE II: Phase II awardees will develop the proof-of-concept prototype described in the software design document developed during the Phase I. Once the prototype has achieved a minimum viable product (MVP) awardee will begin conducting user testing with warfighters such as planners at Pacific Air Forces (PACAF) or other Major Command (MAJCOM). User testing will include gathering feedback on the prototype to evaluate its usability and identify areas for improvement. MVP will preferably be delivered in the python program language and should be able to demonstrate the USE CASES define in the Phase I; 1. UNIVERSAL INTROSPECTION 2. OPSEC VISUALIZATION 3. BIG DATA

## ANALYSIS

PHASE III DUAL USE APPLICATIONS: Phase III awardees will have a proof-of-concept prototype that has completed user testing in an operational warfighter environment such as an exercise held by Pacific Air Forces (PACAF) or other Major Command (MAJCOM) resulting in a TRL 7 at entry. Phase III will focus on transitioning the developed technology to multiple warfighting organizations across the Department of Defense through final refinements required to be accepted into a targeted System of Record (SoR) at TRL 9.

## REFERENCES:

1. "This is What Ground Forces Look Like to an Electronic Warfare System"  
(<https://www.thedrive.com/the-war-zone/33401/this-is-what-ground-forces-look-like-to-an-electronic-warfare-system-and-why-its-a-big-deal>)

KEYWORDS: Contested Logistics; OPSEC; operational contract support (OCS); contractors authorized to accompany the force (CAAF); data centric; data system schema design

SF233-0022 TITLE: Rapid ASCENT propellant loading operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Human-Machine Interfaces

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 repeatable capability to perform ASCENT propellant loading into spacecraft at launch site in

**DESCRIPTION:** While commercial launch providers have dramatically enhanced US spacelift capability and decreased cost per pound to orbit, there remains a clear military necessity for responsive space access (as little as 24 hrs from notification to on-orbit capability) to support time-critical activities during contested space operations [1]. There are many challenges to achieving this capability, but two major challenges arise from the current hydrazine-based propellant infrastructure – due to the high risk to personnel, during both spacecraft/launch vehicle integration and fueling operations, all other ground operations must be halted. The development of green monopropellants, including the high-performance ASCENT green monopropellant propulsion systems [2], offers a potential opportunity to avoid the challenges posed by hydrazine toxicity to responsive space timelines. The NASA GPIM mission pioneered the development of new ground equipment and CONOPS for ASCENT [3,4]; however, the hardware developed was not transitioned to industry and CONOPS development did not result in clear, robust, widely accepted ground procedures. This proposal seeks to leverage this experience to build a responsive, robust ASCENT loading capability to support Responsive Space Access. Propellant ground support equipment (PGSE) should be capable of loading up to 200 kg of ASCENT propellant in the timeframe specified. A robust ground CONOPS (including SOPs, Checklists, and other procedures; potentially captured in digital tools) should be developed with stakeholder input from the entire Responsive Space team (launch vehicle, spacecraft – primary and secondary, range and ground safety). Particular range safety documents of concern include, but are not limited, to AFSPC Manual 91-710 [5].

**PHASE I:** Develop initial CONOPS and tools/communications strategy to satisfy AFSPC Manual 91-710 and other relevant documents. Interact with multiple range equities; range safety, LV provider, potentially primary payload integrators to identify timeline, interfaces, operational requirement to meet refueling timeline. Develop a business plan for potential future commercial applications.

**PHASE II:** Refine Phase 1 strategy, perform PGSE hardware build, and conduct refueling demonstration on non-operational system (either mockup or GFE provided hardware).

**PHASE III DUAL USE APPLICATIONS:** Validation with actual mission with rapid refueling of a satellite such as PUMA or TacRS-3.

**REFERENCES:**

1. Erwin, Sandra. (2002, May 12). Space Force to select small rocket for ‘responsive space’ mission. SpaceNews <https://spacenews.com/space-force-to-select-small-rocket-for-responsive-space-mission/>;

2. Kilcoin, Mackenzie, et al, "Development of ASCENT propellant thrusters and propulsion systems." Small Satellite Conference, Logan, UT, Aug 2022. ;
3. Leitz, Amanda, et al, "Propellant Loading, Pre-Flight Testing, and Launch Integration of the Green Propellant Infusion Mission" AIAA Propulsion and Energy Forum, Aug 2020, AIAA-2020-3811.;
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KEYWORDS: ASCENT; propellant loading; launch operations; PGSE; Responsive Space Access

AF233-0023 TITLE: High energy, multi-component, optical isolator for 2  $\mu\text{m}$  fiber lasers

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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:** Advancements in portable high energy pulsed fiber lasers will have a broad impact on the DOD and for industrial applications including medicine, material processing and remote sensing. Substantial R&D by industry in fiber technologies, thermal management, and nonlinear mitigation techniques has led to advancements in high energy, narrow-linewidth thulium-doped fiber amplifiers operating in the 2  $\mu\text{m}$  regime. These amplifiers continue to show great promise for improved scalability, nonlinear performance, thermal management, and atmospheric transmission. Currently, master oscillator power amplifier (MOPA) architectures using all-fiber designs are being developed and scaled to high average powers and high pulse energies. This architecture consists of multiple amplifier stages, with fiber-coupled isolators separating each stage. To reach commercial use power levels, a fiber amplifier typically consists of multiple pre-amplifier stages, which are spliced together with fiber-coupled isolators. Current isolators either have low isolation or low power handling that is not suitable for high power pulsed fiber amplifiers. Additionally, fiber amplifier designs often include other components (such as tap couplers, mode field adapters, and wavelength division multiplexers) between pre-amplifier stages which can contribute to deleterious nonlinearities such as stimulated Brillouin scattering and modulation instability. The objective will be to develop an innovative fiber-coupled isolator that will handle high average and peak powers found in 2  $\mu\text{m}$  pulsed fiber amplifiers. This high-power isolator should also incorporate multiple common fiber components such as tap couplers and mode field adapters in a single portable package.

**DESCRIPTION:** Demonstrate a production prototype version of a fiber-to-fiber isolator for pulsed fiber lasers operating from 1.9 to 2.1  $\mu\text{m}$  with the following capabilities: 1. average power handling greater than 100 W, 2. peak power handling greater than 100 kW, 3. pulse energy handling greater than 10 mJ, 4. high optical isolation greater than 35 dB, 5. low insertion loss less than 0.5 dB, 6. a B integral less than 1.5 rad., 7. maintain fundamental mode operation with near diffraction limited beam quality from output fiber ( $M^2 < 1.2$ ), 8. insensitive to input polarization. Additionally, the prototype package for the fiber-coupled isolator should be no larger than 80 mm x 50 mm x 50 mm (excluding fiber pigtails) and the design must support the inclusion of common fiber components such as fiber tap couplers and spectral filters.

**PHASE I:** The criteria for substantiating the proposer's technology is at an acceptable stage when a report is provided with a prototype design and sufficient evidence that the design can support the capabilities as outlined in the description. The report will include: 1.) description and design of the multi-component, fiber-coupled isolator, 2.) list of components and fibers selected to build the prototype, 3.) theoretical, experimental or a combination of both, results supporting that the prototype design can meet the desired capabilities listed in the Topic Description. Such results may include: a.) damage threshold calculations and measurements supporting that the components can handle the peak powers and energies, b.) thermal lensing calculations and measurements justifying the selection of the Faraday rotator, c.) calculations and measurements of optical nonlinearities (such as self-focusing, B integral for modulation instability, and

stimulated Brillouin scattering) for components and fiber pigtails, d.) calculations and measurements that the prototype package can the heat loads due to high average powers.

PHASE II: The awardee will demonstrate the performance of a prototype, multi-component, fiber-coupled isolator that meets the specifications in the Topic Description. The intent is to deliver the working prototype to AFRL/RDLT for assessment and testing

PHASE III DUAL USE APPLICATIONS: The awardee will work with RDLT and industry partners to make their isolator design available to the DoD customer base as well as DoD industrial partners.

REFERENCES:

1. G. Stevens, A. Robertson, "Fibre laser component technology for 2-micron laser systems," Proc. SPIE 9135, Laser Sources and Applications II, 91350N (1 May 2014).

KEYWORDS: optical isolator; Faraday rotator; fiber laser components



OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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:** An optical fiber combiner that has demonstrated the ability to receive power from seven or more quantum cascade lasers emitting at a wavelength between 4.5 and 5 micrometers. The total output power from the optical fiber combiner should exceed 80% of the total power input by the combined quantum cascade laser collection as measured at the facets of the lasers without additional optical components, accounting for coupling from laser to fiber, coatings, fiber losses, and other sources of loss systemic to the use of the optical fiber combiner. The optical fiber combiner will be designed in such a way as not to undergo damage or degradation while outputting a sustained average power of up to 60 Watts.

**DESCRIPTION:** As the commercial availability of quantum cascade lasers grow in the 1-3 Watt class, it becomes possible to project a MWIR signal in a compact fashion over distances on the order of kilometers. Greater distances require greater amounts of combined power. To quickly achieve an order of magnitude increase in signal strength for distance propagation, it is necessary to combine the output of multiple devices. Currently, materials used for MWIR fibers are chalcogenides, tellurites, and hollow cores. The losses included in coupling the highly divergent beam of the quantum cascade laser, reflection, and inherent absorption of the fibers lead to a nontrivial amount of loss of the input signal. To achieve long distance propagation of MWIR signal, it is desirable for a collection of quantum cascade lasers with synchronized inputs to have a combined output delivered by a fiber to a beam director. An optical fiber combiner maintaining a large degree of power would be advantageous for applications lacking a strict beam quality requirement, such as target acquisition and illumination systems. The goal of this topic is to produce a commercially viable optical fiber combiner usable as a component of a larger MWIR beam delivery system for long distance directed energy applications. The work involved should include a demonstration of utilizing seven or more commercially available quantum cascade lasers to effectively combine the power of the collection of lasers at a single output fiber. The power measured at the output should retain at least 80% of the sum of the power of the collection of lasers as measured before integration in the combined system, using the same driving setpoint for both measurements.

**PHASE I:** Phase I awardees will be expected to provide a study on fiber materials, coatings, coupling of the quantum cascade laser produced beam (of a wavelength between 4.5-5 micrometer) into fiber, and fiber combining scheme projecting the feasibility of the combiner system output to retain 80% of the total power introduced into its inputs.

**PHASE II:** Phase II awardees will be expected to accomplish fabrication and demonstration of the optical fiber combiner system using commercially available quantum cascade lasers, demonstration and measurement of power at output compared to the sum of the power of the component lasers before combining, and delivery of an optical fiber combiner.

**PHASE III DUAL USE APPLICATIONS:** Phase III awardees will be expected to engage in commercial

production of optical fiber combiners for integration into systems requiring the combined power of multiple MWIR sources.

#### REFERENCES:

1. Francois Chenard, Oseas Alvarez, Hassan Moawad, "MIR chalcogenide fiber and devices," Proc. SPIE 9317, Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XV, 93170B (5 March 2015); <https://doi.org/10.1117/12.2085056>;
2. Dan L. Rhonehouse, Jie Zong, Dan Nguyen, Rajesh Thapa, Kort Wiersma, Chris Smith, Arturo Chavez-Pirson, "Low loss, wide transparency, robust tellurite glass fibers for mid-IR (2-5  $\hat{1}$ /4m) applications," Proc. SPIE 8898, Technologies for Optical Countermeasures X; and High-Power Lasers 2013: Technology and Systems, 88980D (15 October 2013); <https://doi.org/10.1117/12.2033925>;
3. Jason M. Kriesel, Nahum Gat, Bruce E. Bernacki, Rebecca L. Erikson, Bret D. Cannon, Tanya L. Myers, Carlos M. Bledt, James A. Harrington, "Hollow core fiber optics for mid-wave and long-wave infrared spectroscopy," Proc. SPIE 8018, Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XII, 80180V (3 June 2011); <https://doi.org/10.1117/12.882840>;
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KEYWORDS: MWIR; Fiber optics; Optical fiber combiner; QCL

AF233-0025 TITLE: High bandwidth, low latency wavefront sensing for airborne directed energy applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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 Air Force requires a wavefront sensing technology that has the capability of operating at or above 250 kHz. While operating at 250kHz the wavefront sensor must simultaneously sample at least 20 points in both spatial directions and have suitable dynamic range and sensitivity for airborne applications. The proposed wavefront sensor must be designed to operate in the near infrared. In addition, the wavefront sensor body must occupy a volume no larger than 216 in<sup>3</sup>. An additional packaged electronics allocation with a volume no larger than 72 in<sup>3</sup> is permitted. The chosen concept is to be proven by prototype with follow-on build of pilot system and demonstration within the laboratory environment.

**DESCRIPTION:** The Air Force requires a wavefront sensing technology that has the capability of operating at very high bandwidth. This technology would enable long range airborne high energy laser weapon systems operating in tactical environments. For an aircraft in flight, the turbulent flow around the aircraft creates a complex time dependent density field. This complex time dependent density field changes the index of refraction near the aircraft. The dynamic index of refraction field distorts an outgoing laser and severely limits on target intensity. This reduction in intensity on target degrades system performance. The problem outlined above is the so-called aero-optics problem. One potential solution to the aero-optics problem would be the inclusion of higher order adaptive optics to compensate the phase distortions caused by the turbulent flow field. Unfortunately, It has been demonstrated that latency is a significant performance degrader for adaptive optics in airborne directed energy systems<sup>1, 2</sup>. Current state-of-the-art technology in wavefront sensing inhibits the use of higher order adaptive optics for the compensation of high frequency (spatial and temporal) content. Traditional approaches are limited to compensating only the pseudo-steady lensing effect caused by the turbulent flow field. This SBIR topic seeks the development of a wavefront sensing technology that meets the challenging performance, size, weight, and power requirements demanded by an airborne integration of a high energy laser system. The minimum operating threshold for the sampling frequency of this wavefront sensor is 250 kHz. If successful, this SBIR could provide an absolutely critical component needed for all airborne directed energy systems into the future. In the wider DoD such a sensor could provide very significant improvements over the state-of-the-art for actively illuminated reconnaissance applications. As for commercial applications, this device could provide unprecedented capabilities for non-invasive flow measurements in the wind tunnel environment. A market exists in the commercial space at research institutions and Universities interested in high speed flow measurement.

**PHASE I:** Develop a concept for a high bandwidth wavefront sensor with an established path toward meeting frame rate, sensitivity, dynamic range, size, weight, and power requirements. Using appropriate modeling and simulation, establish the technical feasibility of the approach and establish estimates for bandwidth, dynamic range, sensitivity, size, and weight of the device. Furthermore, perform radiometric analysis establishing the feasibility of the wavefront sensor given current state-of-the-art specifications of

laser illuminators. A sample of target requirements for this design are as follows: Bandwidth (threshold): 150 kHz Bandwidth (objective): 250 kHz Sensor Volume (threshold): 360 in<sup>3</sup> Sensor Volume (objective): 216 in<sup>3</sup> Electronics Volume(threshold): 108 in<sup>3</sup> Electronics Volume(objective): 72 in<sup>3</sup> Sensor Weight (threshold): 20 lbs Sensor Weight (objective): 15 lbs

PHASE II: Complete the design of a wavefront sensor prototype complete with any required electronics subsystem. The prototype wavefront sensor should present a clear engineering path toward the objective requirements outlined in the topic description if they are not explicitly met by the prototype. The prototype must be packaged in a state that would enable suitable laboratory testing. The wavefront sensor must be delivered to a DoD laboratory where it will be independently tested against a state-of-the-art Shack-Hartmann Wavefront Sensor. This testing will establish any improvement the new technology presents for the Air Force. A sample of target requirements for this prototype are as follows: Bandwidth (threshold): 150 kHz Bandwidth (objective): 250 kHz Sensor Volume (threshold): 360 in<sup>3</sup> Sensor Volume (objective): 216 in<sup>3</sup> Electronics Volume(threshold): 108 in<sup>3</sup> Electronics Volume(objective): 72 in<sup>3</sup> Sensor Weight (threshold): 20 lbs Sensor Weight (objective): 15 lbs

PHASE III DUAL USE APPLICATIONS: Phase III should focus on transitioning the prototype developed in Phase II to a commercial product. As such, the wavefront sensor should be packaged in a robust housing suitable for the flight environment. Any objective requirements not met in Phase II, should be met by the packaged Phase III pilot device. In addition, tooling and manufacturing processes required for commercialization shall be developed. Finally, the Air Force will assist the vendor in transitioning their compact high speed wavefront sensor to DoD wind tunnel facilities interested in performing aero-optic experiments. Additionally, a market exists to transition such high speed cameras to a multitude of University wind tunnel facilities interested in high speed flow dynamics. A sample of target requirements for this prototype are as follows: Bandwidth (threshold): 150 kHz Bandwidth (objective): 250 kHz Sensor Volume (threshold): 360 in<sup>3</sup> Sensor Volume (objective): 216 in<sup>3</sup> Electronics Volume(threshold): 108 in<sup>3</sup> Electronics Volume(objective): 72 in<sup>3</sup> Sensor Weight (threshold): 20 lbs Sensor Weight (objective): 15 lbs

#### REFERENCES:

1. Burns, W. R. Statistical Learning Methods for Aero-Optic Wavefront Prediction and Adaptive-Optic Latency Compensation. <https://doi.org/10.7274/gt54kk93q7k>;
2. W.R. Burns, E.J. Jumper and S. Gordeyev, " A Latency-Tolerant Architecture for Airborne Adaptive Optic Systems ", 53th AIAA Aerospace Sciences Meeting, 5 - 9 Jan 2015, Kissimmee, Florida, AIAA Paper 2015-0679.

KEYWORDS: Wavefront Sensor; Aero-Optics; Directed Energy; Adaptive Optics; Beam Control

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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**OBJECTIVE:** The objective of this SBIR is to design, build, and test high frequency, high gain antennas for High Power Microwave (HPM) applications. These new antennas would open up a new capability for HPM by allowing the HPM system to use already existing apertures on airborne platforms. This would prevent the need to change the outer mold line of an airborne platform which aids in speeding up the flight certification. There are three main goals for the antenna design from this effort. The first goal 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 second goal would be for the antenna to be broadband and cover the entire X-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. The third goal would be to reduce antenna sidelobes, maximizing the power of directed energy and reducing collateral damage. The first goal 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 second goal would be for the antenna to be broadband and cover the entire X-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. The third goal would be to reduce antenna sidelobes, maximizing the power of directed energy and reducing collateral damage.

**DESCRIPTION:** The goal of this topic is the development of a phased array antenna suitable for HPM sources at GW power levels that are broadband with minimal sidelobes. 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), or by means of controlling the electromagnetic fields at each element (e.g. high power phase shifters). A broadband antenna that can cover the entire X-band (8-12 GHz) with 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. Sidelobes on HPM systems waste energy and can produce collateral damage. There are well known techniques to reduce sidelobes, but they often come at the expense of increased local electric fields in the antenna. New antenna designs, new manufacturing techniques, lensing and understanding of the local discharge breakdown systems can be utilized to dramatically reduce these sidelobes. Modeling HPM antennas as a complete system enables the analysis and design of antenna systems to reduce sidelobes while also reducing antenna hotspots. Advanced material design using new 3D metal manufacturing techniques can produce antennas with better wear conditions and focusing abilities and allow for expanded manufacturing design options. Lensing systems can be developed to improve HPM focusing. Better understanding of local discharge breakdown phenomena through modeling can inform the design process to further improve the system.

PHASE I: The awardee must demonstrate through electromagnetic simulation a phased array antenna with a threshold gain of 24 dBi and an objective gain of 30 dBi of gain across the frequencies within the X-band (8-12 GHz). The antenna shall be phase steerable with at least plus or minus 20 degrees in both azimuth and elevation. The antenna must be able to handle a threshold power of 20 megawatts per square meter with an objective power handling of 100 megawatts per square meter. The awardee must create models of the improvement in performance of proposed new antenna designs and systems, analyze the tradeoffs of sidelobe reduction and hotspot generation, and correlate new manufacturing and materials development with the modelling in order to design a system that optimizes power delivery and reduces material wear.

PHASE II: The awardee 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 awardee 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. Verify sidelobe reduction, reduction of wear and increase of delivered power.

PHASE III DUAL USE APPLICATIONS: The awardee 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 awardee shall provide the cost and schedule to fabricate and demonstrate the full phased array antenna. The awardee shall deliver a complete technical data package for the full array to include all electromagnetic simulations and manufacturing-ready drawings. Explore potential to transfer the technology to military high power electromagnetic and Electronic Warfare systems, as well as civilian communication and radar systems. Work with DoD primes and industry partners to identify other applications for the technology.

#### REFERENCES:

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3. 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: HPM; 3D manufacturing; Antenna Design; Discharge Breakdown; Sidelobe Reduction; Antenna Materials; Antenna Lensing; high power microwave

AF233-0027      TITLE: Combiner Architectures for Maximum Brightness Fiber Laser Amplifier Pumping

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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:** State of the art Yb doped fiber amplifiers (YDFAs) with low size, weight, and power (SWaP) depend heavily on the availability of low SWaP pump diodes to meet their size, weight, and power targets. High power YDFAs have historically used  $(6+1)\times 1$  fiber taper bundle combiners in a co-pumped configuration, but there is evidence that this area of fiber amplifier power scaling could be refined to bring lower cost and/or higher power. Current topics in combiner design include: (1) counter-pumped combiners to reduce amplified spontaneous emission (ASE), spread the inversion profile of the gain fiber and/or support bidirectional gain fiber pumping. (2) tandem pumped co-pumped and counter-pumped combiner configurations to spread the inversion of the gain fiber across multiple fibers and reduce gain per stage. (2) combiners with higher channel count (e.g.  $(7+1)\times 1$  and  $(8+1)\times 1$ ) to reach record powers. Etendue conservation calculations suggest that channel count might be considerably increased from  $(6+1)\times 1$  without a significant increase in loss. Both approaches lead to increased power, should be further explored, and are mutually inclusive. Due to the manufacturing challenges and risks of making high power pump diodes with many single emitters, higher channel count means that an amplifier could make use of more inexpensive pump diodes. Such a combiner design may lead to lower overall system cost at state-of-the-art performance. An optimized bidirectional combiner design which is also optimized to maximize brightness conservation is likely to benefit both next generation directed energy weapons at 1.03-1.07  $\mu\text{m}$  wavelength as well as the commercial laser material processing industry. Cost per watt and material processing speed are key metrics for commercial systems using high power YDFAs.

**DESCRIPTION:** Demonstrate a production prototype of a combiner architecture for a fiber laser amplifier for use with existing commercial off the shelf (COTS) pump diodes. The combiner architecture should support an amplifier design with at minimum 50% more pump power in the gain fiber than existing state-of-the-art Yb laser systems (see references) and operate with minimum loss of brightness in the combiner.

**PHASE I:** The awardees will provide a set of combiner designs, a trade space survey, and simulation justifying a design for a  $(N+1)\times 1$  combiner architecture in the context of an amplifier which can meet the high power constraint laid out in the Topic Description. The awardees will also provide a plan to produce the  $(N+1)\times 1$  combiner(s) necessary to employ the architecture.

**PHASE II:** The awardees will develop manufacturing for and demonstrate a  $(N+1)\times 1$  combiner handling power consistent with the Topic Description with less than 0.1 dB insertion loss. The performer will also demonstrate combiner handling of 15% of forward power in the reverse direction. The awardees will conduct experiments detailing the forward and backward power handling limitations of the combiner, separating manufacturing challenges from fundamental physical limits. The net loss of brightness will be examined and performance limits will be explicitly discussed. Finally, the awardees will deliver four prototype combiners to AFRL/RDLT.

PHASE III DUAL USE APPLICATIONS: Awardees will commence packaging and development work to refine thermal handling and increase the manufacturability of the (N+1)x1 combiner to commercially viable levels, delivering at least 10 units to AFRL/RDLT.

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3. Y. Wang et al., "8-kW single-stage all-fiber Yb-doped fiber laser with a BPP of 0.50 mm-mrad," *Fiber Lasers XVII: Technology and Systems*. SPIE, Feb. 21, 2020. doi: 10.1117/12.2545832.;
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KEYWORDS: High Power Combiner; Combiner Architecture; Brightness optimization; Directed Energy; Fiber Optics; Combiner;



OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

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**OBJECTIVE:** Deliver a compact (up to 2m), high current, L-band modulator/buncher with broad bandwidth (>20% fractional bandwidth) capability to the Air Force Research Laboratory (AFRL). This capability is beyond the scope of what has traditionally been done with bunchers since providing a broad bandwidth is atypical. The buncher/modulator should be designed such that it is optimized to provide L-band modulated electron beams of arbitrary waveform (given Fourier limitations) to a state-of-the-art X-band accelerator (peak beam current 75-250 mA delivered over a 3 us macropulse with length of ~1m). Designs should provide consistent capture efficiency (>25%) going into the X-band accelerator across a variety of lower frequency (DC through L-band) modulated electron beams. The current to the accelerator should ensure that the accelerator can output 75-250mA. This design should include a transition into X-band cavities such that it is integrable with an X-band accelerator. The design should provide broadband modulation within L-band to an input electron beam with arbitrary amplitude modulation containing frequency content from DC to 1 GHz. Designs can include advances in cathodes - the requirement is that they can be operated such that modulated high frequency electron pulses are possible and integrable with X-band buncher/accelerator cavities.

**DESCRIPTION:** The performance of this work should include extensive modeling/simulation/theory of modulator/buncher designs and methods for integration with X-band accelerator cavities. This could include use of software such as HFSS and CST for full wave electromagnetic design, Parmela, ASTRA, GPT, and TRACK for particle tracking, and particle-in-cell software such as CST, Hellweg, or MAGIC for self-consistent study of beam dynamics. Those advancing to Phase II will need to fabricate the modulator and integrate it with an X-band accelerator. Final beam acceleration tests can be performed at AFRL's facilities and will include measurements of key performance parameters such as degree of modulation, bandwidth, and capture efficiency. Improvements to design may be required. Those advancing to Phase III will need to refine their designs, scale them from L-band to S-band and integrate the new design with the X-band accelerator. Final beam acceleration tests for Phase III will proceed as in Phase II with emphasis on key performance parameters.

**PHASE I:** Phase I awardees should design and simulate an L-band modulator/buncher which can effectively produce arbitrary amplitude, L-band modulation on arbitrary input waveforms with frequency from DC to 1 GHz. Designs must be scalable to higher frequency bands. Various approaches can be taken with the design and may include cavities and waveguides (including folded waveguides, tapered bunchers, etc.), or multi-section bunchers incorporating both and other elements such as choppers. Input beams to the modulator should be modulated through gridded or gridless cathodes, modulated photoinjection into accelerator/buncher cavities or any other viable techniques, which can produce distinct and arbitrary on/off cycles from DC to 1 GHz. Required performance parameters will include bandwidth of operation and degree of modulation and should be addressed with modeling/simulation/theory. Other key performance parameters will vary by design choice but should be demonstrated using theory/simulation. Examples of key performance parameters could include shunt

impedance, current/current density handling, capture coefficient/efficiency, length of modulator/buncher section and plots of phase space. The modulator/buncher should not exceed 2m in length in order to maintain compactness. A transition between the modulator and X-band accelerator cavities should be designed such that there is minimal loss of electrons/energy. Full-wave, particle-in-cell analysis of electron propagation and electromagnetic fields should be performed showing performance across L-band. Identify commercial off-the-shelf components including electron gun, pulsed power, L-band RF amplifier or oscillators, or design in-house system(s). Provide quarterly reports to AFRL and write a final Phase I report presenting the modulator design and all modeling, simulation, and theory work (including raw data) indicating the device's progress towards meeting Topic Objectives. Provide a plan to carry out Phase II.

**PHASE II:** Phase II awardees should fabricate modulator designs and purchase/build electron guns, pulsed power supplies, L-band RF sources, or other required equipment to experimentally demonstrate buncher design. Designs can be demonstrated using limited frequency points (e.g. 2 frequencies which represent performance for the full bandwidth). Experiments should demonstrate feasibility of modulator and data for key performance parameters as described in Phase I should be collected and compared to theory/simulation. Designs should be optimized through experimentation to match, as near as possible, the theoretical/computational results. Final integration of modulator with X-band accelerator may be performed in AFRL's facilities. Quarterly reports should be sent to AFRL. A final report should be written to include modulator design, verification of all required/key performance parameters including raw data, standard operating procedures, and analyses of experiments vs. simulation/theory. A plan for Phase III should be provided.

**PHASE III DUAL USE APPLICATIONS:** Phase III awardees will refine their designs and scale the modulator to S-band. The system may also be integrated onto a ruggedized platform for field testing. Improvements to system performance may be required. Quarterly reports to AFRL should be written discussing design and integration of modulator and accelerator and overall performance of the modulator/accelerator system. A final report will be delivered to AFRL which will include a summary of all work performed in Phase III.

#### REFERENCES:

1. Kutsaev, S. V., et. al, "Compact X-Band electron linac for radiotherapy and security applications," 2021.;
2. Kutsaev, S. V., et. al, "Electron bunchers for industrial RF linear accelerators: theory and design guide," 2021.; Mishin, A. V., "Advances in X-Band and S-Band Linear Accelerators for Security, NDT, and Other Applications," 2005.

**KEYWORDS:** Buncher; Modulator; Linear accelerator; RF Linac; Electron Beams; Directed Energy

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber

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**OBJECTIVE:** This topic seeks to develop, mature, apply and advance innovative ideas to control, manage and extend the electrical power and thermal capabilities of an unmanned air vehicle (UAV) through energy aware autonomous algorithms. The effort can focus across a broad range of flight phases or focus on just a few. Flight phases that the proposal could investigate but are not limited to include 1) pre-flight planning, 2) ground operations, 3) terminal area operations, 4) climbing, 5) cruising, 6) mission area, 7) return, or 8) post-flight. Potential energy aware autonomous algorithms may include, but are not limited to, 1) path planning (offline and online), 2) task planning for single vehicle level and/or multi-vehicles, 3) energy contingency management (e.g., causing the electrical system to prioritize actuation energy needs due to sudden wind gusts while landing.), 4) prediction of electrical, thermal, and fuel usage throughout flight phases, 5) optimal formation flying for energy improvements, 6) intelligent electrical startup, and 7) energy run-time assurance. These algorithms could include various artificial intelligent methods, though other methods could be considered.

**DESCRIPTION:** In the military space, growing mission demands (i.e., electronic warfare, advanced sensing, etc.) along with the practical constraints imposed on the size, weight, and power of the energy subsystems of an autonomous vehicle limit the vehicle executing its mission. In the commercial space, optimization of flight paths and energy usage for long endurance package delivery will be needed. Further, vehicles such as electric vertical take-off and landing air taxis require management of energy resources to ensure passengers can safely get to where they need to go in a climate-controlled environment while minimizing fuel usage. In the current state of the art of vehicle power and thermal management, the energy subsystems have only limited communication with autonomy system/pilot and vehicle systems. As a result of this limited information sharing a strategy should be developed to integrate the capabilities of various electrical power and thermal subsystems of the vehicle with appropriate autonomy algorithms to ensure the vehicle can meet its goals. There are two levels of autonomy that could be investigated within this work. The first is a level of autonomy at the vehicle level in which sharing between the mission systems, the air vehicle systems, the autonomous algorithms, and the energy systems (including electrical, thermal, and engine systems) would occur to improve overall capability of a single vehicle. The second level of autonomy exists at the battlefield or mission space. It will integrate the power and thermal performances of each air vehicle across the fleet of multiple UAVs computing trajectory and task assignments based on an operator's intent. In so doing, energy is managed across the battlefield allowing the operator to choose the asset most likely to complete the mission. For example, the pre-flight mission task could include planning for a fleet of UAVs that considers the total energy of each vehicle and its capabilities in the fleet for individual task assignment. Similarly, in-flight contingency planning will involve flight paths and alternate landing sites (down range landing or return to launch site landing) suitable for each vehicle. In the commercial realm, choosing an appropriate taxi to fulfill a customer need before depleting its energy capabilities would be important.

PHASE I: Proposals should include description of work previously done in this area along with a description of which portions of the problem the effort will be focused on. The focus of Phase I should be on development of use cases. The use cases should include relevant benefits that will be achieved, the information that will need to be exchanged between other system(s), and generally describe behaviors that will occur. Discussions with various stakeholders should occur to ascertain the feasibility of the use cases.

PHASE II: Proposals should include further development and maturation of Phase I results for the energy aware algorithms. During Phase II, based on the use cases developed in Phase I, algorithms should be developed and implemented to demonstrate the efficacy of the algorithms. Working with AFRL, relevant models of systems could be incorporated with those algorithms to evaluate the benefits outlined in the use cases.

PHASE III DUAL USE APPLICATIONS: Commercial applications could include use of the energy aware autonomy algorithms for a UAV that is assigned delivery package. Flight routes could be computed according to its available electric power and thermal capabilities to ensure delivery success, public safety, and residential restrictions. Other applications include air taxis or electric Vertical Takeoff and Landing (eVTOL) aircraft that will want to optimize energy usage. Phase III military applications could include use of energy aware autonomy algorithms on unmanned vehicles with relatively large payloads to extend mission capabilities.

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KEYWORDS: Air vehicle; autonomy; energy management; thermal management; electrical power management; artificial intelligence; energy aware autonomy

AF233-0032      TITLE: Design AF DCGS Next Gen Enterprise IT systems using 5G Technology for Low to Zero Maintenance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Integrated Network System-of-Systems;Advanced Computing and Software;Integrated Sensing and Cyber;Microelectronics

OBJECTIVE: Design AF DCGS Next Gen Enterprise IT systems using 5G Technology for Low to Zero Maintenance

DESCRIPTION: The DCGS Next Generation (DCGS Next Gen) delivers a new advantage to the Air Force and its Airmen. Due to the transition from COIN/C-VEO to Great Power Competition, the previous DCGS model no longer offers sufficient capability to produce the needed intelligence and outcomes to counter evolving adversary threats. DCGS Next Gen answers that by enabling analysts to fuse multi-source intelligence and merge into the newest efforts of ABMS and JADC2 to provide decision advantages at all levels. AF DCGS PMO is looking at a breakthrough in 5G Technology and an innovative way to sustain enterprise IT systems beyond existing DOD acquisition strategy today.

PHASE I: Develop a conceptual design for AF DCGS Next Generation (DCGS Next Gen) using 5G Technology and an innovative way to sustain enterprise IT systems. Deliverables include a report or presentation demonstrating the conceptual design and a path forward for Phase II. Develop Modernize AF DCGS 5G Networks to include survivable software mesh topology, prioritized traffic, quality of service (QoS), intelligent routing, flattened converged networks and computing at the tactical edge using SD-WAN. All means of transport, to include commercial 5G cellular/satcom/WIFI will be utilized for maximum resilience while maintaining the security of the data at all classifications. Manage and maintain a new generation of connected devices, wireless networks, and edge computing to ensure the highest standards of mission continuity

PHASE II: Develop and demonstrate a proof-of-concept prototype system based on the preliminary design from Phase 1. Demonstrate proof of concept, Modernize AF DCGS 5G Networks to include survivable software mesh topology, prioritized traffic, quality of service (QoS), intelligent routing, flattened converged networks and computing at the tactical edge using SD-WAN. All means of transport, to include commercial 5G cellular/satcom/WIFI will be utilized for maximum resilience while maintaining the security of the data at all classifications. Manage and maintain a new generation of connected devices, wireless networks, and edge computing to ensure the highest standards of mission continuity.

PHASE III DUAL USE APPLICATIONS: The path for transition is to mature the prototype developed in Phase 2 by delivering phased incremental improvement until fully operational. Delivering phased incremental improvement until fully operational AF DCGS 5G Networks to include survivable software mesh topology, prioritized traffic, quality of service (QoS), intelligent routing, flattened converged networks and computing at the tactical edge using SD-WAN. All means of transport, to include commercial 5G cellular/satcom/WIFI will be utilized for maximum resilience while maintaining the security of the data at all classifications. Manage and maintain a new generation of connected devices, wireless networks, and edge computing to ensure the highest standards of mission continuity

#### REFERENCES:

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2. <https://www.cto.mil/wp-content/uploads/2020/12/DOD-5G-Strategy-Implementation-Plan.pdf>
3. [https://www.cto.mil/wp-content/uploads/2020/05/DoD\\_5G\\_Strategy\\_May\\_2020.pdf](https://www.cto.mil/wp-content/uploads/2020/05/DoD_5G_Strategy_May_2020.pdf)

KEYWORDS: 5G; ABMS; JADC2

AF233-0033      TITLE: Synthetic Weather Environment Injection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

**OBJECTIVE:** Tailored synthetic weather is required for the purposes of DoD exercises, training, and simulation. As examples, weapon systems Program Offices require synthetic weather to support Digital Engineering to help obtain required performance in the natural operations environment. Also, most live, virtual, and/or constructive military training and exercises require tailored synthetic weather to provide forces and systems the opportunity consider the impacts of the environment in planning and executing mission. Weapon system flight and mission planning systems also have needs for synthetic weather injects. Current AF Weather systems cannot produce or process this synthetic weather.

**DESCRIPTION:** Tailored synthetic weather is required for the purposes of DoD exercises, training, and simulation. As examples, weapon systems Program Offices require synthetic weather to support Digital Engineering to help obtain required performance in the natural operations environment. Also, most live, virtual, and/or constructive military training and exercises require tailored synthetic weather to provide forces and systems the opportunity consider the impacts of the environment in planning and executing mission. Weapon system flight and mission planning systems also have needs for synthetic weather injects. Current AF Weather systems cannot produce or process this synthetic weather.

**PHASE I:** Develop a conceptual design for a tool that can generate synthetic weather data and propose means to inject synthetic weather. Identify DoD applications that could utilize synthetic weather to support training, exercises, and/or simulations. Deliverables include a report or presentation demonstrating the conceptual design and a path forward for Phase II.

**PHASE II:** Develop and demonstrate a proof-of-concept Synthetic Data Generation & Injection prototype system based on the preliminary design from Phase I.

**PHASE III DUAL USE APPLICATIONS:** Demonstrate the prototype system delivering synthetic weather data to a set of customers utilizing simulations and virtual exercises. Upon successfully supporting external customers, lay out plan to operationalize the prototype.

**REFERENCES:**

1. AIR FORCE AGENCY FOR MODELING AND SIMULATION (AFAMS):  
<https://www.afams.af.mil/>;
2. AF Weather Web Services: <https://weather.af.mil/>

**KEYWORDS:** synthetic weather; Modeling; Simulation; M&S; Live; Virtual; Constructive; LVC; Digital engineering; environment; exercises; training; numerical; prediction; forecast; data; generation

AF233-0034 TITLE: Creating a digital twin of legacy aircraft

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Integrated Sensing and Cyber;Trusted AI and Autonomy;Integrated Network System-of-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:** The topic objective is to develop a faster, more cost-effective way to integrate new equipment at the system design/digital engineering level by creating a digital twin of the B-52H legacy aircraft system. This digital twin will include CAD models and SysML models, and be connectable to various models in different systems. The end state of this project is to have a digital engineering environment that is dynamically connected to an accredited simulation environment, enabling seamless integration of digital engineering models with other systems/products. To achieve this objective, industry players will be asked to propose a solution for creating a digital twin of a legacy system.

**DESCRIPTION:** The topic objective is to develop a faster, more cost-effective way to integrate new equipment at the system design/digital engineering level by creating a digital twin of the B-52H legacy aircraft system. This digital twin will include CAD models and SysML models, and be connectable to various models in different systems. The end state of this project is to have a digital engineering environment that is dynamically connected to an accredited simulation environment, enabling seamless integration of digital engineering models with other systems/products. To achieve this objective, industry players will be asked to propose a solution for creating a digital twin of a legacy system.

**PHASE I:** Define a system concept, perform a feasibility study, and propose an solution for creating a digital twin of the B-52 legacy system. The developed CAD and SysML models developed during this project will be government-owned, and that the government will have unlimited rights to use, modify, reproduce, release, perform, display, or disclose such technical data or computer software.

**PHASE II:** The objective of the Phase II SBIR project will be to further develop the digital twin of a legacy aircraft for equipment integration and testing created in Phase I. The project will focus on refining and improving the digital twin, creating a well-defined deliverable prototype that can be used for commercialization. Approach The project will involve the following steps: Refinement of the 3D Model The 3D model of the aircraft created in Phase I will be refined and improved to enhance its accuracy and functionality. This will involve further validation of the model to ensure its accuracy and the addition of new components to improve its functionality. Integration of New Equipment The digital twin will be used to simulate the integration of new equipment with the aircraft. The simulation will involve testing the new equipment in different scenarios to identify potential issues and make necessary modifications. Testing The digital twin will undergo rigorous testing to ensure its accuracy and functionality. The testing will involve simulating a wide range of scenarios, including extreme weather conditions, equipment failures, and system malfunctions. Success Criteria The success criteria for this project will be the creation of a well-defined deliverable prototype that accurately simulates the installation of new equipment and changes to the aircraft's systems. The prototype should be able to simulate a wide range of scenarios, including equipment integration and testing, extreme weather conditions, equipment failures, and system malfunctions, and be validated through comparison to the actual aircraft. Commercialization



**Plan** A commercialization plan will be developed to promote the technology and identify potential licensing and partnership opportunities. A marketing strategy will also be developed to reach potential customers and partners. The proposer will have identified potential customers and partners and have a plan to seek additional funding opportunities to continue the development of the digital twin technology and explore other potential applications in the aerospace industry. **Operating Parameters/Prototyping Expectations** The digital twin prototype will be able to simulate a wide range of scenarios, including equipment integration and testing, extreme weather conditions, equipment failures, and system malfunctions. The prototype will be validated through comparison to the actual aircraft, and its accuracy and functionality will be tested in a wide range of scenarios. The prototype will also be tested to ensure its compatibility with different equipment and systems. Additionally, the prototype will be tested for ease of use and user-friendliness. **Conclusion** The success of the Phase II project will result in a well-defined deliverable prototype of the digital twin of a legacy aircraft for equipment integration and testing. The prototype will be able to simulate a wide range of scenarios and be validated through comparison to the actual aircraft. The prototype will provide a safer, more efficient, and cost-effective way to test and integrate new equipment with legacy aircraft. Finally, the commercialization potential of this project is significant, with a potential market among aerospace companies, government agencies, and military organizations.

**PHASE III DUAL USE APPLICATIONS:** The objective of the Phase III/Dual Use SBIR project will be to develop and commercialize the digital twin of a legacy aircraft for equipment integration and testing created in Phase II. The project will focus on transitioning the technology to government and commercial applications and achieving a high technology readiness level (TRL). **Expected Phase III Effort** The expected Phase III effort will involve developing and commercializing the digital twin technology for government and commercial applications. The technology will be refined and optimized to meet the specific requirements of these applications. The project will involve collaboration with potential customers and partners to identify their specific needs and develop a plan for commercialization. The project will also involve seeking additional funding opportunities to further develop the technology and explore other potential applications in the aerospace industry. **Expected TRL at Phase III Entry** The expected TRL at Phase III entry is 9, which means the technology is fully developed, tested, and validated in relevant environments. The digital twin will have been tested and validated in a wide range of scenarios, and its accuracy and functionality will have been demonstrated through comparison to the actual aircraft. The technology will be ready for commercialization and deployment. **Additional Transition Planning:** The additional transition planning for this Phase III project will involve identifying the government approvals required for the commercialization of the technology. The project team will work closely with the Department of Defense (DoD) to identify any necessary certifications, approvals, or standards that need to be met for the technology to be deployed in military applications. The project team will also work with potential commercial partners to identify any necessary certifications, approvals, or standards required for commercial deployment. **Known Government Approvals Required:** The known government approvals required for this project will vary depending on the specific application and customer. However, potential approvals that may be required include certification by the Federal Aviation Administration (FAA) or the Department of Defense (DoD), compliance with relevant military standards, and approval by the appropriate government agencies. **Additional DAF Customer Opportunities:** The additional DAF customer opportunities for this project include potential applications in military and commercial aviation. The digital twin technology can be used to improve the safety and performance of aircraft, reduce risk, save time and money, and increase efficiency. The technology can also be used for training and maintenance, providing a realistic and accurate representation of the aircraft that can improve safety and reduce errors during actual operations. The project team will work closely with potential customers and partners to identify additional opportunities for deployment and commercialization of the digital twin technology

REFERENCES:

1. GAO-23-106453

KEYWORDS: Digital twin; Legacy aircraft; Equipment integration; Testing; Virtual model; Accurate data; Physical dimensions; Risk reduction; Accredited digital simulation; Time and money saving; Realistic representation; Designing CAD; SysML files; B-52; Non Recurring Engineering cost reduction; Digital engineering; Model development

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Advanced Computing and Software;Human-Machine Interfaces

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**OBJECTIVE:** Develop a software solution for optimizing the packing time of Readiness Spares Packages (RSP) deployment, with maintenance and load planning actions considered. The solution should be agile and incorporate activity tracking for pack-out operations, and should provide detailed level 4 data for each pallet and ISU needed for packout, based on input of NSNs and UTC data from HQ. One goal is to reduce the current 14-day packing time to 3 days from notification. Another goal is to maximize the space needed to be utilized when building packages for deployment

**DESCRIPTION:** Readiness Spares Packages (RSP) are pre-positioned spares that enable quick response to a crisis or contingency. The RSPs are typically stored in a containerized system, which can be rapidly deployed to a forward location. However, the current process for packing and deploying RSPs is time-consuming and involves manual processes that are prone to error. This topic seeks to develop a software solution that can optimize the packing time of ISU-90s and 463L pallets for deployment, with maintenance and load planning actions considered. The solution should be agile and incorporate activity tracking for pack-out operations, and should provide detailed level 4 data for each pallet and ISU needed for packout. Proposed solutions should include a software solution that can efficiently and accurately manage the packing process of ISU-90s and 463L pallets for deployment. The solution should be capable of taking NSNs (along with their packing dimensions and weight) and UTC data from HQ and generating a detailed plan for each pallet and ISU needed for packout. The solution should also be agile and incorporate activity tracking for pack-out operations, to ensure that the process is efficient and effective. Maintenance and load planning actions should be considered, to ensure that the spares are properly stored and transported, and that maintenance actions are scheduled and completed as needed.

**PHASE I:** Phase I is used for determining the scientific and technical merit and feasibility of the proposed technology. The Phase I Period of Performance objectives for the RSP Optimization for Efficient Deployment SBIR topic are to develop a concept for a software solution for optimizing the packing time and space of ISU-90s, 463Ls, and custom tire racks for deployment. The concept should include a detailed description of the proposed software solution, including its features and functionality, and a plan for testing and validating the solution. The Phase I objectives also include developing use cases and establishing operating parameters for the proposed software solution. The use cases will be used to determine the effectiveness and efficiency of the solution in various deployment scenarios. The operating parameters will define the inputs, outputs, and conditions under which the software solution will operate, ensuring that it meets the needs and expectations of users. In addition, the Phase I objectives include developing a plan for testing and validating the software solution. This plan should include a detailed description of the testing methodology, including the types of tests to be performed and the metrics used to evaluate the performance of the software solution. The plan should also include a timeline for testing and validating the solution, as well as a description of the resources required to complete the testing and validation process. Phase I deliverables should include a report summarizing the proposed approach and

a plan for testing and validating the software solution. The report should provide a detailed description of the proposed software solution, including its features and functionality. It should also include a description of the use cases and operating parameters established during the feasibility analysis. Finally, the report should describe the testing and validation plan, including the methodology, timeline, and required resources. In summary, the Phase I Period of Performance objectives for the RSP Optimization for Efficient Deployment SBIR topic are to develop a concept for a software solution for optimizing the packing time and space of ISU-90s, 463Ls, and custom tire racks for deployment. The objectives include developing use cases and establishing operating parameters for the software solution, as well as a plan for testing and validating the solution. The Phase I deliverables should include a report summarizing the proposed approach and a plan for testing and validating the software solution.

**PHASE II:** Phase II is used to further develop the first phase, in which awards shall be made on the scientific, technical, and commercial merit of the Phase II proposal. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable prototype. The Phase II Period of Performance objectives for the RSP Optimization for Efficient Deployment SBIR topic are to develop a prototype software solution for optimizing the packing time and maximum utilization of space for RSP deployment, and demonstrate its ability to accurately manage the packing process for deployment. The Phase II objectives also include developing prototyping expectations, including operating parameters, testing requirements, and success criteria. The operating parameters will define the inputs, outputs, and conditions under which the software solution will operate, ensuring that it meets the needs and expectations of users. The testing requirements will include a plan for testing the prototype in a realistic environment, such as a military logistics operation, to validate its effectiveness and efficiency. The success criteria will define the metrics used to evaluate the performance of the prototype and determine its readiness for deployment. The Phase II objectives also include developing a plan for testing and validating the prototype in a realistic environment. This plan should include a detailed description of the testing methodology, including the types of tests to be performed and the metrics used to evaluate the performance of the prototype. The plan should also include a timeline for testing and validating the prototype, as well as a description of the resources required to complete the testing and validation process. The Phase II deliverables should include a well-defined deliverable prototype of the software solution for optimizing the packing time and maximum utilization of space for RSP deployment, and a plan for testing and validating the prototype in a realistic environment. The prototype should be capable of taking National Stock Number (NSN) packing data and weights, as well as Universal Time Code (UTC) data from HQ and generating a detailed plan for each pallet and ISU needed for packout, and should incorporate maintenance and load planning needs. The solution should also be agile and incorporate activity tracking for pack-out operations. In summary, the Phase II Period of Performance objectives for the RSP Optimization for Efficient Deployment SBIR topic are to develop a prototype software solution for optimizing the packing time and maximum utilization of space for RSP deployment, and demonstrate its ability to accurately manage the packing process for deployment. The objectives include developing prototyping expectations, including operating parameters, testing requirements, and success criteria, as well as a plan for testing and validating the prototype in a realistic environment. The Phase II deliverables should include a well-defined deliverable prototype and a plan for testing and validating the prototype in a realistic environment.

**PHASE III DUAL USE APPLICATIONS:** Per OSD, Phase III is accomplished when the Department of Defense (DoD) and/or commercial applications of SBIR/STTR-funded R&D are developed (using non-SBIR/STTR funds). The expected Phase III effort for the RSP Optimization for Efficient Deployment SBIR topic is to transition the technology from development to full-scale production and commercialization. The developed technology has dual-use applications for both military and commercial logistics operations. Military applications include RSP deployment and other supply chain management operations, as well as maintenance and load planning actions. The technology can help the military optimize its logistics operations, reducing costs and increasing efficiency. Commercial applications

include supply chain management and logistics operations for industries such as transportation, manufacturing, and distribution. The technology can help commercial organizations optimize their logistics operations, reducing costs and increasing efficiency. The expected TRL at Phase III entry will be TRL 8 or 9, with a well-defined and validated software solution ready for commercialization. The technology will have been tested and validated in realistic environments, and any necessary modifications or customizations will have been made to ensure that it is compatible with existing systems and workflows. Additional information regarding transition planning includes identifying known government approvals required for deployment and any additional opportunities for deployment of the optimization solution within the government and commercial sectors. The integration plan will involve working closely with government and commercial partners to ensure that the optimization solution is integrated seamlessly into their existing systems and workflows. To facilitate the transition from Phase II to Phase III, a transition plan will be developed that outlines the steps necessary to ensure that the optimization solution is deployed and used effectively by government and commercial partners. The plan will include a timeline for deployment, a plan for identifying potential partners and customers, and a plan for marketing and selling the solution. The plan will also include a detailed description of the integration plan and any necessary modifications or customizations needed to make the solution compatible with existing systems. Overall, the expected Phase III effort for the RSP Optimization for Efficient Deployment SBIR topic is to transition the technology from development to full-scale production and commercialization, with dual-use applications for both military and commercial logistics operations. The expected TRL at Phase III entry will be TRL 8 or 9, and the transition planning will involve working closely with government and commercial partners to ensure seamless integration into existing systems and workflows.

#### REFERENCES:

1. DAFI 23-101;
2. AFMAN 24-604

**KEYWORDS:** Readiness Spares Packages (RSP); optimization; packing time; maintenance; load planning; software solution; activity tracking; NSNs; UTC data; level 4 data; pallets; ISUs.; space.

AF233-0036      TITLE: Commercial Technologies for EMP Hardening and Electrical System Protection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Trusted AI and Autonomy;Advanced Computing and Software;Directed Energy (DE);Integrated Network System-of-Systems;Space Technology

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**OBJECTIVE:** The end state of this effort is to create a robust and resilient nation that is well-prepared to face EMP threats, protecting its citizens, critical infrastructure, and military capabilities. AFGSC is interested in commercial solutions that address the following five key areas: 1. Advanced EMP shielding and hardening technologies 2. Resilient power grid and energy infrastructure and including EMP protected Power and HVAC systems remain operable and ensure equipment maintains a certain temperature for optimal function 3. Rapid detection and monitoring of EMP events 4. EMP-protected communication networks and data centers 5. EMP risk assessment and mitigation strategies The successful completion and integration of the projects would lead to the following outcomes: Enhanced EMP protection: Electronic systems and infrastructure across various sectors would be equipped with advanced EMP shielding and hardening technologies, minimizing the potential damage from E1, E2, and E3 EMP components. Resilient power grid and energy infrastructure: The energy infrastructure would be designed and maintained to withstand the effects of EMP events, ensuring uninterrupted power supply and preventing widespread blackouts during EMP incidents. Rapid response capabilities: Advanced sensors and monitoring systems would enable prompt detection and assessment of EMP events, allowing for swift decision-making and coordinated responses to minimize the impact on national security, public safety, and critical infrastructure. Secure communication networks and data centers: EMP-protected communication networks and data centers would ensure the continuity of essential services and military operations during and after an EMP event, reducing the risk of communication disruptions and data loss. Proactive risk management: Advanced tools and methodologies for assessing and mitigating EMP risks would be widely adopted, enabling stakeholders across various sectors to make informed decisions on resource allocation, policy-making, and emergency response planning.

**DESCRIPTION:** AFGSC is interested in commercial solutions that address one or more of the following five key areas: 1. Advanced EMP shielding and hardening technologies 2. Resilient power grid and energy infrastructure 3. Rapid detection and monitoring of EMP events 4. EMP-protected communication networks and data centers 5. EMP risk assessment and mitigation strategies Advanced EMP shielding and hardening technologies: Topic Description: This research area focuses on the development of innovative materials, methods, and designs to protect electronic systems and infrastructure from the effects of EMP events. Key objectives include identifying and developing new materials with exceptional EMP shielding properties, exploring active shielding systems, and investigating fault-tolerant designs and redundant systems. Examples: a. Research and development of new materials, such as nanocomposites and metamaterials, that demonstrate exceptional EMP shielding properties and can be integrated into electronic devices and infrastructure. b. Exploration of innovative shielding techniques, such as active shielding systems that can detect and neutralize incoming EMP threats. c. Investigation of advanced hardening methods, including fault-tolerant designs and redundant systems, to minimize the impact of

EMP events on critical electronic components and infrastructure. d. Collaboration with industry and academia to accelerate the transition of cutting-edge research findings into practical applications and commercial products.

**Resilient power grid and energy infrastructure:** Topic Description: This research area aims to improve the resilience and reliability of the power grid and energy infrastructure against EMP threats. Research efforts should focus on advanced transformer designs, novel energy storage solutions, adaptive control systems, and best practices for power grid operators and utility companies. Examples: a. Design and development of advanced transformer designs that are resistant to geomagnetically induced currents (GICs) and can maintain their functionality during and after EMP events. b. Research and implementation of novel energy storage solutions, such as grid-scale batteries and supercapacitors, to ensure uninterrupted power supply during EMP incidents. c. Investigation of advanced control systems and strategies that can automatically detect and respond to EMP threats, minimizing the impact on the power grid and energy infrastructure. d. Development of best practices and guidelines for power grid operators and utility companies to enhance their preparedness for EMP events.

**Rapid detection and monitoring of EMP events:** Topic Description: This research area seeks to develop advanced sensors, monitoring systems, and data analytics techniques for the rapid detection, assessment, and response to EMP events. Key objectives include designing highly sensitive sensors, creating real-time data processing algorithms, integrating sensor networks into a centralized platform, and developing early warning systems. Examples: a. Development of highly sensitive sensors and monitoring systems capable of detecting and measuring the characteristics of EMP events in real-time. b. Creation of advanced data analytics techniques and algorithms to process and analyze large volumes of sensor data, providing accurate and actionable information for decision-makers. c. Integration of sensor networks and monitoring systems into a centralized platform, allowing for real-time situational awareness and coordinated response during EMP incidents.

**EMP-protected communication networks and data centers:** Topic Description: This research area focuses on the design and implementation of EMP-protected communication networks and data centers, ensuring the continuity of essential services and military operations during and after EMP events. Research efforts should explore novel communication protocols, architectures, and hardening techniques for existing and emerging communication technologies. Examples: a. Research and development of novel communication protocols and architectures that are inherently resilient to EMP threats. b. Design and implementation of EMP hardening techniques for existing communication networks and data centers, including shielding, grounding, and redundancy measures. c. Investigation of emerging technologies, such as quantum communication and satellite-based systems, that can potentially enhance the resilience of communication networks against EMP events. d. Development of best practices and guidelines for communication service providers and data center operators to enhance their preparedness for EMP incidents. e. Collaboration with international partners to share knowledge and expertise in building EMP-protected communication networks and data centers.

**EMP risk assessment and mitigation strategies:** Topic Description: This research area aims to develop advanced tools, methodologies, and strategies for assessing and mitigating EMP risks across various sectors and critical infrastructure. Key objectives include creating modeling and simulation tools and designing cost-effective and scalable mitigation strategies. Examples: a. Creation of advanced modeling and simulation tools to evaluate the potential impact of EMP events on various sectors and critical infrastructure. b. Development of cost-effective and scalable mitigation strategies that can be implemented across different industries and sectors. c. Design and implementation of training and education programs to raise awareness about EMP risks and promote a culture of preparedness among stakeholders.

**PHASE I: Key Area 1: Advanced EMP shielding and hardening technologies** Objectives: Determine the feasibility of novel EMP shielding materials and hardening techniques, identify potential materials and methods, and conduct initial laboratory tests. Expectations: Develop preliminary material properties, design guidelines, and selection criteria for promising materials and techniques, such as nanocomposites, metamaterials, and active shielding systems.

**Key Area 2: Resilient power grid and energy infrastructure** Objectives: Assess the feasibility of advanced transformer designs, energy storage solutions, and adaptive

control systems for enhancing power grid resilience against EMP threats. Expectations: Establish design concepts, performance benchmarks, and initial use cases for promising solutions. Key Area 3: Rapid detection and monitoring of EMP events Objectives: Explore the feasibility of advanced sensors, monitoring systems, and data analytics techniques for rapid detection, assessment, and response to EMP events. Expectations: Develop initial sensor designs, monitoring system architectures, and data processing algorithms; identify potential use cases for establishing feasibility. Key Area 4: EMP-protected communication networks and data centers Objectives: Assess the feasibility of novel communication protocols, architectures, and hardening techniques for enhancing the resilience of communication networks and data centers against EMP events. Expectations: Establish design concepts, performance benchmarks, and initial use cases for promising solutions. Key Area 5: EMP risk assessment and mitigation strategies Objectives: Evaluate the feasibility of advanced tools, methodologies, and strategies for assessing and mitigating EMP risks across various sectors and critical infrastructure. Expectations: Develop initial concepts for modeling and simulation tools, mitigation strategies, and training and education programs; identify potential use cases for establishing feasibility.

PHASE II: Phase 2 Key Area 1: Advanced EMP shielding and hardening technologies Objectives: Further develop and optimize selected materials and techniques, design and fabricate prototypes, and perform rigorous testing to evaluate performance. Expectations: Deliver functional prototypes demonstrating effective EMP shielding and hardening, establish operating parameters, and develop testing requirements and success criteria. Key Area 2: Resilient power grid and energy infrastructure Objectives: Develop and optimize the selected designs and solutions, create prototypes, and conduct comprehensive testing to evaluate performance and reliability. Expectations: Deliver prototypes of advanced transformers, energy storage systems, and control systems; define operating parameters, testing requirements, and success criteria. Key Area 3: Rapid detection and monitoring of EMP events Objectives: Further develop and optimize selected sensors, monitoring systems, and data analytics techniques; design and fabricate prototypes; and perform extensive testing. Expectations: Deliver functional prototypes demonstrating real-time detection and monitoring capabilities; establish operating parameters, testing requirements, and success criteria. Key Area 4: EMP-protected communication networks and data centers Objectives: Develop and optimize the selected protocols, architectures, and techniques; create prototypes; and conduct comprehensive testing to evaluate performance and reliability. Expectations: Deliver prototypes of EMP-protected communication networks and data centers; define operating parameters, testing requirements, and success criteria. Key Area 5: EMP risk assessment and mitigation strategies Objectives: Further develop and optimize selected tools, methodologies, and strategies; create prototypes or pilot programs; and perform extensive testing and evaluation. Expectation: Deliver functional prototypes of modeling and simulation tools, implement pilot mitigation strategies, and design comprehensive training and education programs; establish testing requirements and success criteria.

PHASE III DUAL USE APPLICATIONS: Phase III / Dual-Use Objectives: Transition the developed technology into commercial and government applications, refine and scale up production, and pursue certification and standardization. Expected TRL at Phase III entry: 6-7 Transition planning: Obtain necessary government approvals, collaborate with relevant stakeholders, and identify additional government and commercial opportunities for technology adoption.

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1. Glasstone, S., & Dolan, P. J. The Effects of Nuclear Weapons;
2. United States Department of Defense and the Energy Research and Development Administration;
3. NATO Standardization Agency. AECTP 250 - Electromagnetic Environmental Effects Requirements for Systems;
4. Radasky, W. A., & Wik, M. W. The Early-Time (E1) High-Altitude Electromagnetic Pulse (HEMP) and Its Impact on the U.S. Power Grid. Metatech Corporation;



5. Kappenman, J. G. Geomagnetic Storms and Their Impacts on the U.S. Power Grid. Metatech Corporation.

KEYWORDS: EMP; shielding; hardening; technologies; materials; active shielding; fault-tolerant; nanocomposites; metamaterials; power grid; energy infrastructure; transformers; energy storage; control systems; resilience; reliability; grid-scale batteries; supercapacitors; geomagnetically induced currents (GICs)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 fabricate a device that can measure the ground-to-air atmospheric transmission path for electromagnetic waves in the wavelength range of 0.2  $\mu\text{m}$  – 14  $\mu\text{m}$ . This device will improve the accuracy and reliability of infrared signature measurements.

**DESCRIPTION:** It is important to account for the atmospheric conditions when collecting infrared signature data. Infrared radiation is absorbed and scattered by atmospheric gases, water vapor, and aerosols, which can affect the accuracy and reliability of the measurements. To obtain accurate data, it is necessary to account for the atmospheric temperature, pressure, humidity, and aerosol content, and to correct for their effects on infrared radiation. The current method of doing this is to deploy a weather balloon on site and feed that data into a modeling software called MODTRAN (MODerate resolution atmospheric TRANsmission). MODTRAN will generate a transmission path factor, otherwise known as a tpfact. The tpfact is defined as the ratio of the effective path length of the radiation through the atmosphere to the total path length. When acquiring infrared signature data, the tpfact becomes a part of the calculation that converts a raw image into one that displays temperature and radiance. MODTRAN has been a useful tool, but it has its limitations. Simulating the atmospheric transmission path relies on mathematical models and assumptions that may not reflect the actual conditions present during data capture. Direct measurement of the transmission path will result in a more accurate representation of complex interactions and phenomena within the atmosphere. This will serve to significantly improve the quality of infrared signature data. The goal for this project is to measure how radiation from an airborne target is attenuated by atmospheric conditions. To achieve this, a blackbody and a spectrometer would need to be configured so that one is attached to an airborne platform and the other is placed at the collection site. The platform would need to loiter at the same altitude as the target under test. The desired platform altitude is 10,000 feet AGL or more, but a minimum threshold of 1,000 feet AGL is acceptable. The challenge will be to find an airborne platform that can carry the payload and collect/calibrate atmospheric attenuation data.

**PHASE I:** In Phase I, the awardees will determine the feasibility of attaching a blackbody or spectrometer to an unmanned aircraft. Questions for which answers will be sought include: 1. What types of spectrometers and blackbodies would need to be used for the spectrometer to gather data from multiple miles away? 2. What type of aircraft is suited to carry the proposed blackbody/spectrometer? 3. How will the data from the spectrometer be recorded? 4. What training, certifications, and FAA approvals will be necessary?

**PHASE II:** The questions answered in Phase I will serve as the foundation for the prototype delivered in Phase II. The prototype will be some sort of aircraft capable of flying at least 1,000 feet AGL while carrying either a spectrometer or blackbody. The delivered device will be tested to confirm that the spectrometer is pointed at the blackbody, recording data in the wavelength range of 0.2  $\mu\text{m}$  – 14  $\mu\text{m}$ , and that the data can be used to perform an atmospheric correction on infrared signature data.

**PHASE III DUAL USE APPLICATIONS:** The proposed aircraft can be adapted to fit a wide variety of needs within the DoD. The device will also provide valuable data that could be of interest to various academic institutions and weather organizations. In Phase III, efforts will be made to identify any other organizations who might be interested in using this device.

REFERENCES:

1. Berk, A., P.K. Acharya, L.S. Bernstein, G.P. Anderson, P. Lewis, J.H. Chetwynd, and M.L. Hoke, "Band Model Method for Modeling Atmospheric Propagation at Arbitrarily Fine Spectral Resolution"

KEYWORDS: Infrared ; Spectrometer ; UAV ; Airborne Platform ; Ultra-violet ; Midwave Infrared ; Longwave Infrared ; MWIR ; LWIR ; UV

**DEPARTMENT OF THE AIR FORCE (DAF)**  
**23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT TO PHASE II (D2P2)**  
**PROPOSAL SUBMISSION INSTRUCTIONS**  
**AMENDMENT 2**

This Amendment adds language to the **METHOD OF SELECTION AND EVALUATION CRITERIA** section of these Component-specific instructions:

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

All other terms and provisions remain unchanged as a result of this Amendment.

**DEPARTMENT OF THE AIR FORCE (DAF)  
23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT TO PHASE II (D2P2)  
PROPOSAL SUBMISSION INSTRUCTIONS  
AMENDMENT 1**

This Amendment modifies several of the topics associated with the DAF SBIR D2P2 offering. Topic numbers that are highlighted have been updated. That includes the following topics:

<b>Topic Number</b>	<b>Topic Name</b>
SF233-D001	Miniature Smart Satellite Threat Warning Sensor
AF233-D002	Aircraft Vibration Harvester (AVH)
SF233-D007	Laser pre-compensation to improve sodium beacon coherence
AF233-D008	AR for Equipment Maintenance
AF233-D009	Robotic Defastening
AF233-D010	Field-level Detection of Hydraulic Fluid Contamination in Jet Fuel
AF233-D011	Functional Gradient Coatings for Landing Gear
AF233-D012	Materials for High-Temperature Performance Electronics: Memory and Packaging
AF233-D013	Development of New Oxidation Resistant Refractory Alloys for Additively Manufactured (AM) Components
AF233-D014	Advanced Nano-Composite Radiation Shielding Manufacturing
AF233-D015	Manufacturing of Nitrogen Vacant (NV) Diamond Substrates for Quantum Sensors
AF233-D016	Technical Data Package (TDP) Modernization for As-Built Data
AF233-D017	Next-Generation SAL Pulse Code
AF233-D018	Conformal Forward Looking Multi-Aperture Seeker for High Speed EO/IR Demonstrator
AF233-D019	Hardened Scalar and Vector Magnetometer Development
AF233-D020	Real-time Sensor Fusion ATA in Golden Horde Colosseum

AF233-D021	Subscription-Based, Real-Time UAS Detection, Tracking, and Identification
AF233-D022	Austere Cargo Offload and Onload System
AF233-D023	TAK Mobile Machine Learning (MML) Model Development
AF233-D024	Integration of Machine Learning (ML) Platforms with a Mobile Device Manager (MDM) for the TAK Ecosystem
AF233-D025	Improved Data Collection and Knowledge Graphing in the TAK Ecosystem
AF233-D026	OptiFrame Topology Optimized Load-Bearing Airframe with Additive Manufacturing
AF233-D027	GPU Accelerated Large Eddy Simulation for Low Pressure Turbine Design
AF233-D028	Video Imaging for Patrol and Emergency Management
AF233-D029	Low-Loss Magnetless Optical Isolators for Quantum Integrated Photonics Applications
AF233-D030	Autonomous Airfield Repair Robotics Swarm Platform
AF233-D031	Rapid Fly Mobile UAS

All other terms and provisions remain unchanged as a result of this Amendment.



**DEPARTMENT OF THE AIR FORCE (DAF)  
23.3 SMALL BUSINESS INNOVATION RESEARCH (SBIR) DIRECT TO PHASE II (D2P2)  
PROPOSAL SUBMISSION INSTRUCTIONS**

The DAF intends these proposal submission instructions 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 23.3 SBIR BAA posted on the DoD SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirthtr.mil/submissions/login>.

Complete proposals **must** be prepared and submitted via <https://www.dodsbirthtr.mil/submissions/> (DSIP) on or before the date published in the DoD 23.3 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.

The DAF 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 DAF 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.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF 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 DAF. **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, "23.3 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](mailto:usaf.team@afsbirsttr.us).
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at [dodsbirthsupport@reissystems.com](mailto:dodsbirthsupport@reissystems.com).
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD 23.3 SBIR BAA.
- Air Force SBIR/STTR Contracting Officer (CO):  
Mr. Daniel J. Brewer, [Daniel.Brewer.13@us.af.mil](mailto: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](http://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.

### **DIRECT TO PHASE II**

15 U.S.C. §638 (cc), as amended by the SBIR AND STTR EXTENSION ACT OF 2022, 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. DAF is conducting a "Direct to Phase II" implementation of this authority for these 23.3 SBIR topics and does not guarantee D2P2 opportunities will be offered in future solicitations. Each eligible topic requires documentation to determine whether the feasibility requirement described in the Phase I section of the topic has been met.

### **DIRECT TO PHASE II PROPOSAL SUBMISSION**

The DoD SBIR 23.3 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.

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.**

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit [www.sam.gov](http://www.sam.gov). A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its 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 proposing small business concerns 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 proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the Small Business Concern profile with the UEI (SAM) as soon as possible.

For new proposing small business concern 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 Small business concern's profile on the DSIP at <https://www.dodsbirsttr.mil/submissions/>.

**INTRODUCTION:** 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 23.3 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: DAF 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. Feasibility documentation MUST NOT be solely based on work performed under prior or on-going Federally funded SBIR and/or STTR work.

## **DIRECT TO PHASE II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS**

A. **Proposal Requirements.** A Direct To 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.

## **DIRECT TO PHASE II PROPOSAL FORMAT**

Complete proposals must include all of the following:

**Volume 1:** DoD Proposal Cover Sheet

Note: 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 this section.

**Volume 2:** Technical Volume

**Volume 3:** Cost Volume

**Volume 4:** Company Commercialization Report

**Volume 5:** Supporting Documents, e.g. DoD Form 2345 (if applicable), 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. 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 23.3 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 under 18 U.S.C. Section 1001, punishable by a fine up to \$250,000, up to five years in prison, or both.

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 DAF 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 DAF will not accept alternative means of submission outside of DSIP.

### **DOD PROPOSAL COVER SHEET (VOLUME 1)**

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.

### **TECHNICAL VOLUME (VOLUME 2)**

The technical proposal includes all items listed below in the order provided.

- (1) **Table of Contents:** A table of contents should be located immediately after the Cover Sheet.
- (2) **Glossary:** Include a glossary of acronyms and abbreviations used in the proposal.
- (3) **Milestone Identification:** Include a program schedule with all key milestones identified.
- (4) **Identification and Significance of the Problem or Opportunity:** Briefly reference the specific technical problem/opportunity to be pursued under this effort.
- (5) **Phase II Technical Objectives:** 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.
- (6) **Work Plan:** 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) **1.0 – Objective:** This section is intended to provide a brief overview of the specialty area. It should explain the purpose and expected

- outcome.
- b) 2.0 – Scope: 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) 3.0 – Background: 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) 4.0 – Task/Technical Requirements: The detailed individual task descriptions 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.”

- (7) **Deliverables**: 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) Scientific and Technical Reports: 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.

- 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.
- (8) **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.
- (9) **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.

(10) **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.

(11) **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.

D. **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 23.3 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.

- E. **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.
- F. **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. These requests can only be made upon proposal submission. 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.
- G. **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 this BAA is substantially the same as another proposal previously, currently, or in the process of being funded by another Federal agency/DoD Component or the DAF, the offeror 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 besubmitted, 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.”

### **COST VOLUME (VOLUME 3)**

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 name, if possible, and labor category, if not. Direct labor hours, labor overhead, and/or fringe benefits, and actual hourly rates for each individual are also necessary for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.
- b) **Direct Cost 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.
- d) **Special Tooling, Special 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 special test equipment purchases must, in the CO’s opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include such items as innovative instrumentation and/or automatic test equipment.
- e) **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.

- f) **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.
- g) **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](http://www.defensetravel.dod.mil).
- h) **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.
- i) **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.

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.

#### **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 23.3 BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

#### **SUPPORTING DOCUMENTS VOLUME (VOLUME 5)**

**The following documents are required for all proposal submissions:**

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1 to the DOD SBIR 23.3 BAA)

2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2 to the DOD SBIR 23.3 BAA)
3. Disclosure of Funding Sources (Attachment 4 to the DOD SBIR 23.3 BAA)

**The following documents may be required if applicable to your proposal:**

1. 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/DD2315Instructions.aspx>. DD Form 2315 approval will be required if proposal if selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD SBIR 23.3 BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

**Feasibility Documentation (required for all proposal submissions)**

1. Offerors must adequately document completion of the Phase I feasibility requirement\*. Offerors must demonstrate completion of R/R&D through means not solely based on previous efforts under the SBIR/STTR Programs to establish Phase II proposal feasibility based on criteria provided in the D2P2 topic descriptions. Phase II proposals require a comprehensive, detailed effort description. Proposals should demonstrate sufficient technical progress or problem-solving results to warrant more extensive RDT&E. Developing technologies with commercial and military potential is extremely important. Particularly, AF is seeking proposals emphasizing technologies' dual-use applications and commercialization.
2. \* NOTE: The offeror shall provide information to enable the agency to make the 15 U.S.C. 638(cc) determination of scientific and technical feasibility and merit. Offerors are required to provide information demonstrating scientific and technical merit and feasibility has been established as part of the Technical Volume (Volume 2). The DAF will not review the Phase II proposals if it is determined the offeror 1) fails to demonstrate technical merit and feasibility are established or 2) the feasibility documentation does not support substantial performance by the offeror and/or the PI. Refer to the Phase I description within the topic to review the minimum requirements needed to demonstrate scientific and technical feasibility. **Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing Federally-funded SBIR or STTR work.**
3. If appropriate, include a reference or works cited list as the last page.
4. 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. 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 23.3 BAA for technical data rights information.
5. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.

**FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)**

Note that 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.

### **DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TAB A)**

The DAF does not participate in the Discretionary Technical and Business Assistance (TAB A) Program. Proposals submitted in response to DAF topics should not include TAB A.

### **METHOD OF SELECTION AND EVALUATION CRITERIA**

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.

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 23.3 BAA.

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the DAF will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The DAF will use information provided by the small business concern in response to the Disclosure of Foreign Affiliations or Relationships to Foreign Countries and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the small business concern and employees of the small business concern to a foreign country, foreign person, foreign affiliation, or foreign entity. The DAF will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13). If DAF assesses that a small business concern has security risk(s), DAF will review the proposal, the evaluation, and the security risks and may choose to either 1) create a plan to mitigate the risk(s) or 2) DAF may decide not to select the proposal for award based upon a totality of the review.

### **DAF USE OF SUPPORT CONTRACTORS**

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), Montech, Oasis, 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 Officer (Daniel.Brewer.13@us.af.mil) with concerns about any of these contractors.**

### **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.

Automated feedback will be provided for proposals designated Not Selected. Additional feedback may be provided at the sole discretion of the DAF.

**IMPORTANT:** Proposals submitted to the DAF are received and evaluated by different organizations, handled 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.

The Air Force anticipates that all 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 J. Brewer, Daniel.Brewer.13@us.af.mil.

**AIR FORCE SUBMISSION OF FINAL REPORTS**

All Final Reports will be submitted to the awarding DAF organization in accordance with Contract instructions. Companies will not submit Final Reports directly to the Defense Technical Information Center (DTIC).

**Air Force SBIR 23.3 Direct to Phase II Topic Index**

<b>Topic Number</b>	<b>Topic Name</b>	<b>Maximum Value*</b>	<b>Maximum Duration** (in months)</b>	<b>Technical Volume Page Limit***</b>
SF233-D001	Miniature Smart Satellite Threat Warning Sensor	\$1,900,000.00	24	35
AF233-D002	Aircraft Vibration Harvester (AVH)	\$1,760,000.00	27	35
AF233-D003	Novel high resolution distributed radar processing for littoral and open ocean environments	\$1,760,000.00	24	35
SF233-D004	Uncertainty Management for Space Domain Awareness of Non-Standard Threats	\$1,900,000.00	24	35
AF233-D005	Ultra-High Laser Damage Threshold Broad Bandwidth Anti-Reflection Treatments	\$1,760,000.00	24	35
SF233-D006	Aircraft avoidance for small telescopes using passive detection	\$1,900,000.00	24	35
SF233-D007	Laser pre-compensation to improve sodium beacon coherence	\$1,900,000.00	24	35
AF233-D008	AR for Equipment Maintenance	\$1,760,000.00	24	35
AF233-D009	Robotic Defastening	\$1,760,000.00	24	35
AF233-D010	Field-level Detection of Hydraulic Fluid Contamination in Jet Fuel	\$1,760,000.00	24	35
AF233-D011	Functional Gradient Coatings for Landing Gear	\$1,760,000.00	24	35
AF233-D012	Materials for High-Temperature Performance Electronics: Memory and Packaging	\$1,760,000.00	24	35
AF233-D013	Development of New Oxidation Resistant Refractory Alloys for Additively Manufactured (AM) Components	\$1,760,000.00	24	35
AF233-D014	Advanced Nano-Composite Radiation Shielding Manufacturing	\$1,760,000.00	24	35
AF233-D015	Manufacturing of Nitrogen Vacant (NV) Diamond Substrates for Quantum Sensors	\$1,760,000.00	24	35
AF233-D016	Technical Data Package (TDP) Modernization for As-Built Data	\$1,760,000.00	24	35
AF233-D017	Next-Generation SAL Pulse Code	\$1,760,000.00	24	35

AF233-D018	Conformal Forward Looking Multi-Aperture Seeker for High Speed EO/IR Demonstrator	\$1,760,000.00	24	35
AF233-D019	Hardened Scalar and Vector Magnetometer Development	\$1,760,000.00	24	35
AF233-D020	Real-time Sensor Fusion ATA in Golden Horde Colosseum	\$1,760,000.00	24	35
AF233-D021	Subscription-Based, Real-Time UAS Detection, Tracking, and Identification	\$1,760,000.00	15	35
AF233-D022	Austere Cargo Offload and Onload System	\$1,760,000.00	15	35
AF233-D023	TAK Mobile Machine Learning (MML) Model Development	\$1,760,000.00	24	35
AF233-D024	Integration of Machine Learning (ML) Platforms with a Mobile Device Manager (MDM) for the TAK Ecosystem	\$1,760,000.00	24	35
AF233-D025	Improved Data Collection and Knowledge Graphing in the TAK Ecosystem	\$1,760,000.00	24	35
AF233-D026	OptiFrame Topology Optimized Load-Bearing Airframe with Additive Manufacturing	\$1,760,000.00	24	35
AF233-D027	GPU Accelerated Large Eddy Simulation for Low Pressure Turbine Design	\$1,760,000.00	24	35
AF233-D028	Video Imaging for Patrol and Emergency Management	\$1,760,000.00	24	35
AF233-D029	Low-Loss Magnetless Optical Isolators for Quantum Integrated Photonics Applications	\$1,760,000.00	24	35
AF233-D030	Autonomous Airfield Repair Robotics Swarm Platform	\$1,760,000.00	24	35
AF233-D031	Rapid Fly Mobile UAS	\$1,760,000.00	24	35

**\*Proposals that exceed this amount will be disqualified**

**\*\* Proposals that exceed this duration will be disqualified**

**\*\*\*Pages in excess of this count will not be considered during evaluations**

SF233-D001 TITLE: Miniature Smart Satellite Threat Warning Sensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Trusted AI and Autonomy;Advanced Computing and Software;Integrated Sensing and Cyber;Integrated Network System-of-Systems

OBJECTIVE: Brass-board level demonstration of a low SWaP smart multi-threat warning autonomous sensor with an extremely low false alarm rate. The design must have inherent manufacturing-friendly characteristics and be launch- and space-qualified for the SDA transport and tracking constellations in low earth orbit (LEO).

DESCRIPTION: Miniature Smart satellite threat warning sensor: Brass-board level demonstration of a low SWaP smart multi-threat warning autonomous sensor with an extremely low false alarm rate. The design must have inherent manufacturing-friendly characteristics and be launch- and space-qualified for the SDA transport and tracking constellations in low earth orbit (LEO).

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. "Phase I-type" feasibility documentation for this DP2 effort consists of: a.) List of threat sensor microelectronic components and structural materials that have either flown in LEO or can be space certified within the work period. b.) Identifying machine learning software modifiable for whatever threat sensor suite is chosen. c.) Candidate list of low-power space-qualified processors. d.) Conceptual sketches to scale of minimum SWaP earth pointing observing system providing coarse quadrant angle-of-arrival of DEW threats and an Omni-directional burst signal warning communication capability to initiate threat warning relay throughout the SDA tranche constellations.

PHASE II: At Phase II, a laboratory brass-board demonstration is undertaken in a vacuum chamber with suitable access ports to stimulate the threat sensor prototype system with low-power threat-based RF and laser signals. A test plan will be devised and approved by the government before the demonstration. In addition, a draft manufacturing plan proving the capability to build the intelligent threat sensor system with minimal SWaP and ease of installation on spacecraft designs for SDA Tranches. A follow-up program (Phase III) draft flight test plan to examine sensor performance utilizing national ranges' resources to evaluate the system's LEO space environmental endurance and low false alert rate. The threat sensor system can only assume that the proposed spacecraft designs can only provide unregulated power and structural attachment.

PHASE III DUAL USE APPLICATIONS: Threat warning systems are valuable to commercial constellation systems for failure diagnostics. Commercial ISR services provide useful information to both the IC and DoD and commercial customers. Phase III is envisioned as a joint government and commercial-funded flight test experiment.

#### REFERENCES:

1. Hilland, Dave, et al., "Satellite Threat Warning and Attack Reporting," IEEE Aerospace Conference, 1998 Obal, Michael, et al., "The Satellite Attack Warning and Assessment Flight Experiment (SAWAFE)," AGARD Conference Proceeding 531 on Smart Structures for Aircraft and Spacecraft, Lindau, Germany, Oct 1992 Moss, C.E. et al., "A Space Fiber-Optic X-ray Burst Detector," LA-UR-1993-3807

KEYWORDS: RF; DEW; lasers; threat warning; machine learning; low power space-qualified processors; manufacturability

AF233-D002 TITLE: Aircraft Vibration Harvester (AVH)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software; Integrated Sensing and Cyber

OBJECTIVE: Develop and manufacture an energy harvesting system to be used in airborne applications.

DESCRIPTION: Current solutions for installing instrumentation systems on flight-test aircrafts are time consuming, consist of large amounts of cabling, and require extensive aircraft downtimes. Generating electrical power near instrumentation sensors reduces the need to install wiring dedicated for power. Also, locally generated power can be used to power wireless systems that can wirelessly connect the sensor to the data acquisition system. Thus, reducing the need to install dedicated signal wiring for the sensor. Reducing the need for dedicated power and sensor wiring will reduce aircraft downtimes during instrumentation installations. Previous research has demonstrated an energy harvesting system that included a piezoelectric structure with a power conditioning circuit. Any solutions must have the following capabilities: 1. Self-tunable frequency range of 85 Hz to 200 Hz 2. Output voltage of 12 to 28 VDC 3. Output power of 650 mW to 9500 mW 4. Comply with Air Force Airworthiness standards 5. Comply with Air Force environmental testing The AVH system will be available for flight testing at least 6 months prior to the end of the Period of Performance. The system shall be at a Technical Readiness Level (TRL) of 6 at this time. If a test aircraft is available, the 812 Aircraft Instrumentation Test Squadron will be responsible for installing the energy harvesting system in the test aircraft.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. No Phase I SBIR is necessary as this topic is intended to compete for a Direct-to-Phase-2 (D2P2) topic. The ability to test the proof-of-concept directly on an aircraft and increase the Test Readiness Level (TRL) based off the existing findings and developments is fundamental, which can only be implemented through a D2P2. Furthermore, testing and evaluating the system is highly desired in this environment and needs to be executed for refining parameters, increasing the overall system power generation, and interfacing with sensors in a relevant application. Flight worthiness is crucial for this design; deliverables include being able to demonstrate the feasibility in converting vibrations similar in amplitude to an aircraft's and generate energy through sufficient studies, analysis of solutions, and lab experiments/procedures.

PHASE II: Develop and manufacture an energy harvesting system that can withstand airborne environments associated with high performance military aircraft. Obtain a TRL of 6 based on Air Force standards and ready to test in an airborne operational environment.

PHASE III DUAL USE APPLICATIONS: Military Application: Energy harvesting system to provide electrical power generation to be used for wireless sensors in an airborne application. Commercial Application: Harvest energy in commercial environments, such as in the auto industry or other vehicular applications.

#### REFERENCES:

1. Samson, D.; Energy Harvesting for Autonomous Wireless Sensor Nodes in Aircraft. Procedia Engineering, Sept 2010 ;
2. Seah, W.; Wireless Sensor Networks Powered by Ambient Energy Harvesting (WSN-HEAP) – Survey and Challenges. Institute for Infocomm Research, May 2009

KEYWORDS: Energy Harvester; Aircraft Energy Harvester; Aerospace Energy Harvester; Piezoelectric;



Vibration Energy; Vibration Harvester; Aircraft Power Piezoelectric; Sensor Vibration Harvester

AF233-D003      TITLE: Novel high resolution distributed radar processing for littoral and open ocean environments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Integrated Network System-of-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:** The objective is to develop novel signal processing for distributed radar operation over open ocean and littoral regions. A team of radar platforms will operate collaboratively with the purpose (threshold) of detecting, tracking, geolocating and imaging with sufficient quality (objective) to enable classifying and identifying surface targets. Operating collaboratively means overlap of beam patterns from different platforms. It is important to be able to work in conjunction with legacy radar systems. It is anticipated that this type of processing technology could enable sensing on airborne platforms of various classes operating over the ocean.

**DESCRIPTION:** Develop combined distributed radar system-of-system concepts for surveillance of littoral and open ocean environments. Emphasis will be on signal processing techniques, geolocation, and imaging.

**PHASE I:** This is a Direct to Phase II SBIR. Offerors are expected to demonstrate relevant past experience and subject matter expertise. Offerors should list past projects and programs connect with bistatic radar.

**PHASE II:** Accurate geolocation over ocean is of particular interest. In addition to geolocation, it is expected that offerors will be able to perform imaging of surface targets, both for pitching and rolling inverse synthetic aperture radar (ISAR) conditions and for ships in calm waters. Basic processing requirements are detection, short time tracking within a coherent dwell (generally less than 10 seconds), motion stabilization, geolocation and imaging. The scope of Phase II does not extend to classification or identification of images produced. Efficiency of algorithms is important in order to make use of low cost, size, weight and power (low C-SWAP) platforms. Offerors are expected to develop simulated data to prove out algorithms as part of the effort, and the government may additionally supply measured data to process.

**PHASE III DUAL USE APPLICATIONS:** Coastal monitoring of commercial sea traffic including container ships and tankers. Support for search and rescue activities. Wildlife monitoring including detecting when whales breach the surface. Monitoring of commercial fisheries and fleets operating in those locations. Monitoring oil spills and ecological disasters.

**REFERENCES:**

1. Jakowatz, Wahl, Eichel, Ghiglia, Thompson, "Spotlight-Mode Synthetic Aperture Radar: A Signal Processing Approach", Springer, 1996, Section 2.7, Tomographic Development of Bistatic SAR.

**KEYWORDS:** Bistatic Radar; Inverse Synthetic Aperture Radar; ISAR; SAR; Synthetic Aperture Radar; Open Ocean Surveillance; Littoral; Brown Ocean; Blue Ocean; Geolocation

SF233-D004 TITLE: Uncertainty Management for Space Domain Awareness of Non-Standard Threats

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

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 algorithms and methodology to allow for better uncertainty propagation of beyond-GEO trajectories, which are subjected to more highly nonlinear dynamics, stochastic excitation, and uncertain initial conditions than typical GEO-and-below trajectories.

**DESCRIPTION:** One of the significant technical challenges in space domain awareness is the accurate and consistent propagation of uncertainty for objects governed by highly nonlinear dynamics with stochastic excitation and uncertain initial conditions. This challenge is even greater in the beyond-GEO region where three-body gravity becomes significant, resulting in the dynamics being more nonlinear. Additionally, the increased distance between an Earth-based sensor and the object reduces the apparent motion between them, resulting in little independent information to initialize an orbit. The initial uncertainties in xGEO orbits are therefore highly non-Gaussian, which inhibits the effectiveness of traditional propagation and filtering methods. Orbits within this area of regard enable low-cost options for spacecraft to rapidly alter course and threaten terrestrial and space-based assets. Being able to accurately understand and propagate the uncertainty of objects within this area is necessary to assess whether they pose a threat.

**PHASE I:** This is a Direct to Phase 2 (D2P2) topic. Phase 1 proposals will not be evaluated and will be rejected. 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. Proposal must show, as appropriate to the proposed effort, a demonstrated technical feasibility to meet the capabilities of the stated objective. The documentation provided must substantiate that the proposer's technology is currently at an acceptable stage to be funded at the D2P2 level. Documentation may include reports demonstrating prior work demonstrating feasibility, results of prior efforts, success criteria of a prototype, or any other relevant documentation as applicable.

**PHASE II:** Develop algorithms and methodology to characterize uncertainty propagation, including contribution of higher-order moments, of xGEO trajectories. Identify uncertainty propagation behavior in presence of variety of mission profiles, including low-thrust, long-duration maneuvers, quasi-periodic trajectories, and Lyapunov and transfer orbits. Evaluate uncertainty propagation across sensor exclusion and occultation geometries and assess impact of maneuvers in this space. Identify sensor network placement and tasking strategies to maximize information gain of xGEO objects and satisfy object custody requirements. Identify and develop estimation techniques applicable to the identified uncertainty distributions. Evaluate the resultant uncertainty from initial orbit determination as well as catalog maintenance (filtering) algorithms.

PHASE III DUAL USE APPLICATIONS: Develop a strategy to transition prototype residual capabilities and incremental proliferation based on operational USSF requirements.

REFERENCES:

1. T. Wolf, E.M. Zucchelli and B. A. Jones, "Multi-Fidelity Uncertainty Propagation for Objects in Cislunar Space," AIAA 2022-1774. AIAA SCITECH 2022 Forum. January 2022;
2. C. Freuh, K. Howell, K.J. DeMars, S. Bhadauria, and M. Gupta, "Cislunar Space Traffic Management: Surveillance Through Earth-Moon Resonance Orbits," 8th European Conference on Space Debris, ESA Space Debris Office, Darmstadt, Germany, Apr. 2021;
3. M.R. Thompson, N.P. Re, C. Meek, and B. Cheetham, "Cislunar Orbit Determination and Tracking via Simulated Space-Based Measurements," Advanced Maui Optical and Space Surveillance Conference, Maui, HI, Sept. 2021

KEYWORDS: beyond-GEO; xGEO; cislunar; space traffic management; space domain awareness; uncertainty propagation; orbit determination; space sensor tasking

AF233-D005      TITLE: Ultra-High Laser Damage Threshold Broad Bandwidth Anti-Reflection Treatments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 an anti-reflection treatment for tungstate laser materials with a surface optical damage threshold exceeding 50 Joules per square cm in 10 nanosecond pulses over three separate wavebands (500-700 nm, 1000-1500 nm, 2000-5000 nm)

**DESCRIPTION:** Nonlinear optical materials are key components in modern high-intensity laser systems which require very high damage threshold anti-reflection treatments. Conventional multi-layer dielectric coatings are frequently prone to surface damage, especially when required to be effective over a wide spectral range. Stress within multilayer dielectrics often leads to failure during temperature cycling, especially over an extended timeframe. These issues are accentuated when higher-order optical nonlinearities are needed, as these require increased optical intensities to drive the nonlinearity. Third-order nonlinearities, such as direct third harmonic generation, Raman generation, and Stimulated Brillouin Scattering (SBS) are frequently difficult to employ in real-world laser systems due to the excessive pump intensities needed to drive the nonlinearity with high efficiency without incurring surface optical damage to the laser components. The frequently required broad bandwidths needed to encompass pump and emission wavelengths at high intensities is extremely challenging for conventional dielectric coating technology. A preferable option would be to develop anti-reflection treatments based on surface texturing. This approach provides a technical path to achieving surface optical damage thresholds that approach those of the internal bulk material. Anti-reflection treatments based on surface texturing comprise a dense “forest” of microscopic rod or cone-like structures which are etched into the surface of an optical component. The morphology of these structures varies and may be regularly spaced structures of identical size (often referred to a “moth eye” structures) or may be random in size and density within prescribed dimension bounds (called Random Anti-Reflection, or “RAR” structures). The process for creating these structures varies considerably according to the specific optical materials involved. This topic seeks to develop surface anti-reflection treatments specifically for tungstate based third order nonlinear optical media, such as potassium gadolinium tungstate (KGW). The goal is to demonstrate surface optical damage thresholds exceeding 50 Joules per square cm for laser pulse widths in the nanosecond regime (e.g. 10 ns). Three separate spectral regions are sought; 500-700 nm, 1000-1500 nm, 2000-5000 nm, each designed for normal incidence operation. The spectral coverage may be three separate surface treatment designs, but a single design to span all three spectral regions would also be acceptable. The reflectivity at normal incidence should not exceed 1% at any wavelength of interest, with a goal of less than 0.5%.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Qualifying “Phase I-type” efforts would include the prior design, development, and demonstration of surface textured anti-reflection treatments for broadly transparent

solid state laser media with a damage threshold of 10 Joules per square cm, or greater, for nanosecond type pulse durations. Examples of appropriate laser media include yttrium aluminum garnet (YAG), yttrium lithium fluoride (YLF), potassium gadolinium tungstate (KGW), and zinc selenide (ZnSe), with broad band reflection values of less than 1 % peak across an optical bandwidth of at least 20% of the design center wavelength. For example, 200 nm bandwidth of anti-reflection treatment with less than 1% reflectivity at normal incidence from 900 nm to 1100 nm with a damage threshold of 10 Joules per square cm, or greater, would qualify as a “Phase I-type” effort.

PHASE II: This topic seeks to develop surface anti-reflection treatments specifically for tungstate based third order nonlinear optical media, such as potassium gadolinium tungstate (KGW). The goal is to demonstrate surface optical damage thresholds exceeding 50 Joules per square cm for laser pulse widths in the nanosecond regime (e.g. 10 ns). Three separate spectral regions are sought; 500-700 nm, 1000-1500 nm, 2000-5000 nm, each designed for normal incidence operation. The spectral coverage may be three separate surface treatment designs, but a single design to span all three spectral regions would be acceptable. The reflectivity at normal incidence should not exceed 1% at any wavelength of interest, with a goal of less than 0.5%. The demonstration should be initially characterized using small scale samples of KGW (to be sourced by the awardee), and then demonstrated at both ends of KGW rods, 5 mm square by at least 50 mm long. Demonstrate that all topic goals are met and develop a plan to scale to 25 mm or larger diameter rods. Deliver five rods of AR treated KGW at all three wavebands of interest.

PHASE III DUAL USE APPLICATIONS: Develop scaling and manufacturing capability for anti-reflection treatments in KGW with crystal apertures exceeding 25mm in diameter and at least 50mm in length. Identify and procure samples of KGW, or similar, in sufficient sizes to meet these requirements, and verify optical damage threshold of the completed crystals exceeds 50 J per square cm in 10 ns pulses across each of the three wavebands of interest (500-700 nm, 1000-1500 nm, 2000-5000 nm).

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KEYWORDS: Motheye; random anti-reflection; SBS; Raman; nonlinear; high laser damage threshold

SF233-D006 TITLE: Aircraft avoidance for small telescopes using passive detection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE);Space Technology

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 project is to develop and demonstrate an aircraft detection and avoidance system that would allow astronomical and space situational awareness observatories and other atmospheric laser operators to avoid accidental illumination of aircraft from eye-hazardous lasers. Specifically, the system would need to be configured in a way that's appropriate for small (e.g., less than 1 meter) telescopes. The objective is to develop the necessary aircraft detection and avoidance components and demonstrate them on-sky, in conditions that are representative of typical sites for ground-based observations of earth-orbiting satellites. These components could be demonstrated on government, university, or civilian telescopes.

**DESCRIPTION:** AFRL supports the US Space Force in researching and developing effective, affordable techniques to identify, track, and characterize satellites in Earth orbit. Radar, although it is expensive to build and operate, works for satellites in low-Earth orbit. However, because of the distances involved, only a few specialized ground-based radars are capable of tracking satellites in geosynchronous orbit. Compared to ground-to-space radars, ground-based optical telescopes are less expensive to build and operate; in addition, they work well for satellites in all orbits. However, atmospheric turbulence limits the resolution and effectiveness of ground-based optical telescopes. Laser-beacon adaptive optics is an established technique to overcome the effects of atmospheric turbulence. However, laser beacons are not usually eye-safe and present a significant hazard to pilots and the safe operation of aircraft. One type of laser beacon that is not hazardous to pilots is ultraviolet (UV) Rayleigh laser beacons. However, UV laser beacons have a number drawbacks. Before discussing these drawbacks, it is helpful to discuss the different types of laser beacons used for adaptive optics. There are two main types of laser beacons used in adaptive optics, Rayleigh beacons and sodium beacons. Rayleigh beacons are formed by scattering light from molecules of nitrogen and oxygen lower in the atmosphere; typical altitudes range from 10 km to 20 km. Pulsed lasers are typically used for Rayleigh beacons so that the light may be sampled from a particular altitude by using a technique called range gating. Because Rayleigh scattering is much stronger for shorter wavelengths of light, common wavelengths for Rayleigh beacons are 355 nm and 532 nm. Typically, the 355 nm (UV) beacons are eye-safe, but the 532 nm (visible) beacons are not eye-safe. Because Rayleigh beacons rely on scattering from air molecules, they are limited to relatively low altitudes where the density of air molecules is higher. Light from the beacon traverses a cone of air above the telescope, with the beacon at the apex of the cone and the telescope pupil at the base of the cone. If a Rayleigh beacon is used for a larger telescope, the cylindrical column of air above the telescope will not be well sampled. Because of this cone effect, Rayleigh beacons are suitable only for smaller telescopes of up to about 2 m in diameter. Sodium beacons are formed from scattering light from a layer of ionic sodium that is centered at an altitude of 90 km above the ground. Because of their high altitude, sodium beacons sample a much larger cone of air when compared to Rayleigh beacons. So, they are better suited for use with large telescopes. So, UV Rayleigh beacons are suited only for smaller telescopes. Now that we have discussed the different types of laser beacons, we can put the drawbacks of UV laser beacons in context. Astronomical telescopes usually use a series of mirrors to reflect and focus light onto sensors.



The best coating for these mirrors, especially in smaller telescopes, is protected silver. However, silver does not reflect UV light efficiently. The reflectivity of typical silver coatings at 355 nm wavelength is about 0.5. A typical AO system at Nasmyth focus would have at least 5 silver-coated mirrors before the wavefront sensor. This means about 3 percent of the UV light would make it to the wavefront sensor. Now, UV-enhanced silver coatings have much higher reflectivity at 355 nm, but that would require recoating several large mirrors, which would be costly. In addition to the issue with silver-coated mirrors, pulsed UV lasers with good beam quality required for laser beacons do not have sufficient power to form beacons bright enough for observatories with strong turbulence. For most astronomical observatories, this is not a problem, because they are located in places with weak atmospheric turbulence. However, observatories for space situational awareness (SSA) and ground stations for laser communications (lasercom) are typically located in places with stronger atmospheric turbulence. To make matters worse for SSA observatories, when a ground-based telescope tracks a satellite in low-Earth orbit, it must slew quickly across the sky. This, in effect, creates a situation that is equivalent to a strong wind blowing across the aperture of the telescope. This means the adaptive optics system must operate at a higher frame rate and higher gain to compensate for atmospheric turbulence. In addition, there's a growing need for SSA and lasercom systems to operate during the day, which means the atmospheric turbulence is much worse than it is at night. The combination of these factors means a laser beacon for SSA and lasercom purposes must be much brighter than a laser beacon for astronomy. Thus, UV Rayleigh beacons are not ideal for some applications. In the past, observatories have used human aircraft spotters and radar systems to avoid illuminating aircraft. However, human spotters are expensive to employ and they can not observe for long periods of time in potentially very cold weather. In addition, human aircraft spotters have a very difficult time spotting aircraft during the day. As for radar systems, they produce radio-frequency interference, which can adversely affect sensitive electro-optical equipment. Radar systems are expensive to operate, maintain, and calibrate, plus they produce ionizing radiation that is hazardous to personnel. Radar systems also have a difficult time detecting aircraft that have a small radar cross-section. One system that meets many of the requirements is the Transponder-Based Aircraft Detector (TBAD). (<http://www.aircraft-avoid.com/>). However, the TBAD antenna system is too large to install on small-aperture telescopes, which may have domes with relatively small openings. Furthermore, the current antenna format can act as a sail and catch wind, which may cause jitter of the optical telescope. Passive infrared detectors have been developed and used in the past, but these systems were less effective than TBAD. That said, passive infrared detectors do not rely on the aircraft having a transponder, thus they may be able to detect experimental aircraft, such as hang gliders. Thus, AFRL is seeking development of reliable, passive systems that would allow astronomical and space situational awareness observatories and other atmospheric laser operators to avoid accidental illumination of aircraft from eye-hazardous lasers, but is suitable for small telescopes and avoids the issues of telescope jitter due to wind buffeting.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. "Phase I-type" deliverables include a report that describes thoroughly concepts, analyses, and simulations for aircraft avoidance systems that are suitable for SSA ground-to-space imaging applications that use small telescopes. These analyses and simulations must show that the proposed components are effective and affordable. The report should describe the components at a level suitable for a conceptual design review. (See [https://en.wikipedia.org/wiki/Engineering\\_design\\_process#Concept\\_Generation](https://en.wikipedia.org/wiki/Engineering_design_process#Concept_Generation)) The report shall include a plan for demonstrating the aircraft avoidance systems on-sky, in conditions that are representative of typical sites for ground-based observations of earth-orbiting satellites. (Since this is a D2P2 topic, this section describes the content expected to substantiate that the proposer's technology is currently at an acceptable stage to award a D2P2.)

PHASE II: Phase II deliverables include a detailed design of aircraft avoidance systems that are suitable for SSA ground-to-space imaging applications that use small telescopes. This design must illustrate that the proposed components are effective and affordable. The design documents should describe the components at a level suitable for preliminary and critical design reviews. (See [https://en.wikipedia.org/wiki/Design\\_review\\_\(U.S.\\_government\)#Preliminary\\_Design\\_Review\\_\(PDR\)](https://en.wikipedia.org/wiki/Design_review_(U.S._government)#Preliminary_Design_Review_(PDR)), and [https://en.wikipedia.org/wiki/Design\\_review\\_\(U.S.\\_government\)#Critical\\_Design\\_Review\\_\(CDR\)](https://en.wikipedia.org/wiki/Design_review_(U.S._government)#Critical_Design_Review_(CDR))) The report shall include a detailed plan for demonstrating the aircraft avoidance systems on-sky, in conditions that are representative of typical sites that use small telescopes for ground-based observations of earth-orbiting satellites. As cost and schedule constraints allow, a prototype aircraft avoidance system shall be built, tested, and demonstrated on-sky at government, university, or civilian observatory.

PHASE III DUAL USE APPLICATIONS: A Phase III effort would require identifying a suitable transition partner, which could be a government program office, a government contractor or other commercial entity, or a civilian astronomical observatory. Potential phase III applications include other defense SSA observatories in the US, Europe, and Australia; civilian astronomical observatories that wish to observe at visible wavelengths, which requires improved adaptive optics performance; and ground-to-space laser communications research facilities or ground sites.

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KEYWORDS: laser beacons; adaptive optics; aircraft laser safety; aircraft avoidance

SF233-D007

TITLE: Laser pre-compensation to improve sodium beacon coherence

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE);Space Technology

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 project is to develop and demonstrate key components that would increase the spatial coherence of laser beacons (i.e., generate smaller laser beacons) to help improve the performance of adaptive optics systems for ground-to-space imaging applications. The final design should not require a light source external to the system itself (i.e., light from a star or satellite) to preserve the dim object imaging capability of a laser beacon adaptive optics system. For this effort, we are primarily focused on continuous wave sodium beacons in a side-launched or bi-static configuration. That said, pulsed sodium or Rayleigh beacons, are also of interest. The primary focus of this topic is to develop, build, and test the necessary adaptive optics components to achieve reliable pre-compensation of the beacon. It is also highly desired that an on-sky demonstration of the system be completed in conditions that are representative of typical sites for ground-based observations of earth-orbiting satellites. The system demonstration can be performed on government, university, or civilian telescopes; however, our primary goal is to demonstrate the pre-compensation system on the island of La Palma in the Canary Islands, Spain.

**DESCRIPTION:** AFRL supports the US Space Force in researching and developing effective, affordable techniques to identify, track, and characterize satellites in Earth orbit. Radar, although it is expensive to build and operate, works for satellites in low-Earth orbit. However, because of the distances involved, only a few specialized ground-based radars are capable of tracking satellites in geosynchronous orbit. Compared to ground-to-space radars, ground-based optical telescopes are less expensive to build and operate; in addition, they work well for satellites in all orbits. However, atmospheric turbulence limits the resolution and effectiveness of ground-based optical telescopes. Laser-beacon adaptive optics is an established technique to overcome the effects of atmospheric turbulence. However, there remain significant challenges to improving the utility and effectiveness of laser beacon adaptive optics for defense applications. There are two main types of laser beacons used in adaptive optics, Rayleigh beacons and sodium beacons. Rayleigh beacons are formed by scattering light from molecules of nitrogen and oxygen lower in the atmosphere; typical altitudes range from 10 km to 20 km. Pulsed lasers are typically used for Rayleigh beacons so that the light may be sampled from a particular altitude using a technique called range gating. Because Rayleigh scattering is much stronger for shorter wavelengths of light, common wavelengths for Rayleigh beacons are 355 nm and 532 nm. Because Rayleigh beacons rely on scattering from air molecules, they are limited to relatively low altitudes where the density of air molecules is higher. Light from the beacon traverses a cone of air above the telescope, with the beacon at the apex of the cone and the telescope pupil at the base of the cone. If a Rayleigh beacon is used for a larger telescope, the cylindrical column of air above the telescope will not be well sampled. Because of this cone effect, Rayleigh beacons are suitable only for smaller telescopes of up to 2 m in diameter. Sodium beacons are formed from scattering light from a layer of ionic sodium that is centered at an altitude of 90 km above the ground. Because of their high altitude, sodium beacons sample a much larger cone of air when compared to Rayleigh beacons. So, they are better suited for use with large telescopes. Typical current laser beacon systems for astronomical applications do not compensate the outgoing laser

beam to correct for atmospheric turbulence. As a result, the laser beacon can be large and extended, especially when compared to an unresolved point source, like a star. For most astronomical observatories, this is not a problem, because they are located in places with weak atmospheric turbulence. However, observatories for space situational awareness (SSA) are typically located in places with stronger atmospheric turbulence, so their laser beacons are typically larger than those at astronomical observatories. A larger laser beacon results in lower sensitivity of the laser-beacon wavefront sensor. To make matters worse for SSA observatories, when a ground-based telescope tracks a satellite in low-Earth orbit, it must slew quickly across the sky. This, in effect, creates a situation that is equivalent to a strong wind blowing across the aperture of the telescope. This means the adaptive optics system must operate at a higher frame rate and higher gain to compensate for atmospheric turbulence. The combination of these two factors means a laser beacon for SSA purposes must be much brighter and smaller than a laser beacon for astronomy. Thus, AFRL is seeking development of systems to generate smaller more spatially coherent laser beacons to help improve the performance of adaptive optics systems for ground-to-space imaging applications.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. "Phase I-type" deliverables include a report that thoroughly describes concepts, analyses, and simulations for laser beacon components that are suitable for SSA ground-to-space imaging applications. These analyses and simulations must show that the proposed components are effective and affordable. The report should describe the components at a level suitable for a conceptual design review. (See [https://en.wikipedia.org/wiki/Engineering\\_design\\_process#Concept\\_Generation](https://en.wikipedia.org/wiki/Engineering_design_process#Concept_Generation)) The report shall include a plan for demonstrating the laser components on-sky, in conditions that are representative of typical sites for ground-based observations of earth-orbiting satellites. (Since this is a D2P2 topic, this section describes the content expected to substantiate that the proposer's technology is currently at an acceptable stage to award a D2P2.)

**PHASE II:** Phase II deliverables include a detailed design of laser beacon pre-compensation components that are suitable for SSA ground-to-space imaging applications. This design must illustrate that the proposed components are effective and affordable. The design documents should describe the components at a level suitable for preliminary and critical design reviews. (See [https://en.wikipedia.org/wiki/Design\\_review\\_\(U.S.\\_government\)#Preliminary\\_Design\\_Review\\_\(PDR\)](https://en.wikipedia.org/wiki/Design_review_(U.S._government)#Preliminary_Design_Review_(PDR)), and [https://en.wikipedia.org/wiki/Design\\_review\\_\(U.S.\\_government\)#Critical\\_Design\\_Review\\_\(CDR\)](https://en.wikipedia.org/wiki/Design_review_(U.S._government)#Critical_Design_Review_(CDR))) After successful completion of the PDR and CDR, a prototype system will be built, tested in the lab environment. A detailed test plan shall also be developed for demonstrating the laser pre-compensation components on-sky, in conditions that are representative of typical sites for ground-based observations of earth-orbiting satellites. As cost and schedule constraints allow, the prototype pre-compensation system shall be demonstrated on-sky at a government, university, or civilian observatory. The proposer will not include the sodium beacon laser, launch telescope, gimbals, and safety systems in their proposal, as these components could be made available, depending on the location for the on-sky demonstration. Currently, the goal is to support on-sky testing on the island of La Palma in the Canary Islands, Spain

**PHASE III DUAL USE APPLICATIONS:** A Phase III effort would require identifying a suitable transition partner, which could be a government program office, a government contractor or other commercial entity, or a civilian astronomical observatory. Potential phase III applications include other defense SSA observatories in the US, Europe, and Australia; civilian astronomical observatories that wish to observe at visible wavelengths, which requires improved adaptive optics performance; and ground-to-space laser communications research facilities.

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KEYWORDS: sodium beacons; laser beacons; laser beacon coherence; adaptive optics

AF233-D008      TITLE: AR for Equipment Maintenance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

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:** Implement AR and VR technology to improve efficiency and reduce error in equipment maintenance

**DESCRIPTION:** Preventative maintenance and corrective maintenance are two different approaches to equipment maintenance. Preventative maintenance involves regular upkeep and scheduled inspections to prevent equipment failure before it even happens. On the other hand, Corrective maintenance is reactive since it is done after a piece of equipment has broken down. Maintainers continue to rely on conventional maintenance resources, which communicate increasingly complex instructions and processes using images and text, even with increasingly complex machineries. Currently, technicians must duplicate the equipment's operation as it was prior to the problem developing. Each technician's effort is different and takes time. Advanced tools, machines, knowledge, and skills are needed to resolve maintenance issues in order to address and reduce equipment failures that eventually cause aircraft maintenance to be delayed. Additionally, training new technicians requires hands-on experience and depends on the workload that is available. AR can be used to diagnose equipment problems by overlaying diagnostic information on top of live video feed of the equipment. This can help technicians to quickly identify and troubleshoot issues. VR can provide simulated training environments that allow technicians to practice maintenance procedures on virtual equipment models. This can help to reduce the risk of damage to actual equipment during training, while also providing a more realistic training experience. By leveraging AR & VR technology, organizations can improve equipment uptime, reduce maintenance costs, increase the overall safety and reliability of their operation, enhance the efficiency and accuracy of equipment maintenance.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. To demonstrate the requisite feasibility 1 requirements, applicants should be able to demonstrate an understanding of the maintenance groups' needs and potential use cases for AR in equipment maintenance. This may be demonstrated by citing prior work including feasibility studies or interviews with key stakeholders. Applicants should be able to evaluate available AR & VR technologies and develop a detailed plan for implementing AR in equipment maintenance.

**PHASE II: Pilot Phase:** This phase involves testing the AR technology in a small-scale pilot project to evaluate its effectiveness and identify any issues. This may involve training technicians on the use of AR technology, monitoring performance metrics, and gathering/analyzing feedback from stakeholders, evaluating the effectiveness of the AR technology and identifying areas where the technology can be optimized.

**PHASE III DUAL USE APPLICATIONS: Implementation Phase:** This phase involves rolling out the AR technology across the organization. This may involve scaling up the pilot project to a larger

deployment, providing training to technicians, and ensuring that the technology is integrated with existing systems and processes.

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**KEYWORDS:** Augmented Reality for Equipment, AR for Equipment, Augmented Reality, Augmented Reality in factory maintenance, AR in MRO

AF233-D009 TITLE: Robotic Defastening

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber;Human-Machine Interfaces;Trusted AI and Autonomy

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 AI assisted defastening robot to improve process time and quality.

DESCRIPTION: Various Programmed Depot Maintenance (PDM) processes require removal of fasteners on the aircraft to access behind aircraft skins. The defastening process is currently conducted across all aircraft at Tinker AFB (E-3, E-6, B-52, KC-135, KC-46, and B-1B) by production personnel with hand drills. This amounts to hundreds of thousands of hours spent removing fasteners annually. With the B-1B FIF workload coming to Tinker AFB in FY25, over 10,000 fasteners will need to be removed from each jet. The defastening process is tedious and even the most skilled artisans are subject to fatigue, resulting in reduced quality over long periods of time, as well as increased risk of injury to personnel. Manual drilling is difficult and produces shavings and debris that prove challenging to collect, and drill bits tend to break quickly requiring frequent replacement. As the B-1B workload approaches, there is a concern that removing aircraft skins will become overwhelming to the production line and better methods need to be implemented before the workload arrives. Automating the defastening process will significantly improve personnel quality of life, reduce process time, and drive down risk of rework. Robotics have been implemented in industry to assist the defastening process, but no directly on an aircraft. Other technology, such as E-Drill, has proven successful in improving quality and speed, but still requires artisans to easily access the skins with heavy equipment. 76 AMXG is unique in that the aircraft requirements for this technology is much larger than other ALC's, requiring stricter parameters for space/motion.

PHASE I: To meet Phase 1 requirements, proposers should be able to demonstrate an understanding of requirements of fastener removal on aircraft and show feasibility of defastening on aircraft with 50% or more time reduction compared to manual process and maintain 95% accuracy. Proposer should include a detailed plan for demonstrating this capability on military aircraft.

PHASE II: Provide mobile prototype capable of accomplishing Phase I requirements demonstrating ability to reduce flow days on various aircraft with various types of fasteners. Develop integration path to implementation across Maintenance Depots.

PHASE III DUAL USE APPLICATIONS: Integrate multiple mobile defastening robots into the PDM process, possibly across different aircraft, with data to prove efficiency/accuracy improvements.

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3. <https://www.afllmc.af.mil/NEWS/Article-Display/Article/3294689/rso-seeks-to-scale-innovation/>



KEYWORDS: Robotic Defastening, Defastener, De-fastener, manual drill rivets, manual riveting, match drill, replacement skin, automated repair, structural repair, skin repair, fastening system, mobile robotic drilling, electrostatic discharge machining, E-Drill

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Hypersonics

**OBJECTIVE:** Develop for field and depot maintenance applications, an integrated, palm size analytical type instrument with control software application utilizing an Artificial Intelligence Deep Learning Algorithm that is capable of detecting, identifying, and quantifying by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in a jet fuel sample within five minutes of analysis initiation from the scan of a 10mL or less sample of the suspected contaminated fuel. The instrument should have a targeted final cost of \$2,500 or less not including any consumables or required calibrations.

**DESCRIPTION:** The US Air Force uses various grades/types of jet fuels, hydraulic fluids, and coolants in support of aircraft weapons system operations.

The primary grades of jet fuels used by the US Air Force are:

- 1) Jet A (ASTM D1655) with standard military additive package to include Fuel System Icing Inhibitor (FSII), Electrical Conductivity Improver (ECI) and Corrosion Inhibitor/Lubricity Improver (CI/LI).
- 2) JP-8 (MIL-DTL-83133)
- 3) Jet A-1 (DEF STAN 91-091) with standard military additive package to include FSII, ECI, and CI/LI.
- 4) JP-5 (MIL-DTL-5624) 5) JPTS (MIL-DTL-25524) There are different types of hydraulic fluids used by aircraft weapon systems, each with a unique chemical makeup. These include both petroleum and synthetic based products.

The primary hydraulic fluid specifications used by the US Air Force for aviation purposes are:

- 1) MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base
- 2) MIL-PRF-87257 Hydraulic Fluid, Fire Resistant; Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile
- 3) MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance
- 4) AS SAE 1241 Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft

This product is clear and not distinctly visible during visual analysis of PAO contaminated fuel samples.

The primary Polyalphaolefin (PAO) coolant specification used by the US Air Force for aviation purposes is MIL-PRF-87252 Coolant Fluid, Hydrolytically Stable, Dielectric. Hydraulic and/or PAO coolant fluid contamination of jet fuel poses both a real and existential threat to unit readiness. Jet fuel contaminated with hydraulic fluid has shown to impact engine operability and accelerated turbine blade and nozzle wear. PAO coolant fluids have been demonstrated as being able to dis-arm the water coaleser elements used in fuel water separators that provide a water/solid defense for aircraft from contaminated jet fuel.

The problem begins when hydraulic fluid and/or coolant levels are found to be low when checked by aircraft maintenance personnel. Maintenance personnel must report the suspected contamination event and request removal of the fuel from the aircraft so that internal maintenance actions can be completed.

The suspect fuel is generally defueled into a mobile refueling unit(s) or bowser. At this point a determination must be made on disposition of the defueled product i.e. return fuel to DLA Energy Capitalized bulk inventories, return to the aircraft, or dispose as hazardous waste. Currently, to obtain the data to support any of the above decisions the suspect fuel is sampled and sent overnight to the closest regional fuel laboratory with the ability to detect and quantify contamination levels. At some locations this is achieved quickly, however the process may take 2-10 days depending on lab and base location.

This situation can escalate quickly because of further delays associated with country clearance or customs. While waiting for the sample results, the mobile refueling unit or bowser holding the suspect product is placed on a quality hold. This means it is unusable to the base or to DLA Energy to support other requirements. Additionally, most refueling locations have limited refueling assets to support aircraft operations and loss of an asset for even a couple of days can directly impact aircraft sortie generation and downed aircraft time due to maintenance. These incidents led to countless direct and

indirect costs associated with mobile refueling truck and/or aircraft downtime, mobile refueling truck remediation (tank cleaning, filter coarser replacement, etc.) and sample transportation. Aircraft engine original equipment manufacturers (OEM) have placed a 0.0 vol % or 0 ppm max allowable tolerance of both products. An analytical type instrument that is capable of detecting, identifying, and quantifying by either percent by volume (vol%) or parts per million (ppm) of the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in an aviation turbine fuel sample will save a significant amount of time and money sampling a product with no detectable contaminants. This capability will also be used to validate product quality following incidents and/or natural disasters. The instrument shall be capable of being stored and operated in conditions ranging from -25 degrees F to +135 degrees F and have the ability to operate on AC, rechargeable battery or a 12-DC volt sources. The instrument will minimize generation of any hazardous waste and require minimum consumables. The integrated system must be able to operate in a hazardous environment. Phase I: Develop a proof of concept for an integrated, palm size analytical type instrument utilizing an Artificial Intelligence Deep Learning Algorithm that is capable of detecting, identifying, and quantifying by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) contamination within five minutes of analysis initiation from the scan of a sample of the suspected contaminated aviation turbine fuel that consists of a targeted 10 mL or less size sample. The proof of concept demonstration will be based on a demonstrated with a jet fuel (Jet A with FSII, ECI, CI/LI) contaminated with 1) a hydraulic fluid meeting any of the identified specifications, 2) a PAO coolant meeting the identified specification, and 3) a mixture of a hydraulic fluid and PAO coolant, with each meeting respective identified specifications.; at three concentrations defined by the Technical Point of Contact (TPOC). The concept must incorporate Air Force Human Systems Integration (HSI) Domains WRT requirements for operating the device in a field environment. Develop a plan to raise the technology to Technology Readiness Level (TRL) 8 by the end of Phase II. Provide a Rough Order of Magnitude (ROM) range of cost estimates for the purchase price of the Phase III product. Since most cost components in the cost estimate are unknown, the ROM should itemize known cost components and describe the rationale for unknown cost components. The ROM should include a maximum expected cost and likely expected cost. Phase II: Develop and evaluate eight prototypes in a laboratory and field environment of an integrated analytical type instrument capable of detecting, identifying, and quantifying by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) of the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in a jet fuel sample. The prototypes by the end of Phase II must be able to demonstrate the ability to detect, identify, and quantify by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) of the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in an jet fuel (Jet A with FSII, ECI, CI/LI) contaminated with 1) each of the four identified hydraulic fluids meeting the identified specifications, 2) a PAO coolant meeting the identified specification, and 3) a mixture of each respective hydraulic fluid and PAO coolant, with each meeting respective identified specifications. For the neat hydraulic fluid and PAO samples, three concentrations for each sample will be defined by the Technical Point of Contact (TPOC) will be tested. For the hydraulic fluid/PAO mixture, three concentrations for each of the identified hydraulic fluid specifications, along with the identified PAO specification will be tested. Draft an ASTM test method based on the instrument technology and conduct an Inter-Laboratory Study IAW ASTM E691-22 Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method in support of data gathering to support a research report for submission of the draft ASTM test method for ballot by ASTM for adoption of the test method. Performance parameters to consider are: Performance in a field environment. Time required for analysis of the fluid, Cost to analyze the fluid, Accuracy of the analysis, Safety for the operator to conduct the analysis. Calibration, How? Who? Where? Repair ability, How? Who? Where Mean time between failures (MTBF): Transportability/drop ability: How does the devices handle transportation and accidental dropping? The prototype should be a TRL 8 or greater per Department of Defense Technology Readiness Assessment (TRA) Guide, April 2011. As TRL increase is each achieved, a revised cost estimate will be included in

the next required progress report. Note: this cost estimate is for budgeting planning purposes only; an authorized government-contracting officer will negotiate the purchase price of the final product.

**PHASE I:** For this Direct-to-Phase II topic, evaluators are expecting that the submittal firm demonstrate the ability to achieve the following: Develop a proof of concept for an integrated, palm size analytical type instrument utilizing an Artificial Intelligence Deep Learning Algorithm that is capable of detecting, identifying, and quantifying by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) contamination within five minutes of analysis initiation from the scan of a sample of the suspected contaminated aviation turbine fuel that consists of a targeted 10 mL or less size sample. The proof of concept demonstration will be based on a demonstrated with a jet fuel (Jet A with FSII, ECI, CI/LI) contaminated with 1) a hydraulic fluid meeting any of the identified specifications, 2) a PAO coolant meeting the identified specification, and 3) a mixture of a hydraulic fluid and PAO coolant, with each meeting respective identified specifications.; at three concentrations defined by the Technical Point of Contact (TPOC). The concept must incorporate Air Force Human Systems Integration (HSI) Domains WRT requirements for operating the device in a field environment. Develop a plan to raise the technology to Technology Readiness Level (TRL) 8 by the end of Phase II. Provide a Rough Order of Magnitude (ROM) range of cost estimates for the purchase price of the Phase III product. Since most cost components in the cost estimate are unknown, the ROM should itemize known cost components and describe the rationale for unknown cost components. The ROM should include a maximum expected cost and likely expected cost.

**PHASE II:** Develop and evaluate eight prototypes in a laboratory and field environment of an integrated analytical type instrument capable of detecting, identifying, and quantifying by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) of the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in a jet fuel sample. The prototypes by the end of Phase II must be able to demonstrate the ability to detect, identify, and quantify by either percent by volume (vol%) ranging from 0.0 to 5.0 percent or parts per million (ppm) (ranging from 0 to 9,000 ppm) of the presence of a aviation grade hydraulic fluid and/or a Polyalphaolefin (PAO) coolant contamination in an jet fuel (Jet A with FSII, ECI, CI/LI) contaminated with 1) each of the four identified hydraulic fluids meeting the identified specifications, 2) a PAO coolant meeting the identified specification, and 3) a mixture of each respective hydraulic fluid and PAO coolant, with each meeting respective identified specifications. For the neat hydraulic fluid and PAO samples, three concentrations for each sample will be defined by the Technical Point of Contact (TPOC) will be tested. For the hydraulic fluid/PAO mixture, three concentrations for each of the identified hydraulic fluid specifications, along with the identified PAO specification will be tested. Draft an ASTM test method based on the instrument technology and conduct an Inter-Laboratory Study IAW ASTM E691-22 Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method in support of data gathering to support a research report for submission of the draft ASTM test method for ballot by ASTM for adoption of the test method. Performance parameters to consider are: Performance in a field environment. Time required for analysis of the fluid, Cost to analyze the fluid, Accuracy of the analysis, Safety for the operator to conduct the analysis. Calibration, How? Who? Where? Repair ability, How? Who? Where Mean time between failures (MTBF): Transportability/drop ability: How does the devices handle transportation and accidental dropping? The prototype should be a TRL 8 or greater per Department of Defense Technology Readiness Assessment (TRA) Guide, April 2011. As TRL increase is each achieved, a revised cost estimate will be included in the next required progress report. Note: this cost estimate is for budgeting planning purposes only; an authorized government-contracting officer will negotiate the purchase price of the final product.

**PHASE III DUAL USE APPLICATIONS:** Commercialize the integrated analytical type instrument for use by commercial and/or Government, overhaul entities, and DOD users/depot facilities. Develop and execute a transition plan to military and commercial customers based on requirements. Develop and

document procedures for operation, calibration, and servicing.

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9. MIL-PRF-87257 Hydraulic Fluid, Fire Resistant; Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile <https://quicksearch.dla.mil/qsSearch.aspx>
10. MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance  
<https://quicksearch.dla.mil/qsSearch.aspx> ;
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12. AS SAE 1241 Fire Resistant Phosphate Ester Hydraulic Fluid For Aircraft  
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13. MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37) <https://quicksearch.dla.mil/qsSearch.aspx> ;
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<https://quicksearch.dla.mil/qsSearch.aspx> ;
15. MIL-DTL-25524 Turbine Fuel, Aviation, Thermally Stable  
<https://quicksearch.dla.mil/qsSearch.aspx> ;
16. ASTM D1655 Standard Specification for Aviation Turbine Fuels <https://www.astm.org> ;
17. Defense Standard 91-091 Turbine Fuel, Kerosine Type, Jet A-1, <https://www.dstan.mod.uk>

KEYWORDS: Hydraulic Fluid, Jet Fuel, Aviation Turbine Fuel, Polyalphaolefin (PAO) Coolant

AF233-D011 TITLE: Functional Gradient Coatings for Landing Gear

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics;Microelectronics;Advanced 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:** Develop and activate coatings that will allow for greater dimensional restoration of work surfaces on landing gear. As compared to the current process, this will reduce or eliminate Hexavalent Chrome on many aircraft part surfaces. The new process will reduce production time by a quicker deposition process and elimination of an 8 hour relief bake of production parts.

**DESCRIPTION:** Aircraft components wear down over time. To prolong the service life of parts, wear resistant coatings are applied to the working surface of the parts. Previously, this was done with Engineering Hard Chrome (also known as hexavalent chromium / hex-chrome). This coating is replaced by High Velocity Oxygen Fuel (HVOF) deposited Tungsten Carbide Cobalt, a metal/ceramic blend that has a very long functional life without the health hazards of hex-chrome Tungsten Carbide Cobalt, as applied per AF DWG 200310641, has a maximum thickness before the coating develops stress cracks. Excessive build can lead to the coating removing itself from the part's surface. This exposes the underlying part to wear, and the shards of the coating can damage seals. A careful balance of proper coating thickness must be maintained for part functionality and preventing the part from rusting as well. A Functional Gradient Coating (FGC), consisting of a build layer, then an intermediary transition layer, then the wear coating layer, allows for much greater dimensional restoration while still applying a replaceable wear resistant layer on top. The coating's intermediary transition layer absorbs and dissipates much of the stresses that would normally cause a two-part coating system to fail under stress, eliminating or severely reducing the problem of stress cracks and coating separation. This process will reduce our condemnation rate, which will help maintain functional supply of available assets reduce aircraft part replacement delivery times, allowing faster asset readiness to deploy or fight.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. **FEASIBILITY DOCUMENTATION.** For this Direct-to-Phase II topic, evaluators are expecting that the submittal firm demonstrate the ability to spraying of representative samples and candidate aircraft parts with the FGC and examining the cross-sectional properties, bend strength, adhesive strength, and fatigue characteristics. Submittal Firm shall demonstrate on a representative sample, a functionally graded coating comprising of a thickness build/bond layer graded into a wear resistant layer. This functionally graded coating shall demonstrate a wear layer with FGM that satisfies performance criteria as identified in AF DWG 200310641.

**PHASE II:** Spraying the FGC on multiple candidate aircraft parts. Destructive testing would be done on the first item to confirm characteristics between representative samples and actual aircraft parts. Surface would then be ground to operational dimensions, then flight worthiness testing would commence. Addendums or supplements to AF DWG 200310641 would then be supplied to the 417 SCMS/GUEA for

adaptation.

**PHASE III DUAL USE APPLICATIONS:** Once flight worthiness is established, upgrading Hill AFB machinery to be able to apply FGC's to aircraft parts. First article acceptance procedures would be carried out, then workload activation begins. Addendums or supplements to AF DWG 200310641 would then be supplied to the 417 SCMS/GUEA for adaptation. Coordination with 417 SCMS/GUEA to update applicable technical orders to use this process across the various assets as needed.

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**KEYWORDS:** Thermal Spray, High Velocity Oxygen Fuel, HVOF, Functional Gradient Coating, Wear Surface, Landing Gear, Dimensional Restoration

AF233-D012

TITLE:

Materials for High-Temperature Performance Electronics: Memory and Packaging

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics;Space Technology;Advanced Materials

OBJECTIVE: The objective is to develop materials, devices/subcomponents, and integration processes that will enable a fully functional microprocessor capable of continuous operation at elevated temperatures. Here, elevated means anything above the current limitation of Silicon Complementary metal-oxide-semiconductor (Si CMOS) electronics of roughly 250 degrees Celsius. Ultimately, the goal is to develop materials and components capable of operation above 500 degrees Celsius to be used in Department of the Air Force platforms subject to extreme temperatures during operations.

DESCRIPTION: The realization of fully functional microprocessors operating at temperatures above 250 degrees Celsius will require advances in the materials and fabrication processes used for transistors/switches, memory elements, and passives, as well as new approaches to heterogeneous integration of these various components. Current solutions to thermally protect electronics negatively affect the size, weight, and performance (SWAP) of the systems. Electronics capable of surviving and operating in the high-temperature realm will improve the SWAP of systems by the removal of insulating materials thus improving numerous system capabilities. The topic is expected to deliver at least two lab-scale testbeds of fully packaged electronics capable of operating at temperatures of at least 400 degrees Celsius (up to 500 degrees Celsius desired) without detrimental loss to functionality.

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 AF customer. The feasibility study should have;

- Identified the prime potential Department of the Air Force 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-like" 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 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. These Phase II awards are intended to provide a path to commercialization, not the final step for the proposed solution. The successful Phase 2 effort will build on emerging high temperature electronics technology such as Silicon Carbide (SiC) transistors, ferroelectric memory elements, correlated electron oxide memory elements, and laminate ceramic circuit boards to demonstrate integrated functionality towards a full high-temperature microprocessor. The contractor will establish a research and development strategy that addresses key technical hurdles in one or more of the following areas. Scalable memory fabrication and integration. There is currently no commercially available memory technology that is able to be manufactured in commercial microelectronics foundries, small enough to provide reasonable data densities, and capable of repeated read/write cycles at temperatures



above 250 degrees Celsius. Candidate memory technologies must show the potential to satisfy these requirements. The associated read/write protocols should require voltage and current levels that can reasonably be achieved in an integrated microprocessor on a remote air or space platform. Transistor fabrication and integration. Transistors fabricated from wide band gap (WBG) semiconductor materials are the most promising candidates for high temperature logic, switches, and power amplifiers. The NASA SiC Junction Field Effect Transistor (JFET-R) process results in transistors capable of continuous operation at greater than 800 degrees Celsius. However, the speed, density, and voltage/power requirements of these devices must be improved to meet future Department of the Air Force system demands. Furthermore, integrating SiC transistors with emerging memory technology is uncharted ground, and will require novel device and circuit design approaches. Subcomponent integration. A key technology gap is the integration of high temperature logic with high temperature memory into a circuit architecture that can enable the development of digital algorithms for signal processing, data storage, and system control. This requires circuit design specific to these high temperature subcomponents, and the development of packaging processes that ensure the reliability of both the active and passive components of the circuit. The Phase 2 awardee will build on the current state of the art to advance the Technology Readiness Level in one or more of these technology areas by delivering designs and physical prototypes that demonstrate enhanced performance in one or more of the areas above. The awardee will coordinate with the Department of the Air Force technical point of contact (TPOC) via regular information exchange meetings and technical reports. The final deliverable will consist of one or more prototypes devices with demonstrated continuous operation at elevated temperature.

**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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**KEYWORDS:** high-temperature electronics; high-temperature memory; nonvolatile memory; Silicon Carbide transistors

AF233-D013 TITLE: Development of New Oxidation Resistant Refractory Alloys for Additively Manufactured (AM) Components

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Space Technology;Advanced 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 program objective is to explore new oxidation resistant refractory alloys that are amenable to additive manufacturing (AM). Developed alloy should be non-coating reliant to function at elevated temperatures. Alloy should have a depressed ductile to brittle transition temperature and exhibit some ductility at room temperature. This effort will assess the integration and performance of novel oxidation resistant refractory alloy, address the limitations of the alloy and consider (but not develop) possible protective coating solutions.

DESCRIPTION: Refractory alloys are being explored for advanced aerospace applications where material requirements exceed the capabilities of Nickel superalloys. In this realm, the emergence of Additive Manufactured (AM) refractory alloys has provided an innovative approach that enables complex geometries and/or graded microstructures for alloys that exhibit superior performance, but have been historically difficult to process and susceptible to oxidation. However, in all cases, refractory alloys require environmental coatings for protection to prevent chemical and structural degradation. The coating process for refractory alloys is very resource intensive and failure of this coating could cause failure of the part. Thus, an alloy that forms a passive or slowly progressing oxide layer is desired for structural material applications. The envisioned program will explore this application space. It is recommended that the selected small business will partner with relevant alloy/coating/component Original Equipment Manufacturers, as needed, to select and produce the required material stock. Overall, this Phase II effort will 1) investigate novel, oxidation, refractory alloys that can be produced via AM, 2) Consider which AM effort will best construct the material 3) Consider a quantifiable metric to assess any novel alloys 4) Consider what coating systems may be possible for the novel alloy.

PHASE I: This topic is intended for technology proven ready to move directly into Phase II. Therefore, a Phase I award is not required. The applicant 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. The applicant should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Phase I type efforts include 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 Air Force customer.

PHASE II: Eligibility for D2P2 is predicated 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, product, or process in order to conduct a small number of relevant 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. This program will require a team approach with several disciplines. [1] Material modelers that can use advance methods to assess candidate refractory coating and substrate combinations such they that will have the thermal, physical, mechanical and environmental properties needed to survive operations. [2] Process modelers to build property and life models using different refractory coating and substrate combinations with various architectures to minimize defects and provide uniform distribution of thermal protection. [3] Fabricators to build and deliver a cost effective refractory coating and substrate archetypes. These will have undergone screening methodologies (mechanical and environmental) to determine viability of component in an extreme high temperature environments. [4] The offeror will have to conduct microstructural characterization of refractory coating and substrate pre and post testing. The performance and microstructural data shall be used to validate and inform developed models.

**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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**KEYWORDS:** refractory alloy; oxidation resistant materials; additive manufacturing

AF233-D014 TITLE: Advanced Nano-Composite Radiation Shielding Manufacturing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Quantum Science;Advanced Materials

OBJECTIVE: This topic seeks to mature manufacturing processes for polymer based multi-layer radiation shielding. Ideal projects would improve shield quality and drive down shield cost through increased production, improvements to layer adhesion, efficient use of consumables, and development of a manufacturing process enhancement model capable of shield composition/architecture design, predictive manufacturing processes, and long-term tracking of manufacturing process data.

DESCRIPTION: The Department of the Air Force and the U.S. Space Force needs light weight and thinner radiation shields to protect our space assets from the dangers of radiation on orbit. Today, radiation shielding of electronics in space is primarily accomplished with aluminum slabs or metallic mesh. While inexpensive and easily attainable, this type of shielding adds unnecessary mass and bulk, reducing payload capacity and limiting the adoption of non-rad hardened commercial-off-the-shelf (COTS) electronics. This topic is expected to deliver space-ready, validated multi-layer radiation shields that are lighter weight and thinner than existing alternatives at an affordable cost. This effort should include manufacturing maturation techniques and software to reduce shield cost and improve yields for proliferated space. End of effort should also provide the Air Force with a trusted industrial partner for further development and procurement.

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 and/or defense potential. The applicant must demonstrate that a prototype composite radiation shielding manufacturing capability already exists or provide a modeling capability to support design of composite radiation shields based upon environmental requirements. 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; describe 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/STTR Programs. Under the phase II effort, the offeror shall sufficiently develop the modeling capability for design of composite radiation shields, and modeling capability for predictive and data tracking of manufacturing processes, and/or the offeror must demonstrate new manufacturing processes and demonstrate increased production rates. Phase II efforts shall conduct analysis, further Modeling & Simulation optimization and experimentation on developed products to determine efficacy and address military requirements. Specific attention shall be paid to manufacturing readiness, preliminary costing, and Air Force logistical considerations. 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: Phase III or phase II enhancements shall include upgrades to the manufacturing process, further Modeling & Simulation test and evaluation results, and provide delivery of concepts. Phase IIE and Phase III shall provide a business and manufacturing plan including cost and further ruggedization if needed. Delivery of high-rate production is desired along with an improved manufacturing readiness.

**REFERENCES:**

1. More, C.V., Alsayed, Z., Badawi, M.S. et al. Polymeric composite materials for radiation shielding: a review. *Environ Chem Lett* 19, 2057–2090 (2021).
2. <https://doi.org/10.1007/s10311-021-01189-9>

**KEYWORDS:** nano-composite; radiation shielding; high-energy particles; electromagnetic; heavy-ions; manufacturing

AF233-D015

TITLE:

Manufacturing of Nitrogen Vacant (NV) Diamond Substrates for Quantum Sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

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 Manufacturing of Nitrogen Vacancy (NV) Diamond Substrates for Quantum Sensors program will scale-up growth manufacturing techniques that achieve the crystal properties required to enable the subsequent growth of high quality quantum defect containing epitaxial films. To enable various quantum technologies, the following properties must be achieved on a free-standing crystal. Specifically, the offeror will demonstrate a crystal with dimensions no less than 5x5x0.5 millimeters, with strain less than 0.5 parts per million at any point on the crystal measured with 10 micron spatial resolution, a nitrogen doping level less than 5 parts per billion, and a crystal warp less than 5 micron across the 5x5 millimeter surface. High yield and throughput approaches are desired, with an objective yield of 6 substrates per reactor per week, which will likely require parallelization due to anticipated growth times. As an example, high quality microwave plasma chemical vapor deposition (MPCVD) growth has been demonstrated to achieve low strain and low background doping density when grown on a high quality high pressure high temperature (HPHT) seed crystal [1]. Growth conditions were optimized to enable a free-standing film with crystal strain less than 0.1 parts per million, which is in line with the strain requirements. For proposed effort that require a seed crystal, it is essential to demonstrate vertical integration with a goal of 5% of grown substrates being of sufficient quality to use as a new master seed. Alternatively, high pressure-high temperature (HPHT) techniques have been used by foreign commercial suppliers to grow substrates with negligible stress and parts per billion-level unintentional dopants, domestic investments in mature HPHT techniques is a feasible and viable technique [2].

**DESCRIPTION:** There is a strong demand for the commercial supply of diamond with consistent and controllable properties for scientific applications. Diamond is an ultra-wide bandgap material that has the ability to host quantum defects, including nitrogen vacancies (NV), silicon vacancies (SiV) along with many other defects that enable quantum sensing and entanglement-based techniques. The majority of quantum systems depend on defect containing thin films that are epitaxially grown on single crystal diamond substrates, where the strain in the substrate crystal propagates into the epitaxial film containing the quantum emitters resulting in resonance broadening that degrades system performance. As a result it is essential that the supply of high quality, low strain, low background doping single crystal diamonds that can be reliably and consistently sourced. Currently the development of diamond based quantum materials is being limited by the inconsistent availability and quality of materials, this has limited both academic development as well as the commercialization of diamond quantum-defect related systems and sensors.

**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. The offeror should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Phase I type efforts would include demonstration of the capability to grow a crystal with dimensions no less

than 5x5x0.5 millimeters, with strain less than 1.5 parts per million at any point on the crystal, nitrogen doping level less than 5 parts per billion.

PHASE II: Eligibility for D2P2 is predicated on the offeror having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. These efforts will include demonstration of nitrogen vacant (NV) diamond substrate growth with dimensions no less than 5x5x0.5 millimeters with the crystal properties required to enable the subsequent growth of high quality quantum defect containing epitaxial films. Under the phase II effort, the offeror shall sufficiently scale-up the aforementioned growth process to yield a minimum of six substrates per reactor per week, which will likely require parallelization due to anticipated growth times. The offeror shall also demonstrate vertical integration and the regeneration of new master seed crystals. A minimum of 5% of grown substrates should be of sufficient quality to use as new master seed material. Specific attention shall be paid to manufacturing readiness levels (MRL), with an objective of MRL 6.

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. Focus should be on transitioning the nitrogen vacant (NV) diamond substrates for use in vector magnetometers.

#### REFERENCES:

1. Polyakov, S. N. et al. Large-Sized X-ray Optics Quality Chemical Vapor Deposition Diamond. *physica status solidi (RRL) – Rapid Research Letters* 16, 2200164 (2022).
2. Diggle, P. L. et al. Decoration of growth sector boundaries with nitrogen vacancy centers in as-grown single crystal high-pressure high-temperature synthetic diamond. *Phys. Rev. Mater.* 4, 093402 (2020).

KEYWORDS: Quantum; diamond; nitrogen-vacancy; microwave plasma chemical vapor deposition; high power high pressure; low strain; Optically Detected Magnetic Resonance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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**OBJECTIVE:** The topic seeks to develop a software platform that facilitates the delivery of Technical Data Packages (TDPs) with the necessary Product Manufacturing Information (PMI), including inspection and machine controller data, using neutral data exchange standards to provide a complete as-built assembly model. The envisioned platform will provide traceability throughout the manufacturing process (from design through final inspection), while maintaining a linked single fit-for-purpose Authoritative Source of Truth (ASoT) geometric model. The underlying models are expected to be agnostic of commercial computer-aided engineering platforms; i.e., the models should leverage open data formats.

**DESCRIPTION:** The Department of Air Force (DAF) is exploring new capabilities for obtaining accurate digital representations of their acquired weapon systems. In the current DAF acquisition practice, idealized computer-aided design (CAD) models are shared as part of the required technical data package (TDP) delivery. However, as with the complexity of any DAF asset, an “as-designed” model of an aircraft will not match the delivered physical asset. In other words, sustainment depots, original equipment manufacturers (OEMs), and other stakeholders, cannot rely on geometry and topology values defined in as-designed models for operational and sustainment activities. In short, geometric deviations naturally occurring across a distributed production system significantly impact overall acquisition costs, including assembly challenges, component re-work, and significant human labor. This goal of this effort is to demonstrate the utility of emerging industrial data standards for (1) efficiently curating manufacturing data from machine controllers and inspection activities, (2) exporting native as-designed or CAD models into a neutral, open data representation with limited loss of information, and (3) spatially relating the aforementioned manufacturing data and other relevant Product Manufacturing Information (PMI) to the as-designed model. Outcome of this effort will produce an as-built model per aircraft tail number that could be used as a more indicative TDP for DAF stakeholders. The effort is expected to leverage existing DAF partnerships with OEMs that own the native CAD models. End of effort should also provide the Air Force with a “template” that could be used across other DAF acquisitions.

**PHASE I:** This topic is intended for technology proven ready to move directly into Phase II. Therefore, a Phase I award is not required. The applicant 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. The applicant should have defined a clear, immediately actionable plan with the proposed solution and the AF customer. Phase I type efforts include conceptualizing a data model that systematically links open data standards to realize an as-built model with PMI, such as dimensional data. Phase I type efforts would also include reporting on the readiness of the DAF partners, such as aircraft OEMs, in producing well-constructed neutral, open as-designed models.

**PHASE II:** Eligibility for a Direct to Phase Two (D2P2) is predicated on the applicant having performed a “Phase I-like” effort predominantly separate from the SBIR Programs. Under the Phase II effort, the



applicant shall sufficiently develop the technical approach via a demonstration in a small number of use cases and appropriate documentation. 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. 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:** A Phase III or Phase II enhancement should include upgrades to the software platform, further test and evaluation results, and provide delivery of system concepts. Phase III could also include additional model healing and other related efforts on OEM-specific data. Delivery of a field ready system for deployment for testing purposes is desired, as well as a high technology readiness, enabling further procurement.

**REFERENCES:**

1. AFRL-2022-5873 [08 DEC 2022];
2. International Journal of Production Research: Defining requirements for integrating information between design, manufacturing, and inspection [2022, VOL. 60, NO. 11, 3339–3359]

**KEYWORDS:** Technical Data Package; As-Built Digital Twin; Quality Informaiton Framework; Neutral Engineering Data Exchange Standards

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Hypersonics;Space Technology

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OBJECTIVE: Develop a new type of laser designation pulse code, or other technology, to significantly improve the countermeasure resiliency of laser guided weapons while providing benefits to performance and logistical employment.

DESCRIPTION: Semi-active laser guided weapons have been in use for decades. Commonly, these weapons lock-on to an encoded laser designator to allow deconfliction between multiple munitions and multiple designators, as well as to provide resiliency against countermeasures. Two type of pulse codes, existing in the open literature, include pulse repetition frequency (PRF) and pulse interval modulation (PIM). PRF codes have a consistent interval between each pulse. PIM codes have a varying interval between each pulse. Due to the sensitivity of this topic, details about the current employment of laser pulse codes, beyond a certain point, cannot be shared openly in this topic. However, some materials are available in the open domain covering these techniques. Countermeasures, especially from sophisticated adversaries, can significantly degrade the performance of semi-active laser seekers. As these codes are decades old, it is likely that there is significant risk in using these codes against near-peer adversaries. The Air Force is seeking new concepts that will provide robust defense against active laser countermeasures often referred to as “spoofing.” This topic is not intended to address destructive directed-energy countermeasures.

An ideal code will have the following attributes:

- 1) Despite being measured by an adversary in real-time, the munition will not lose track on the original code.
- 2) The code does not result in any performance loss (range, lock-on time, etc) compared to simple code options. Ideally results in performance benefits compared to baseline alternatives.
- 3) The code does not require cumbersome logistics for employment, such as robust communications between laser designator operator and weapon platform or regular updates in the field.
- 4) The code will be backwards compatible with other common codes and will not require munition or laser modifications to switch between codes.
- 5) The code will primarily require software modifications. Ideally involves zero hardware modifications, or limited/simple hardware modifications.
- 6) Mathematical efficiencies within the code generation and decode process such that the code generation is simple, yet the code decomposition is complex.

In addition to this understood need, the Air Force will also consider other approaches, which may not be well-understood, for laser designators or seekers that may provide high-value benefits in terms of performance or counter-measure resiliency for SAL seekers. These approaches should be limited to a single sub-system or component which can be upgraded (hardware or software) to provide a benefit when combined with the other existing sub-systems in inventory. Approaches requiring a complete overhaul of

existing infrastructure will not be considered. Proposers should consider partnerships with manufacturers of SAL seekers, and clearly articulate a strategy for acquiring appropriate hardware and demonstration of algorithm improvements on that hardware (ideally in a shoot-out comparison with currently fielded hardware). Following successful laboratory demonstration, laser ranges will be available at Eglin AFB, FL for field testing.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Prior work expected to be completed in a "Phase-I type" effort, in order to qualify for this D2P2, requires demonstrated feasibility which should include work and results in the following areas:

- 1) Complete analysis of multiple laser encoding scheme options, to including software modeling & simulation with objective mathematical metrics to assess benefits and risks. Subjective benefits and risks, such as human factors which may affect user-adoption, will also be relevant.
- 2) Down-selection of theoretical laser encoding scheme, with objective mathematical and modeling results which demonstrate practical feasibility for future hardware development, to include laser repetition rate, pulse width, or any other factors that may affect compatibility with fielded or next-generation laser designators, such as duty cycle or other power limitations. Seeker processing limitations should also be considered and characterized, at least at a basic fundamental level.
- 3) While not required, an excellent proposal may include results from prior work which involves physical laboratory testing. Any data which objectively proves agreement between computer modeled and laboratory measured data would be the strongest form of established feasibility.

PHASE II: Develop a system design and produce a prototype capable of demonstrating functionality and benefits. 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 update fielded munitions. There are a wide variety of fielded munitions using SAL guidance that this technology will directly apply to.

#### REFERENCES:

1. Patent US 7,767,945, "Absolute time encoded semi-active laser designation," Raytheon Company, Darin S. Williams, Aug. 3, 2010.;
2. Patent US 5,023,888, "Pulse code recognition method and system," Martin Marietta Corporation, Thomas E. Bayston, Jun. 11, 1991.

KEYWORDS: semi-active laser seeker; laserr designator; infrared seeker; laser pulse code; missile guidance; laser countermeasure

AF233-D018

TITLE:

Conformal Forward Looking Multi-Aperture Seeker for High Speed EO/IR Demonstrator

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Hypersonics

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:** Build a prototype EO/IR multi-aperture seeker that can actively mitigate thermal loading associated with Mach 5+ flight while viewing forward through a hot nose cone. Innovative solutions are desired that can target surface and airborne objects without blind spots in the field of view.

**DESCRIPTION:** Hypersonic vehicles generate excessive aerodynamic heating from friction and shear forces at the boundary layer between the nose cone and the free stream air. The resulting convective and radiative heat-flux into the nose cone and viewing windows can elevate the temperature of those components beyond 800C, making window survival and forward viewing a formidable challenge. Multi-aperture imagers based on biological principles can distribute the entrance aperture across an array of small windows for which thermal stresses and gradients can be reduced significantly using active cooling. Cooling not only improves window survival, it also reduces thermal background noise, thereby enhancing target detection sensitivity. Innovative concepts are sought that take advantage of the design features of biologically inspired, multi-aperture technologies to demonstrate operational capability in high-speed regimes. The desired concept will be conformal to the nose cone to minimize aerodynamic heating and will be capable of viewing forward without blind spots obscuring any portion of the field of view. The optical image is to be captured on a middle wavelength infrared (MWIR) focal plane array (FPA), which will be cryo-cooled to increase its detection sensitivity. The optical system must be designed to have its exit pupil positioned at the cold shield aperture of the cryo-cooled MWIR FPA.

**PHASE I: UPDATE:** The technical work that would need to have been completed prior to the proposal being submitted in order for the applicants to demonstrate the necessary feasibility to move directly into Phase II are:

- A complete optical design for a multi-aperture infrared sensor intended for high-speed forward looking seeker applications.
- A complete thermal management design of an actively cooled infrared window with components that can survive beyond 800 C.
- Benchtop testing of components or sub-systems to demonstrate the design as a proof-of-concept. Therefore, if an optical design and thermal management design have already been completed and components have been demonstrated at a benchtop level, then the Phase I requirements have been met; and Phase II shall build a complete prototype and test in a relevant environment.

As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Phase I shall consist of a vetted optical design for a MWIR multi-aperture sensor and thermal management design of an actively cooled MWIR window. These designs shall be intended for high-speed forward looking seeker applications with components that can survive beyond 800 C. Furthermore, benchtop testing of components or sub-systems shall be performed to demonstrate the

design as a proof-of-concept. AFRL/RWTSE has verified that these milestones have been met and a Direct-to-Phase II is required to mature the technology.

PHASE II: Implement, integrate and demonstrate hardware. Execute an experimental program using the prototype hardware to demonstrate performance capabilities and limitations. Document the prototype experimental results in preparation for a demonstration flight experiment.

PHASE III DUAL USE APPLICATIONS: Possible teaming with Lockheed Martin, using matching funds through AFWERX STRATFI program.

#### REFERENCES:

1. W. Tروف, M. Thomas, T. Harris, S. Lutz, "Performance of Optical Sensors in Hypersonic Flight," Johns Hopkins APL Technical Digest, Volume 8, Number 4 (1987);
2. D. Kalin, S. Mullins, L. Couch, T. Blackwell, D. Saylor, "Experimental investigation of high velocity mixing/shear layer aero-optic effects," SPIE Vol. 1326 Window and Dome Technologies and Materials II (1990);
3. L. Brooks, D. Kalin, B. Peters, "Experimentally simulated aero-optic measurements through multi-aperture windows," SPIE Vol. 1760 Window and Dome Technologies and Materials III (1992);
4. D. Kalin, L. Brooks, C. Wojciechowski, G. Jones, "Performance characterization of an internally cooled window in a nonuniform high heat flux environment," SPIE Vol. 3060 Window and Dome Technologies and Materials V (1997);
5. D. Harris, "Materials for Infrared Windows and Domes – Properties and Performance," SPIE Press, 1999, ISBN 0-8194-3482-5;
6. F. Reininger, "Multihybrid artificial compound eye with varied ommatidia," U.S. Patent No. 8,576,489. 5 Nov. 2013;

KEYWORDS: MWIR Imaging; Multi-Aperture; Biologically Inspired; Hypersonic; Aero Thermal Response; Cooling

AF233-D019

TITLE: **Hardened Scalar and Vector Magnetometer Development**

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber;Trusted AI and Autonomy;Integrated Network System-of-Systems

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**OBJECTIVE:** Develop an environmentally hardened sensor package to provide magnetic navigation aiding on manned, unmanned, and weapon systems. Hardware should be appropriate for high vibration, low and high temperatures and altitudes while providing high-rate, accurate, and accurately timestamped magnetic measurements

**DESCRIPTION:** Navigation in contested environments is a critical capability for the Air Force and DoD. More flight systems are beginning to employ non-GPS navigation aiding to increase system robustness in contested environments [1]. This effort seeks to develop or modify magnetometer sensor payloads in support of modular, service-based GPS-denied navigation capabilities. Hardware should provide a highly accurate measurement of the magnitude of the magnetic field (i.e. a scalar measurement) at a rate of 100Hz or higher (ideally 1000Hz), regardless of the orientation of the magnetic field relative to the hardware. The standard deviation of the scalar magnetic measurement error should be below 5nT, with 1-2nT preferred and should not experience prolonged measurement drop-outs. This may require multiple sensor heads, or any other approach that delivers consistent, high-rate measurements. However, output of the measurements of each individual head is desired. The system should also provide a measurement of the magnetic field vector at a rate of 25Hz or higher. The standard deviation of the measurement error in each axis of the magnetic vector sensor should be less than 100nT, with better than 25nT preferred. If the vector sensor can meet the scalar sensor requirement, i.e., the three measurements combined to meet the scalar specifications, no scalar sensor would be required [2]. Sensitivity of the magnetic sensors to environmental factors (e.g. temperature, pressure, humidity) should be well understood (and possibly compensated), and additional sensors to measure any relevant quantities that could affect the magnetic measurements should be considered in the development of the hardware package, e.g., a system temperature sensor or multiple sensors in the case higher resolution is necessary. Hardware solutions should target a small size, weight, and power (SWaP). The sensor package and necessary drivers/processors should target 12 cubic inches. Sensor development may target larger SWaP values if needed, however proposals meeting SWaP goals will be prioritized and proposals with larger SWaP goals must include a clear path to a reduced footprint. The system should accept a 1 pulse per second (PPS) time source to drive timestamping. When an external 1PPS is not provided, the hardware package should still maintain accurate relative time stamping between each individual sensor. Sensor and drivers/processors can be collocated or packaged separately. Any necessary cabling should be highly flexible, appropriate for varied lengths, and provide shielding to the sensor data transmitted. All external messaging to and from the sensor package will be based on the All-Source Positioning and Navigation (ASPN) 3.1 or higher ICDs wherever feasible. Relevant ASPN ICD information will be provided upon request.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by

means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. A successful "Phase I-type" effort will constitute the development of a hardware system bread-board level prototype demonstrating real-time, time-stamped magnetic scalar (possibly x2), vector, and temperature measurements UPDATE: A successful phase I effort will constitute the design of a hardware system bread-board level prototype demonstrating real-time, time-stamped magnetic scalar (possibly x2), vector, and temperature measurements.

PHASE II: A successful phase II effort will constitute the development of a hardware system and testing of real-time, time-stamped magnetic scalar (possibly x2), vector, and temperature measurements. Hardware development efforts will produce prototype hardware systems appropriate for flight environments, lab vibration, temperature, and altitude testing, and demonstrate data acquisition on AFRL-lead flights.

PHASE III DUAL USE APPLICATIONS: Phase III will consist of a) transitioning prototype sensor hardware to an operationally approved ASPN compliant navigation system on an operational UAV or weapon system and/or b) scaling production beyond 1-5 units to show MRL/repeatability.

#### REFERENCES:

1. A. Canciani and J. Raquet, "Airborne Magnetic Anomaly Navigation," in IEEE Transactions on Aerospace and Electronic Systems, vol. 53, no. 1, pp. 67-80, Feb. 2017, doi: 10.1109/TAES.2017.2649238;
2. A. J. Canciani and C. J. Brennan, "An Analysis of the Benefits and Difficulties of Aerial Magnetic Vector Navigation," in IEEE Transactions on Aerospace and Electronic Systems, vol. 56, no. 6, pp. 4161-4176, Dec. 2020, doi: 10.1109/TAES.2020.2987475.

KEYWORDS: Magnetometer; Navigation; GPS-denied; GPS-Degraded; Open Architecture; ASPN, Modular

AF233-D020

TITLE:

Real-time Sensor Fusion ATA in Golden Horde Colosseum

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces;Integrated Network System-of-Systems;Integrated Sensing and Cyber;Advanced Computing and Software;Trusted AI and Autonomy

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**OBJECTIVE:** The objective is to expand the current vanguard modeling, simulation, and analysis (MS&A) ecosystem (Golden Horde Colosseum [GHC]) to include the ability to simulate swarming-munition fusion-based automatic target acquisition (ATA) capabilities. This will support digital engineering approaches to solving long standoff and denial and deception ATA challenges. The proposed research should explore approaches for bringing physics-based sensing and sensor fusion into the M&S environment that uses AFSIM for exercising battlespace scenarios. It will also help to establish fusion architectures that support collaborative ATA. The Golden Horde Colosseum Capability is a Multi-Tier Digital Weapon Ecosystem, consisting of a high fidelity, government owned, open architected live, virtual and constructive (LVC) development pipeline for networked collaborative autonomy (NCA) technology and tactics. The Colosseum enables accelerated delivery, evaluation, and verification of NCA weapon technologies across numerous AFSIM-based scenarios. Expanding this environment to include the fusion of a diverse mix of sensors and data sources for ATA is critical to the development of future systems. The GHC ecosystem would be expanded to include target identification and tracking in real-time based on a myriad of inputs. The inputs would include sensor measurements assigned to the weapons, as well as inputs from prior intelligence, surveillance, and reconnaissance (ISR) and contextual inference of the local terrain. This effort will require advanced algorithmic R&D to bring the reality of the physical world to a high-level simulation environment. It must also develop a collaborative architecture that can maintain real-time or faster than real-time processing. These competing goals of increased fidelity and reduced computational load will require AI/ML hardware-aware algorithms, efficient protocols, and software development. There are two complementary scenarios – long distance standoff that requires evolving in-route ATA and closer distance target specific ATA that addresses denial, deception, and other challenges to developing exquisite target state estimates (TSEs). Thus, both the architecture and simulation tools must support the exploitation of multiple categories of information. This means that background databases – including terrain, structures, and roads – as well as live measurement simulations must be simultaneously simulated. A stretch objective would be to support contextual inference and a priori information into the process. For instance, fusion algorithms need to be able to leverage terrain-based insights such as when a possible detection of a wheeled vehicle occurs in a tree-filled ravine where it could not operate. Other examples include a priori information from ISR assets or human insights such as sightings of a convoy of tanks in a general area of regard (AoR). The proposed research must enable and even foster the future development of these sophisticated data fusion algorithms. Note that this proposed work is meant to enable, encourage, and evaluate sensor fusion R&D, but it does not include fusion R&D efforts. Relevant sensor and data fusion R&D is being executed under complementary programs.



DESCRIPTION: In order to support Global Precision Strike capabilities using Networked Collaborative Autonomous (NCA) systems, there is a great need for simulation of the highly complex battlespace and ATA challenges, as well as the need for orders of magnitude increases in synthetically generated physical sensor-based outputs for Fusion R&D. The GHC ecosystem and AFSIM provide a great way to simulate both battlefield level scenarios and target specific engagements. To date, this ecosystem has focused on fleet management, probability of kill assessments, and other swarm guidance and control factors. The proposed effort would expand GHC/AFSIM to include real-time target identification (i.e., ATA) along with other target engagement support. This is the natural next step in advancing the state-of-the-art in NCA weapon engagements. The effort would involve R&D aimed at ray-tracing or alternate methods that balance high-fidelity and reasonable compute loads to represent physical entities as part of scene generation simulation. It would also require the ability to represent emerging AI/ML methods for converting those physical entities into sensor outputs. Further, it would require completing the signal exploitation pipeline by introducing efficient methods for fusing context, data, features, and/or low confidence TSEs to produce actionable target engagements. Finally, it would need to include the data sharing architecture that supports precise time, precise location, and multi-tiered information fusion. The topic of Contextual Information overlaps both Information Fusion and Machine Learning and has received increasing amounts of attention in the past few years. There are multiple kinds of contextual information (hard, soft, low-level, high-level) and determining how much context to include in a given mission requires system knowledge such as local compute resources, and communication bandwidths. The proposed work should enable research in this area by providing data and analysis of alternatives, but the development of that research area would be funded separately. The result would be both the ability to generate the much-needed orders of magnitude increase in synthetically generated data and the ability to assess fusion-based ATA approaches in a rich ecosystem. It would utilize the Golden Horde Autonomy Architecture (GHAA) for data sharing between platforms. The inclusion of GHAA would help flesh out an emerging de facto standard for sharing TSE-related data in real time between cooperating munitions. Golden Horde Autonomy Architecture establishes a Government-owned autonomy architecture to provide vendors/users with a set weapon autonomy architecture to which they can develop specific algorithms/plays/behaviors. The autonomy architecture is open and Future Airborne Capability Environment (FACE) compliant and capable of running SWAP constrained weapon hardware. The architecture also provides the direct interface to simulated weapons to rapidly test the new algorithms, plays, and/or behaviors in the Colosseum.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. In order to demonstrate the feasibility of research completion, the applicant must have experience doing development inside of the AFSim environment, as well as experience working with live virtual and constructive Modeling and Simulation (M&S) environments such as Golden Horde Colosseum (GHC). Additionally, to better understand the communication and physical simulation requirements posed by physical simulation of ATR algorithms in AFSim, the selected vendor must have experience either with automatic target recognition/acquisition or similar research. Investigate approaches 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. Conceptualize, develop, and model an algorithmic solution that provides near real-time collaborative ATA for heterogeneous sensors.

PHASE II: In this direct to Phase II SBIR, there would be a heavy combination of algorithm focused R&D and efficient coding practices, with the encouragement of utilizing model-based design (MBD) methods. First a significant effort would be undertaken to determine how best to represent physical targets in a large-scale MS&A ecosystem. Approaches such as raytracing are often too computational demanding, although some of these methods utilize GPU hardware to overcome this. Other

representations include point clouds, statistical models, and even some AI-based methods. Early efforts would focus on determining the best approach for each phenomenology (EO, IR, or RF). Dovetailing with those efforts would be AI/ML and other approaches for transforming the physical representations into features that represent both canonical and specialized sensor technologies. Finally, a baseline fusion algorithm would be leveraged from other programs to complete the pipeline from the I/Q or pixel level data provided by scene generation tools into target state estimates. This completely integrated system would then enable future Sensor Fusion R&D competitors to supply their own fusion algorithms that drop in place in lieu of the placeholder fusion software object or container. In addition to establishing the ATA sensor processing pipeline within GHC, there is a complementary requirement to advance the fusion architecture (GHAA) alongside this research. The architecture will provide the necessary infrastructure for assessing future sensor exploitation and fusion algorithms in the MS&A environment. Specifically, protocols such as peer-to-peer networking, precision navigation and timing (PNT) support, and data coordination methods must be developed in order to support fusion R&D that is operationally relevant. The GHC assessments would need to score competing fusion ATA approaches based on the following metrics: 1) Accuracy of classification (Pid) 2) Time to classification (secs or epochs) 3) CPU utilization (flops) 4) Memory requirements (RAM) 5) Comms requirements (kbps)

**PHASE III DUAL USE APPLICATIONS:** Other potential PH III military and commercial applications of this technology include advances made towards fusing automatic targeting information across other distributed airborne platforms, such as ISR; and advances made towards fusing object classification and identification information across heterogeneous sensors onboard an autonomous or semi-autonomous automobile.

#### REFERENCES:

1. De Villiers, J.P., Pavlin, G., Joussetme, A.L., Maskell, S., de Waal, A., Laskey, K., Blasch, E. and Costa, P., 2018. Uncertainty representation and evaluation for modeling and decision-making in information fusion. *Journal for Advances in Information Fusion*, 13(2), pp.198-215;
2. Snidaro, L., Garcia-Herrera, J., Llinas, J. and Blasch, E., 2016. Context-enhanced information fusion. *Boosting Real-World Performance with Domain Knowledge.*;
3. Mahalanobis A, Van Nevel A. Integrated approach for automatic target recognition using a network of collaborative sensors. *Appl Opt.* 2006 Oct 1;45(28):7365-74. doi: 10.1364/ao.45.007365. PMID: 16983426;
4. Rao, Nageswara SV, David B. Reister, and Jacob Barhen. "Information fusion methods based on physical laws." *IEEE transactions on pattern analysis and machine intelligence* 27, no. 1 (2005): 66-77.;
5. M. Robinson, J. Henrich, C. Capraro and P. Zulch, "Dynamic sensor fusion using local topology," 2018 IEEE Aerospace Conference, 2018, pp. 1-7, doi: 10.1109/AERO.2018.8396546.

**KEYWORDS:** Sensor Fusion; Networked Collaborative Autonomy; Automated Target Acquisition; Scene Generation; Digital Engineering; Modeling Simulation and Analysis;

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

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 an affordable and scalable subscription-based, real-time UAS tracking information system to provide authorized DoD end users with tailorable data feeds (UAS identity, location, and altitude) to meet DoD security and operational needs.

**DESCRIPTION:** The United States (U.S.) Department of Defense (DoD) is responsible for ensuring the safety, security, and protection of DoD personnel, facilities, and assets from various threats or hazards, including certain UAS operating in the National Airspace System (NAS). Given the increasing adoption of UAS for various legitimate purposes (recreation, commerce) and the potential for malicious actor use, DoD has a need to detect, track, and identify UAS operating in proximity to certain DoD facilities and assets in the U.S., pursuant to all applicable federal, state, and local laws and regulations. In the U.S., outside of certain DoD facilities, UAS tracking, unlike tracking of manned aircraft, is nearly non-existent, which introduces new risks to the safety, security, and protection of DoD personnel, facilities, and assets. As the Federal Aviation Administration (FAA) pushes out direction on how to integrate UAS into the NAS—including the remote identification of unmanned aircraft—there is an anticipated need for geographically scalable, filterable, and affordable commercial hardware and software solutions for UAS tracking, fusion, and data integration of existing and future DoD information systems. This approach would allow for widespread coverage and need-based service and cost levels to address DoD's dynamic current and future needs. Acceptable proposals may consider novel or efficient methods for detecting, tracking, and identifying UAS (compliant and/or non-compliant with applicable FAA rules and regulations); fusing, moving and storing data; and secure ways for providing data, in real-time, to authorized DoD entities with responsibility to ensure the safety, security, and protection of DoD personnel, facilities, and assets. In particular, proposals shall address how data feeds will be tailored or filtered to only include data (UAS location, altitude, identity) associated with certain UAS operations in the NAS (e.g., UAS operating in proximity to DoD covered facilities and assets pursuant to section 130i, Title 10, U.S. Code). Additionally, proposed solutions shall demonstrate compatibility with current and future FAA remote identification standards and rules, and the ability to integrate with existing and future DoD information systems.

**PHASE I:** 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 UAS sensors providing coverage in proximity to DoD equities located throughout the U.S. (pursuant to all applicable federal, state, and local laws and regulations); ii. Hardware or software guardrails to ensure data feeds are tailored or filtered to only include authorized DoD user needs; iii. Scalability and affordability curves for notional adoption and subscriptions; iv. Sensor to Database and Database to User Security plans; v. User Data consumption technical approach; and vi. Open architecture approach to support adaptability and integration with other systems. vii. Integration with at least one DoD information system.

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.

REFERENCES:

1. FAA, "Concept of Operations v2.0", <https://www.faa.gov/researchdevelopment/trafficmanagement/utm-concept-operations-version-20-utm-conops-v20>
2. FAA, <https://www.faa.gov/uas>

KEYWORDS: UAS activity, Drone, Remote ID, RF, Signal Detection, Radar Detection, Data Fusion, Data Management, Cloud data,

AF233-D022

TITLE: Austere Cargo Offload and Onload System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Advanced Computing and Software

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 capable of working with the 463L Pallet Cargo Handling System to offload and onload cargo pallets from aircraft in austere and standard environments.

DESCRIPTION: Numerous government and private industry groups have experienced the challenges of material handling in an austere environment where normal methods, supported by local infrastructure, are sparse or non-existent. Current technology designed to be supported by local infrastructure does not translate well to austere environments for a multitude of reasons. Austere environments can be expected to include non-paved surfaces, rolling terrain, poor access to local material handling equipment, poor access to local energy sources including suitable fuel, and tight access to airfields and aprons. Furthermore, existing onload/offload equipment is large and heavy, prohibiting transport with the cargo. In a future fight, it is expected cargo aircraft like C-130s and C-17s will have to increasingly rely on austere bases that are smaller and lack modern aerial port amenities. In order to align with operational imperative 5 (see Reference 1), resilient basing, a system needs to be developed that allows for easy offload and onload of cargo in the 463L Pallet Cargo Handling System (see Reference 2) on C-130s and C-17s. Current systems like modern forklifts are too large and heavy to bring in with the cargo, and too expensive and vulnerable to stage ahead of time or leave behind at these remote, unserved airfields. In addition, the system to be developed needs to be transported with the incoming cargo aircraft. The maximum allowable physical size of the system should be limited to the capabilities of a single standard 463L pallet position.

PHASE I: 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 a new method or system to offload and onload cargo from aircraft that utilize the 463L Pallet Cargo Handling System that will work in austere locations. i. Develop and demonstrate a method or system, comprised of one or more pieces of equipment, that is capable of handling a 10,000 lbs ISU 90 standard container ii. Develop and demonstrate a method or system that can transport a 10,000 lbs ISU 90 standard container from the cargo bay of the aircraft 500 ft away from the flightline iii. The

method or system should be designed to function in an austere environment that could include, but is not limited to salt fog, packed dirt runways and aprons, lack of other common support equipment, and sparse fuel and electrical power availability iv. Develop matrix of operational tradeoffs relating to employing the new system v. Generate Interface Control Document (ICD) and overview descriptions in parallel with the system development. vi. System needs to be deployable with the inbound cargo aircraft, weigh less than 10,000 pounds and fit, in the transport configuration, onto a 463L pallet position or smaller. vii. System needs to be rapid deployable and ready to offload or onload cargo with 10 minutes of the plane coming to a stop and lowering the ramp. Complete the design of the system, demonstrate performance of a prototype system through field 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 airfield operations and cargo delivery, but offer options for weapons loading and other aerial port operations in both austere and well-supported locations. Solutions may have application to commercial air cargo operations, warehouse material handling operations, and construction.

**REFERENCES:**

1. Department of the Air Force Operational Imperatives, [https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL\\_IMPARITIVES\\_INFOGRAPHIC.pdf](https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf)
2. J. Schroeder, C. Martinez, G. Galloway; USAF Pallet and Dunnage System Evaluation, 1997 <https://apps.dtic.mil/sti/pdfs/ADA356785.pdf>
3. Management and control of Intermodal Containers and System 463L Equipment, Defense Transportation Regulation – Part VI [https://www.ustranscom.mil/dtr/part-vi/dtr\\_part\\_vi\\_608.pdf](https://www.ustranscom.mil/dtr/part-vi/dtr_part_vi_608.pdf)

**KEYWORDS:** Contested Logistics, austere operations, austere environment, aerial port, logistics, cargo handling, forklifts, material handling equipment (MHE), onload, offload, combat offload

AF233-D023

TITLE: TAK Mobile Machine Learning (MML) Model Development

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System-of-Systems

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**OBJECTIVE:** The objective of this topic is to develop and train cutting-edge machine learning models for edge deployment via TAK using the Model Integration Software Toolkit (MISTK) format.

**DESCRIPTION:** Training can be accomplished server-side, but inference must be done on device. TAK-ML, a client and server-side framework for ML development, and NodeDrop, a technology to reduce the size of neural networks without affecting efficacy, are provided to performers. Sample models/algorithms developed in and integrated with TAK-ML are provided (e.g., biometrics, edible plants). Example use cases may include, but are not limited to geolocation, command and control, search and rescue, surveillance, communications, IOT, cloud or intelligence (including open-source intelligence). Use of digital engineering tools to at a minimum define the APIs and where applicable build reference implementations is preferred. Leveraging TAK-ML and StreamlinedML to integrate into the TAK ecosystem is strongly preferred.

**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-like” effort, in this instance demonstrating familiarity and proficiency with applied machine learning, preferably at the tactical edge.

**PHASE II:** As an applied ML topic, Phase II objectives mirror standard machine learning lifecycle steps to include data collection, model architecting and design, implementation either standalone or via registration/integration with provided AFRL toolkits, training, testing, and evaluation at the tactical edge.

**PHASE III DUAL USE APPLICATIONS:** Successful Phase II technology development will be eligible for additional Phase III work, with specific transition paths depending on the domain and problem set selected by the proposer. AFRL will work with the Tactical Assault Kit (TAK) Product Center (TPC) and domain-relevant end-user communities to promote transition of machine learning models that reach sufficient TRL (5-7) and interface well with mobile end-user devices in use by operators in the field.

**REFERENCES:**

1. <https://mistkml.github.io/>; <https://github.com/raytheonbnn/tak-ml>; <https://dl.acm.org/doi/abs/10.1109/MILCOM52596.2021.9652909>;
2. <https://tak.gov/>; <https://civtak.org>

**KEYWORDS:** mobile machine learning; end-user devices; edge computing; machine learning/artificial intelligence; resource constraints

AF233-D024

TITLE: Integration of Machine Learning (ML) Platforms with a Mobile Device Manager (MDM) for the TAK Ecosystem

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

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**OBJECTIVE:** The objective of this topic is to integrate a Mobile Device Manager (MDM) with a machine learning (ML) management infrastructure (StreamlinedML, WingmanAI) to allow the ability to define, compare, evaluate, train, deploy, and update ML Models for use in Mobile Machine Learning (MML) applications which support the TAK ecosystem in a secure, reliable environment for both cloud-based and disconnected environments.

**DESCRIPTION:** The Tactical Assault Kit (TAK) ecosystem currently has no end-to-end means to evaluate, compare, fine tune, and deploy MML to end user devices at scale. The environment should enable the comparison of models (e.g., Model Cards) with onboard inferencing. Provide the ability to scan ML models to check functionality, security, and reliability. Provide enterprise management of a "Marketplace" for ML models within the MDM's "App Store". Support both connected and disconnected environments. Provide the ability to review and version control, models and apps/plugins before analytics are pushed back to the developers on how the models are used. StreamlinedML, a government ML management and TAK-ML, a TAK-oriented ML development framework, are provided to performers. Use of digital engineering tools to at a minimum define the APIs and where applicable build reference implementations is preferred.

**PHASE I:** This topic aims at D2P2 awards with a "Phase I-type" minimum feasibility study that demonstrates experience developing, deploying, orchestrating, integrating and managing the likes of a Tactical Assault Kit (TAK) with a Mobile Device Manager in conjunction with a machine learning (ML) management infrastructure framework that supports the evaluation, comparison, fine tuning and deployment of Mobile Machine Learning to end user devices at scale.

**PHASE II:** The phase II objective of this topic seeks to integrate a Mobile Device Manager (MDM) with a machine learning (ML) management infrastructure (StreamlinedML, WingmanAI) to allow the ability to define, compare, evaluate, train, deploy, and update ML Models for use in Mobile Machine Learning (MML) applications which support the TAK ecosystem in a secure, reliable environment for both cloud-based and disconnected environments. StreamlinedML, a government ML management and TAK-ML, a TAK-oriented ML development framework will be provided to performers. Use of digital engineering tools to at a minimum to define the APIs and where applicable build reference implementations is preferred.

**PHASE III DUAL USE APPLICATIONS:** Successful Phase II technology effort reaching suitable TRL (6-7) will be candidates for additional Phase III development, including potential for transition to the Tactical Assault Kit (TAK) ecosystem in partnership with the TAK Product Center (TPC). In addition, Phase III efforts will focus on delivering the TAK mobile device manager technology with a machine learning (ML) management infrastructure to potentially a broader spectrum or series of diversified



customers for operational use in a relevant commercial/civilian, or government/military working environment.

REFERENCES:

1. <https://tak.gov>;<https://civtak.org>;
2. <https://dl.acm.org/doi/abs/10.1109/MILCOM52596.2021.9652909>;
3. <https://github.com/raytheonbbn/tak-ml>;<https://github.com/mistkml/mistk>

KEYWORDS: mobile machine learning; machine learning model verification; mobile device management; machine-learning marketplace; machine-learning model cards

AF233-D025 TITLE: Improved Data Collection and Knowledge Graphing in the TAK Ecosystem

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;Directed Energy (DE)

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OBJECTIVE: The objective of this topic is to demonstrate a capability to define, capture, organize, label, and reason over the data that is generated by end-user devices and servers in the Tactical Assault Kit (TAK) ecosystem for use by machine learning model development, re-training, fine tuning, and federated learning of existing models, or consumption by AFRL ML tools.

DESCRIPTION: The TAK ecosystem currently has a wealth of sensor data, usage data, and analytics that is under-utilized for artificial intelligence/machine learning (AI/ML). Leverage general-purpose machine learning (ML) tools (StreamlinedML/MISTK, WingmanAI), Android sensor hubs (TAK-ML sensor framework, Foresight and Sensor Manager), and semantic network/knowledge graphing tools (KnowML, FuelAI) to extend the TAK-ML framework. Accept analytics back from any frameworks, models, or plugins developed for further refinement. Use of digital engineering tools to at a minimum define open application programming interfaces (APIs) and where applicable build reference implementations is preferred.

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 experience with extension, modification, or creation of enterprise machine learning life cycle management toolkits for knowledge graphic, data curation, and related machine learning tasks.

PHASE II: Phase II objectives include the development of technologies to collect, reason over, and harness data from the TAK ecosystem for use in machine learning tasks, demonstrating integrations with (and extensions of) AFRL toolkits such as TAK-ML, StreamlinedML/MISTK, and KnowML to apply broader Air Force machine learning development to the tactical edge.

PHASE III DUAL USE APPLICATIONS: Successful Phase II technology effort reaching suitable TRL (6-7) will be candidates for additional Phase III development, including potential for transition to the Tactical Assault Kit (TAK) ecosystem in partnership with the TAK Product Center (TPC) or to other AFRL programs developing next generation AI/ML capabilities.

#### REFERENCES:

1. <https://github.com/raytheonbbn/tak-ml>;
2. <https://dl.acm.org/doi/abs/10.1109/MILCOM52596.2021.9652909>;
3. <https://mistkml.github.io/>;
4. <https://tak.gov>;
5. <https://civtak.org>;

KEYWORDS: semantic web; knowledge graphing; mobile machine learning; end-user devices; data analytics; ATAK

AF233-D026

TITLE: OptiFrame-- Topology Optimized Load-Bearing Airframe with Additive Manufacturing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy;Advanced Computing and Software

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:** This topic seeks to develop a new design and manufacturing paradigm capable of rapidly producing a low-cost, lightweight, full-scale airframe structure for a next-generation aircraft system by combining topology optimization (TO) and additive manufacturing (AM) technologies. The new design tool and printed structure will be evaluated by ground testing, during which the new and baseline structures will be compared based on weight, stiffness, strength, cost, fatigue life, and manufacturing time.

**DESCRIPTION:** The Department of the Air Force is exploring the concept of design for manufacturing to enable agile development and delivery of full-scale airframe structures for next-generation air vehicles. Air Force Research Laboratory (AFRL) is assessing emerging airframe design tools and 3D printing technologies to address rapidly changing warfighter needs more efficiently during airframe design and manufacture. The emergence of new design and manufacturing technologies, such as TO and AM, provides possible solutions to improve the development and delivery of capable airframe structures. First, TO offers design freedom, allowing structures to be designed around load paths rather than constrained to orthogonal rib and spar layouts. Second, AM offers manufacturing freedom, using truly toolless fabrication to manufacture complex geometries without the need for extensive machining. The combination of TO and AM opens the door to new possibilities in the design and manufacture of airframe structures. Current developments in TO and AM technologies have shown the power of TO and AM in addressing design and manufacture at the component scale, but further work is needed to prove the power of TO and AM at the structural scale. For example, TO is widely used to design optimal geometries at the component scale, but the design of a large-scale structure system with TO has yet to be proven. Similarly, AM technologies are available to manufacture parts at the component scale, but the inherent link between the printing footprint of AM machines and maximum producible part size precludes the complete manufacture of full-scale structures. This effort aims to explore a new hybrid way of designing and manufacturing a full-scale, load-bearing airframe structure at a fraction of the time and cost without sacrificing structural capabilities such as weight, stiffness, strength, and fatigue life. The hybrid approach will harness the complementary capabilities of TO and AM in creating an approach that can adapt to fast-changing mission needs. TO will be used to design an airframe structure that is divided into the minimum number of segments, considering the maximum AM print part size. Toolless fabrication capability, enabled by AM, is essential to produce the resulting TO structures efficiently. The entire system should be printed, including the wing skin, and each segment will be printed with novel joint concepts to minimize assembly efforts and the number of parts. The material is not limited to polymer, chopped/continuous fiber, metal, or any combination thereof to build the most weight-efficient structure, but the load-bearing airframe structure should satisfy the stiffness and strength requirements of over a 10,000 lb vehicle. A baseline structure will be provided upon selection of the award. The main deliverable for this topic is a redesigned, full-size, printed airframe structure matching AF's provided baseline structure. The contractor should analyze, design, build, and test to validate the new printed structure and demonstrate that the fabricated structure will be equivalent to or outperform the baseline structure.

PHASE I: As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. The proposer should have already demonstrated a technology to prove the concept at a scaled or component level, including a feasibility study prior to submitting a proposal. 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 applicant should have defined a clear, immediately actionable plan with the proposed solution. Relevant areas of demonstrated experience and success include designing and modeling prototype concepts, concept development, concept demonstration, concept evaluation, and field testing. Phase I-type efforts include the assessment of the structural concept and the potential for 3D printing.

PHASE II: This effort shall conduct analysis, tool development, experimentation, and fabrication of representative full-size prototype systems to address unique requirements that may not be otherwise met by a scaled conventional airframe design and fabrication.

PHASE III DUAL USE APPLICATIONS: Phase III shall include the fabrication of more complex prototypes, such as a full vehicle.

#### REFERENCES:

1. Taylor, Robert & Niakin, Bijan & Lira, Nicholas & Sabine, Gavin & Lee, Joakim & Conklin, Craig & Advirkar, Sangram. (2020). Design Optimization, Fabrication, and Testing of a 3D Printed Aircraft Structure Using Fused Deposition Modeling. 10.2514/6.2020-1924. ;
2. <https://www.ga.com/ga-asi-partners-with-divergent-technologies-inc>;
3. <https://www.forbes.com/sites/ericteglar/2023/04/27/uas-startup-firestorms-ambition-to-crank-out-combat-drones-fast-cheap-and-en-masse-is-a-lesson-for-dod/?sh=168b9f871409>;
4. <https://aviationweek.com/aerospace/advanced-air-mobility/firestorm-flies-modular-3d-printed-small-uas>;

KEYWORDS: topology optimization; additive manufacturing; low-cost UAV; design for manufacturing; ACP; lightweight structure;

AF233-D027

TITLE: GPU Accelerated Large Eddy Simulation for Low Pressure Turbine Design

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Integrated Sensing and Cyber; Integrated Network System-of-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:** To increase the fidelity of turbine aerodynamic predictions performed during the design cycle via the adoption of Large Eddy Simulation techniques that are enabled by Graphical Processing Unit (GPU) architectures to achieve unprecedented turnaround times for the completion of calculations

**DESCRIPTION:** Large Eddy Simulation (LES) represents a substantial increase in the fidelity of viscous modeling used in turbomachinery design. LES is an essential capability for the accurate prediction of flows over Low Pressure Turbine (LPT) airfoils at conditions that are consistent with high-altitude Unmanned Air Systems (UAS). Successful application of LES in the design cycle of an LPT is expected to yield geometries that have unprecedented levels of lift, work, and resistance to flow separation at high altitude conditions. This would lead to substantial reductions in engine weight, length, and cost while at the same time enabling increased engine fuel-efficiency as well as increased range, endurance, and ceiling for an UAS. However, the grid topologies required to obtain accurate LES simulations of LPT flowfields make it impossible to complete such calculations in a timely manner for design purposes. Typically, LES simulation is a research tool used to increase the understanding of turbomachinery flow physics, and it is not currently used in the turbine design cycle at any Original Equipment Manufacturer for jet engines due to the large calculation times required by state-of-the-art, commercially available flow solvers. Fortunately, the application of advanced computer architectures incorporating Graphical Processing Units (GPUs) to flow solvers for turbomachinery holds the promise of reducing the turnaround time required for such flow simulations to a level consistent with design iterations. Accordingly, an SBIR project is proposed to apply GPU architectures to an available flow solver (or flow solvers) and to demonstrate the efficacy of that capability for design purposes. Long range, high endurance Unmanned Air Systems are an essential component of an effective Tactical Air Dominance, NGAD Family of Systems capability. This effort is in keeping with the Air Superiority 2030 Flight Plan which states that “development efforts for ... persistent ISR capabilities will focus on multi-domain alternatives for placing the right sensor in the right place at the right time.” Increases in turbine aero-performance at high altitude lead directly to increased range and endurance for Unmanned Air Systems, and operationally this leads to increased time on station. Finally, this effort is an excellent illustration of the intent of the S&T 2030 document which states that “the Air Force will increase focus on and strengthen relationships with ... industry” and that “partnerships will expand and strengthen to draw technology out of government, university, and industry laboratories and mature it into transformational operational capabilities.”

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Accordingly, to qualify for consideration under this D2P2 topic, applicants must have accomplished the following in a prior “Phase I-type” of effort: Perform initial Large

Eddy Simulation code development along with proof-of-concept calculations and a demonstration of potential improvements in turnaround time through use of GPU architectures on a Low Pressure Turbine airfoil of interest to the USAF. An example airfoil of interest is the well known Pack B airfoil that is widely distributed throughout industry, government, and academia and is readily found in the open literature.

PHASE II: Perform code development and demonstration of net improvements in turnaround time through use of GPU architectures for Large Eddy Simulations of Low Pressure Turbine stages. Perform code validation studies against datasets defined by both the USAF and an Original Equipment Manufacturer of turbine engines.

PHASE III DUAL USE APPLICATIONS: Commercialize and transition GPU-enabled LES code to tier 1, tier 2, and tier 3 OEMs for turbine engines and additional government agencies.

REFERENCES:

1. Kerestes, J., Marks, C., Clark, J., Wolff, J., Ni, R-H., and Fletcher, N., 2023, "LES Modeling of High-Lift High-Work LPT Blades, Part II: Validation and Application," ASME Paper No. GT2023-101950.

KEYWORDS: Low pressure turbine; GPU computing; Large eddy simulation; Turbine design

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

**OBJECTIVE:** The objective of this project is to develop a mobile camera system that meets the Air Force Security Forces Center's specifications. The system should be lightweight, compact, durable, and equipped with 360° thermal vision. It should also be capable of live streaming the video feed to a separate video source that is carried by the officer and is also available to controllers at the Defense Operations Center.

**DESCRIPTION:** The proposed mobile camera system for law enforcement and military use would feature a tetherable, compact and lightweight design, allowing for easy integration with an officer's standard duty gear. The camera would be engineered to be highly durable and capable of withstanding harsh conditions and aggressive impacts, such as being thrown into a room or down a flight of stairs. The camera's casing and lens would be made from high-quality materials to ensure optimal functionality in any environment. The tether would allow for system retrieval from areas where situational awareness is required but physical entry to the area would be catastrophic for its operator. The camera's casing and lens would be made from high-quality materials to ensure optimal functionality in any environment. To provide enhanced situational awareness and threat detection capabilities, the camera would be equipped with 360° thermal vision. This feature would allow officers to view a complete picture of the room or area under surveillance, eliminating the need for them to enter and potentially endanger themselves or others. The camera would also be equipped with night vision and zoom capabilities, providing additional surveillance options in low-light and longrange scenarios. The camera system would also be designed to allow for live streaming of the video feed to a separate video source that is carried by the officer and is also available to controllers at the Defense Operations Center. This would enable real-time analysis of the video feed, providing critical information to officers and command centers in emergency situations. The camera system would be designed to be easily deployable, with the officer able to throw the camera into a room before entering, allowing them to quickly and accurately vet the room for potential threats. The camera's compact size and lightweight design would make it easy to carry and maneuver, ensuring rapid deployment and efficient use in high-pressure situations. To meet the Air Force Security Forces Center's requirements, the camera system would need to be highly durable, compact, lightweight, and equipped with 360° thermal vision. The camera system would also need to be easily deployable and retrievable utilizing a tether to or something similar to retrieve. Capable of live streaming the video feed to a separate video source

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. The development plan would involve concept design, component selection, prototype development, testing and evaluation, and deployment. The estimated costs for the development of the mobile camera system would depend on various factors, such as the cost of components, research and development, and testing and evaluation.

**PHASE II: System Development, Testing, Deployment Testing and Evaluation:** The camera system would undergo rigorous testing and evaluation to ensure its safety, effectiveness, and compatibility with other equipment and technology. Testing scenarios would assess the camera's performance in different environments and against various targets, evaluating its ability to withstand impact, accuracy, and provide a complete view of the room without the need for the officer to enter. Deployment; The camera system would be integrated into existing operational procedures, including training and education for security



forces. Logistical and operational considerations would also need to be addressed, including distribution and handling of any malfunctions

**PHASE III DUAL USE APPLICATIONS:** Expand the capability of a camera system by conducting further research and development to identify additional features or improvements that could be made to enhance its effectiveness and versatility. Additionally, expanding the system's capability would require ongoing testing and evaluation to ensure that any new features or improvements do not compromise the safety of security forces or the system's effectiveness. This testing and evaluation process could involve simulated scenarios and real-world testing under controlled conditions. Finally, expanding the capability of the system would also require ongoing training and education for security forces to ensure that they are equipped with the knowledge and skills necessary to use the system in various situations effectively. This could involve regular training exercises and simulations, as well as incorporating the system into the standard training curriculum for security forces

**REFERENCES:** 1. AFI 31-101

**KEYWORDS:** Active shooter; Law enforcement; Security forces; Mobile camera system; Room vetting; Moving target engagement; Lightweight; Compact; Durable; Hi-impact; 360° thermal vision; Live streaming; Testing and evaluation; Deployment; Safety; Effectiveness; Commercial development; Situational awareness; Emergency response; Versatility

AF233-D029

TITLE:

Low-Loss Magnetless Optical Isolators for Quantum Integrated Photonics Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy; Hypersonics

OBJECTIVE: This topic seeks to develop wafer scale processes to produce compact and robust low loss, magnetless, magneto-optic isolators. This technology should show a path towards compatibility with commercial silicon photonics foundries (preferably AIM Photonics), either through homogeneous, hybrid, or heterogeneous integration. These isolators should target isolation of 780 nm optical wavelength for quantum applications, and have an optical loss of < 3 dB, and an isolation ratio of > 20 dB. Due to the 780 nm wavelength, it is anticipated that integration with the semiconductor photonics platform may be through an intermediate dielectric waveguide layer such as silicon nitride. However, other approaches may be proposed, provided the optical loss specification can be met. Optical loss is of critical importance in single photon quantum systems. Judicious selection of the magneto-optic material or device structure, low scatter loss waveguides, design of mode matching device structures will be an important aspect of the isolator integration development process.

DESCRIPTION: Optical isolators are a key element in preventing the deleterious effects of back reflections and standing waves in integrated photonic circuits. Quantum technologies are especially susceptible to these effects since they are inherently highly coherent systems operating at extremely small photon counts, with a high integration density on a single compact chip. The most common type of optical isolator is based on the Faraday magneto-optic effect, of which bulk isolators are currently available that are based on externally applied magnetic fields. Fiber-connectorized isolator components are available, but are still based on discrete free space coupled bulk elements within the component package. Demonstrations of quantum key distribution and sensing have been done at the benchtop level using such discrete parts. The challenge now is to implement these circuits in a chip-scale integrated photonic form-factor such that they are robust and compact enough to place on airborne and space platforms. While integrated magneto-optic isolators have been realized, they typically rely on external magnets, either from a permanent magnet or from an electromagnet. An important requirement for quantum technologies is that the isolator element be magnetless since the presence of a magnetic field in a high density photonic circuit can disrupt single photon quantum entanglement processes. Additionally, it is also anticipated that such magnetless integration will reduce the size and cost of these circuits through wafer scale production and economies of scale. Significant strides have been made in developing magnetless integrated isolators that operate at telecommunications wavelengths, and other efforts have scaled the technology to operate at the 780nm wavelength targeting quantum applications. These works have typically relied on the use of latched magneto-optic films or through resonant acousto-optic effects.

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. Device designs demonstrating the ability for magnetless optical isolation must be provided either through simulation, or preferably, previously-fabricated and tested devices. While operation at 780nm and integration within a commercial foundry-like platform are not required for the proposal, a realistic plan to take the previously designed device to this point must be provided.

PHASE II: Eligibility for D2P2 is predicated 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 device design and fabrication process for the 780nanometer isolator structure. This device will then be fabricated and characterized, with the intended performance meeting the required specifications. This device structure must then be adapted to a platform compatible with commercial integrated photonics foundries (preferably AIM Photonics). Ideally, work with the commercial foundry will begin and proposer will demonstrate preliminary integration of the device design with the foundry itself (for example, successful integration and characterization of a magneto-optic material bonded to the AIM Photonics interposer platform). At the end of the effort, reports and characterization results will be provided to AFRL, as well as a fabricated device for independent test verification in AFRL's laboratories. 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 device design developed in Phase II for transitioning expanded mission capability to a broad range of potential government and civilian users and alternate mission applications through a commercial integrated photonics foundry. 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. This work should meet at least Technology Readiness Level 4 before entry into Phase III, and a specific foundry for which the technology will be inserted must be identified. The foundry must be accessible by the DAF for DoD applications (this will place limitations on overseas foundries), and will be preferably domestic.

**REFERENCES:** 1. E. Kesto, V. Stenger, A. Pollick, S. Nelson, M. Levy. (2022) Bias-Magnet-Free Optical Isolating Ridge Waveguide Operating at 780 nm. *Journal of Lightwave Technology* 40:18, 6207-6212, (2022);

2. Sohn, D.B., Örsel, O.E. & Bahl, G. Electrically driven optical isolation through phonon-mediated photonic Autler–Townes splitting. *Nat. Photon.* 15, 822–827 (2021);

3. M. Serrano, Y. Shoji, T. Mizumoto, “Small magnetless integrated optical isolator using a magnetized cobalt ferrite film. *IEICE Electronics Express*. 19. 10.1587/elex.18.20210500. 2021;

4. G. Portela, M. Levy, H.E. Hernandez “Magnetless Optical Circulator Based on an Iron Garnet with Reduced Magnetization Saturation,” *Molecules* (Basel, Switzerland) vol. 26, 15 4692, (2021);

**KEYWORDS:** isolator; magneto-optic; integrated photonics; quantum

AF233-D030 TITLE: Autonomous Airfield Repair Robotics Swarm Platform

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces;Trusted AI and Autonomy

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 demonstrate the ability for a robotic swarm platform to autonomously accomplish airfield repair tasks currently performed by personnel. This includes damage assessment, UXO identification and removal, spall and crater repair, paint striping, and airfield lighting.

**DESCRIPTION:**

Currently, repairing an airfield after attack is a manually intensive and time-consuming task, with numerous interrelated and sequential tasks needing to be done by dozens of personnel. Even in the most ideal circumstances, this requires substantial training, large amounts of equipment, and an airfield free from the possibility of being attacked before repairs are complete. This is a set of assumptions that is increasingly difficult to make in today's contested environments. Rather, adapting robots to the various tasks needed to repair an airfield and having a swarm accomplish these interrelated tasks removes several of the assumptions and has the potential to get the overall effort done faster and with less errors.

**PHASE I:**

As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior "Phase I-type" effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. The applicant must be able to demonstrate its technical solution can accomplish the following to show the feasibility of adapting the technical solution into a prototype: 1) a software platform capable of monitoring and reporting on the status, location, and current operation of dozens of individual robots as well as commanding them to do a set of tasks in a given area, 2) a base robotic platform capable of being fitted with various attachments to accomplish different tasks, 3) the ability for an individual robot to sense its environment and adapt what it is doing to the situation (e.g., noticing a 5 foot deep crater and navigating around it, avoiding other robots or large debris), 4) a drivetrain or similar locomotion that is able to navigate extremely uneven terrain and self-right in the event of tip-over or similar, 5) the ability to do operations completely autonomous within the swarm with no outside communication.

**PHASE II:** The Government will seek awardees to adapt their existing technology to the specific requirements of airfield damage repair and recovery. This will include: 1) determining the technical requirements for each task and the ones best suited for demonstrating the potential of further development and scaling, 2) adding various attachments appropriate to needed tasks, 3) adapting the existing software

platform to monitor and control the new tasks, 4) iterating through various approaches to operations flow as the interrelated tasks start and complete over time, 5) demonstrating the use case from objective 1 in a live setting.

**PHASE III DUAL USE APPLICATIONS:** From a military standpoint, extending the functionality of the robot swarm beyond this use case will be comparatively simple with the basic framework already in place and demonstrated. Adapting the technology to further simple tasks in different environments will create a force multiplier effect on the technology itself, benefiting the military far beyond this first use case. From a commercial standpoint, autonomous robots that can perform interrelated but simple tasks from either centralized control or as a networked swarm has application in numerous fields beyond airfield damage repair. Natural disaster recovery could have robots removing debris, locating survivors in hard-to-reach places, delivering supplies, etc. Performing maintenance in remote areas could be simplified by having robots stationed there instead.

#### REFERENCES:

1. Department of the Air Force, “Introduction to Rapid Airfield Damage Recovery (RADR)”, AFTTP 3-32.10, 15 Oct 2019;
2. Bell, Haley P., Cox, Benjamin C., Edwards, Lulu, Garcia, Lyan I., et al, “Rapid Airfield Damage Recovery Technology Integration Experiment”, US Army Corps of Engineers Engineer Research and Development Center, June 2019;

**KEYWORDS:** Airfield repair; robotics; autonomous; swarm; crater; UXO; multi-purpose; robot

AF233-D031 TITLE: Rapid Fly Mobile UAS

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Sciences; Microelectronics

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 customizable Unmanned Aerial System (UAS) suite that will conduct 360-degree detection of air-based threats from a safe stand-off distance that enables targeting of air-based threats to include: Rockets, Artillery, Mortars and Small Unmanned Aerial Systems (sUAS). Demonstrate the extensibility for future payloads and missions.

**DESCRIPTION:** The Air Force Security Forces Center is seeking an autonomous, economical UAS. The UAS must be an economical solution meant to be deployed and retrieved multiple times, however, should be inexpensive to maintain, use, and replace. The operator must be able to carry the UAS on their person with the ability to retrieve and deploy within five minutes over a distance of at least 2 miles. The UAS must demonstrate autonomous abilities and awareness of its surroundings. Autonomy must include collision avoidance, course and restricted sites (no fly zones) avoidance, autonomous take off, autonomous recovery, and autonomous flight to its destination and back, with the ability of command signal change while in flight. The UAS must be lightweight. Lightweight is specified in being 4lbs or lighter including payload. The UAS must not require a special license to operate. The UAS must be able to go from out of the box to flight with little to no training for the average 18–24-year-old, high school educated Airman. The UAS must have the ability to be used both indoor and outdoor during the same mission set.

**PHASE I:** As this is a Direct-to-Phase-II (D2P2) topic, no Phase I awards will be made as a result of this topic. To qualify for this D2P2 topic, the Government expects the applicant to demonstrate feasibility by means of a prior “Phase I-type” effort that does not constitute work undertaken as part of a prior SBIR/STTR funding agreement. Evaluate vendor solutions to proposed requirements and ensure key requirements are met: autonomous software, TAK integration, and customizable platform(s)/payload mounting system. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

**PHASE II:** Develop and test autonomous Blue UAS suite for emergency response. Capabilities/issues identified but not address in previous phase can be resolved, added or remove as needed.

**PHASE III DUAL USE APPLICATIONS:** Expand capability to additional mission sets and tie into base network. Fully operational capability requires seamless integration onto the Air Force Information Networks (AFIN) for network transport and Air Forces Network (AFNET) for software utilization. The system will utilize these networks for software application usage (both for on premises and remote access), security practices and procedures, and data transport requirements. Prior to inclusion on Air Force Installation Base Enclaves, all hardware components must comply with DoD Unified Capabilities Requirements (UCR), and be listed on the Department of Defense Information Network (DoDIN) Approved Products List (APL). All software components must adhere to UCR and be certified per the Air Force Evaluated Products List (EPL). In the event components are not currently authorized, authorization

will be completed with support of government sponsorship prior to capability delivery to enable immediate operational usage. Request solution use current common criteria certified components when/where possible.

REFERENCES:

1. DoD C-sUAS Strategy 2021;
2. AFMAN 11-502;
3. DAFMAN 17-1301

KEYWORDS: UAS; Autonomous; sUAS, Defense

**CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM  
FY23.3 Small Business Innovation Research (SBIR)  
Proposal Submission Instructions**

The approved FY23.3 topics 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. Instructions detailing the CBD SBIR program requirements are provided below.

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirstr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirstr.mil/submissions/login>.

Please read the entire DoD Announcement and these CBD SBIR instructions carefully prior to submitting your proposal. Important programmatic changes have been incorporated as required by the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). 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.

All proposals submitted to the CBD SBIR program must comply to the terms of this Announcement. CBD SBIR reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality, as determined by Technical Evaluation Team and the CBD SBIR program office 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, paying special attention to the new requirements under the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). 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: Ms. Abigail L. Roots, Chemical and Biological Defense SBIR/STTR Program Manager, JSTO-CBD, at [dtra.belvoir.rd.mbx.jsto-cbd-chem-bio-defense-sbir@mail.mil](mailto: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. Firms 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](mailto:DoDSBIRSupport@reisystems.com)

**NEW:** The maximum dollar amount for a Phase I proof-of-concept/feasibility study is \$197,283.00 for a period of performance of up to six (6) months. **The CBD SBIR Program will not accept proposals exceeding \$197,283.00 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 \$1,315,219.00.

Selection of Phase I proposals will be based upon the three (3) 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 "Additional Information" below for further information regarding all research that will include animal and/or human subjects.

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 \$197,283.00. 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, however these documents will not be considered by the Chemical and Biological Defense Program during proposal evaluations.

All proposing small business concerns 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
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

Please note, under the SBIR and STTR Extension Act of 2022 and the SBA SBIR/STTR Policy Directive, proposals are required to include additional forms, to include the SBA-approved “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” form. **NOTE:** Failure to submit the foreign disclosure form along with the proposal will automatically disqualify a SBC from receiving a SBIR award for that proposal.

### **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, Phase II proposal may be submitted no sooner than five (5) months from date of Phase I contract award. **All Phase II proposal submissions must be submitted electronically through DSIP system: <https://www.dodsbirsttr.mil>**

At the DSIP 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.

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 at the discretion of the Contracting Officer, but may award a firm fixed price contract.

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 (TAB A)**

At this time, the CBD SBIR Program is not participating in the Technical and Business Assistance (TAB A) 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](mailto: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. Requests from the Offerer for further information after the debriefing statement will not be provided.

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. Abigail L. Roots, Chemical and Biological Defense (CBD) SBIR Program Manager, Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), [dtra.belvoir.rd.mbx.jsto-cbd-chem-bio-defense-sbir@mail.mil](mailto:dtra.belvoir.rd.mbx.jsto-cbd-chem-bio-defense-sbir@mail.mil).

#### **ADDITIONAL INFORMATION**

##### ***Fraud, Waste and Abuse***

All offerors must complete the Fraud, Waste, and Abuse training (Volume 6) that is located on 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](mailto: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 Subjects***

Refer to the DoD SBIR Program BAA for Research Involving Animal Subjects.

Companies should plan carefully for any research involving animal subjects, 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 mandatory DoD level review of this research is typically a period of no greater than four (4) months.

Written authorization to begin animal research under the applicable protocol(s) proposed as part of the CBD SBIR program will be issued after the contract award in the form of an approval memo from the U.S. Army Medical Research and Development Command (MRDC), Animal Care and Use Review Office (ACURO), and the Research Oversight Board (ROB) of the Defense Threat Reduction Agency (DTRA), both of which provide DoD compliance oversight to the CBD SBIR program office.

The offeror is expressly forbidden from using or subcontracting for the use of animals in any manner prior to these approvals. Furthermore, modifications to approved protocols require review and approval by the ACURO prior to implementation.

Non-compliance with these terms and conditions may result in withholding of funds and/or the termination of the award. The ACURO and DTRA ROB reviews are separate from, and in addition to, the responsible Institutional Animal Care and Use Committee (IACUC) review(s). Further information may be required if the proposal is successful.

***CBD SBIR Projects Requiring Human Subjects, Human Anatomical Substances, and/or Human Data***

Refer to the DoD SBIR Program BAA for Research Involving Human Subjects and Recombinant DNA Molecules.

Companies should plan carefully for any research involving human subjects, human data, and/or human biospecimens (human anatomical substances; e.g., blood, saliva, tissue), to include cadaveric specimens, hereafter referred to as “research”, 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 mandatory DoD level review of this research is typically no greater than four (4) months.

Projects under CBD SBIR awards involving the use of human subjects shall not be proposed for any Phase I Period of Performance, but may be proposed during the Phase II Period of Performance.

Written authorization to begin the research under the applicable protocol(s) proposed as part of the CBD SBIR program will be issued after the contract award in the form of an approval memo from the U.S. Army Medical Research and Development Command (MRDC), Office of Human Research Oversight (OHRO), and the Research Oversight Board (ROB) of the Defense Threat Reduction Agency (DTRA), both of which provide DoD compliance oversight to the CBD SBIR program office.

The offeror is expressly forbidden from beginning the research in any manner prior to these approvals. Furthermore, modifications to approved protocols require review and approval by the OHRO prior to implementation.

Non-compliance with these terms and conditions may result in withholding of funds and/or the termination of the award. The OHRO and DTRA ROB reviews are separate from, and in addition to, the responsible Institutional Review Board (IRB) review(s). Further information may be required if the

proposal is successful.

**CBD SBIR 23.3 Phase I Topic Index**

CBD233-001	Blister Chemical Warfare Agent Disclosure Spray System
CBD233-002	Polynomial-Curved Bespoke Prescription Lens for Respiratory Protection
CBD233-003	Real Time Physiological Status Monitor for MicroClimate Control
CBD233-004	Breathable, Non-Fluorinated Chemical Barrier Materials
CBD233-005	Development of an early-warning biosensor based on the detection of helical structures in biomolecules

CBD233-001 TITLE: Blister Chemical Warfare Agent Disclosure Spray System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

OBJECTIVE: Develop a chemical warfare agent (CWA) disclosure spray system with the capability to visually disclose the location of blister CWA contamination on surfaces.

DESCRIPTION: Warfighters need to remove blister CWA contamination as quickly as possible and to reduce the logistical burden to warfighters for decontamination processes, perform a more targeted decontamination process through visualization and mapping of blister CWA contamination on surfaces (equipment, tactical vehicles, and weapons). There also is need to check surfaces post decontamination to confirm the area has been decontaminated to at or below detectable levels of blister CWA contamination. While there is previous research into colorimetric blister CWA mapping/detection, additional research and development is needed to improve sensitivity, ease of use, increase pot life, increase shelf-life, and incorporate these elements into a spray type application. This blister CWA disclosure spray prototype will enhance visual contamination mapping capabilities for both decontamination assurance and/or mapping to determine extent of contamination on surfaces to decrease the logistical burden to warfighters conducting decontamination operations and assure that the decontamination operations were complete, and the item is safe to use.

The objective of this project is the design and development of a system consisting of a fully formulated spray or other form factor and associated applicator capable of applying a liquid, foam or other medium on a surface to visually (human eye readable) indicate location of blister CWA contamination. The final prototype must identify less than 0.01 g/m<sup>2</sup> levels of blister CWA and enable visual mapping of the location of blister CWA on surfaces in less than 5 minutes, post-application, in complex surface environments. The color change must remain visible for more than 10 minutes. It is anticipated a simple colorimetric reaction will not be sufficient to meet the sensitivity goal, and a description of how the sensitivity goal will be met is required in the proposal. The positive indication should be specific for blister CWA with low to no potential for false positive indication or environmental interference. Reaction schemes that produce a change in IR, colorimetric, fluorescent, or a combination of these responses for visual change/indication is acceptable. Using excitation light sources (e.g. flashlights) or other external means for visualization are acceptable. Solutions that require sampling, instrumentation, detectors or paper-based detection to measure the contamination are not acceptable. The desired system for the purposes of this SBIR is envisioned to be a small hand held sprayer with a positive response for blister agents on surfaces, with potential follow on (if successful) for larger scale applicators and scaling. Other requirements include not requiring an outside (e.g., electric, fuel, battery) power source, all required components for warfighter use (including water, if applicable) will be included in the kit (i.e. kit should be ready to use as supplied) and will weigh less than 5 pounds (including reagents), need for warfighters to mix reagents should be minimized, should be will be able to operate from 0-45 °C, one kit will cover at least 50 feet<sup>2</sup> of surface, will not interfere with standard DoD detectors (such as, M8 paper, M9 paper, M256A1, or JCAD), will not create a hazard when exposed to standard decontaminants (such as, hot soapy water, high test hypochlorite, M100, M295, M333, or RSDL), will have an estimated shelf life of at least 5 years when stored under climate controlled conditions, and will have a pot life of at least 6 hours after components are mixed, will not cause degradation of military relevant surfaces (such as, CARC, MOPP suit fabrics, etc.) when reagent is left on these materials for 12 hours, and will not impact performance of military filters (such as N95, M61, etc.).

PHASE I: Establish and demonstrate proof of concept for blister positive response indication/reaction by developing robust reaction and verify ability of chemistry to identify the presence of simulants of blister CWA (target blister CWA is sulfur mustard, HD) in solution with sensitivity of sub-microgram per milliliter. Estimate potential for positive response visual indication and specificity for simulant/agent on



varying surface types and in varying environmental conditions. Estimate the logistical requirements of the proposed solution and how the requirements described above can be met.

PHASE II: Demonstrate system feasibility to include optimization of visual indicator, investigation of positive signal amplification, laboratory method validation, and user assessment. Verify ability of chemistry to identify the presence of HD in solution and on surfaces with sensitivity of sub-microgram per milliliter (solution) and less than 0.01 grams/m<sup>2</sup> (surfaces). Verification of performance on surfaces will be conducted in multiple orientations of the test surface – horizontal, vertical and sloped at 45 degrees. Surfaces will be selected by the awardee and will be representative of military-relevant surfaces. Validate indication at sub-microgram/cm<sup>2</sup> of HD. Live agent testing should be conducted as part of this phase of the work and will be conducted at an approved surety laboratory. Demonstrate how the requirements described above can be met. Provide a cost estimate per kit, primary cost drivers, and any anticipated supply chain issues. Scaling to work on sprayer and deliver 20 blister spray systems each containing the formulation, sprayer, and instructions for the warfighter.

PHASE III DUAL USE APPLICATIONS: PHASE III: Continue development and optimization of the prototype including optimizing formulation, continued laboratory testing, and applicator design. Successfully conduct user assessments and incorporate user feedback into optimized system design. Investigate and report requirements for formulation and applicator scaled manufacture.

PHASE III DUAL USE APPLICATIONS: This technology will be useful to civilian first responders for localizing contamination during civilian incidents.

#### REFERENCES:

1. Hurst, C.G. et al. Medical Aspects of Chemical Warfare - Vesicants. 2008. [https://medcoe.army.mil/borden-tb-med-aspects-chem-warfare](https://medcoe.army.mil/borden-tb-med-aspects-chem-warfare;).;
2. Feng, W. et. al. Bifunctional Fluorescent Probes for the Detection of Mustard Gas and Phosgene. 2023. Anal. Chem. 2023, 95, 1755–1763. <https://doi.org/10.1021/acs.analchem.2c05178>.;
3. Chemical Agent Disclosure Spray, Agentase C2. <https://www.flir.com/products/agentase-c2/?vertical=chem+bio&segment=detection>.

KEYWORDS: vesicant; blister; HD; disclosure; decontamination; chemical warfare; hazardous materials

CBD233-002 TITLE: Polynomial-Curved Bespoke Prescription Lens for Respiratory Protection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

OBJECTIVE: Develop a respirator lens that can provide visual correction on a polynomial curved surface (e.g. M50 respirator lens) with varied prescription strength as needed at either eye.

DESCRIPTION: Most single-lens full facepiece air-purifying respirators (APR) are unable to provide vision correction via the primary lens of the respirator due to its complex geometry and the requirement of providing different prescription strengths for each of the wearer's eyes. Instead, vision correction is traditionally provided through a vision correction assembly that is hung inside the respirator, close to the user's eyes. The vision correction assembly available for the M50 can accommodate lenses ranging from -10.00 to +8.00 Diopters in power. While the inserts offer vision correction functionality to the respirator, the accommodation of inserts increases eye relief and thus negatively impacts compatibility with external sighting systems.

This effort seeks to develop a prescription lens solution that can eliminate the need for an internal vision correction assembly building the visual correction directly into the primary lens of the respirator. These lenses would need to be made-to-order with specified diopter strengths available on either half of the respirator lens in order to accommodate conditions such as anisometropia which requires different prescriptions in each eye. The lens would also need to support a range of prescription strengths ranging from -10.00 to +8.00 Diopters and maintain the current shape and size of the primary lens of an M50. Since the primary lens of a full facepiece respirator is a part of the critical sealing surface, this lens will also need to have threat agent permeation resistance characteristics required by the NIOSH Statement of Standard for Chemical, Biological, Radiological, and Nuclear (CBRN) Full Facepiece APR. Durability and optical requirements shall compare favorably to existing military respirator materials and shall comply with the requirements set forth in MIL-STD 810G.

PHASE I: Investigate lens solutions that demonstrate two different prescription strengths on a single flat surface and provide eight (8) flat circular coupons (4" diameter, 0.05" thickness) that are resistant to chemical warfare agent materials as required by the NIOSH Statements of Standard for CBRN Full Facepiece APR to be subjected to government testing. Additionally provide two (2) coupons that demonstrate two different prescription strengths on a polynomial-curved surface, constructed using the same materials as the flat coupons.

PHASE II: Refine the material to develop a full respirator lens of size and shape equivalent to the primary lens of the M50 APR. This lens shall be resistant to chemical warfare agent materials, capable of providing a different prescription strength on each half and demonstrate equivalent optical properties to the primary lens of the M50.

PHASE III DUAL USE APPLICATIONS: PHASE III: Further improve and refine the lens material, demonstrating the ability to be integrated into a full facepiece APR. Additionally, demonstrate that the technology is durable and suitable for military combat applications.

PHASE III Dual Use Applications: Potential alternative applications include industrial, pharmaceutical, healthcare, international, and other commercial respiratory protection uses.

#### REFERENCES:

1. [https://www.avon-protection.com/downloads/product%20datasheets/accessories/outserts/Avon-Protection\\_Vision-Correction-Assembly\\_Data-Sheet\\_EN.pdf](https://www.avon-protection.com/downloads/product%20datasheets/accessories/outserts/Avon-Protection_Vision-Correction-Assembly_Data-Sheet_EN.pdf) ;
2. <https://www.atec.army.mil/publications/Mil-Std-810G/MIL-STD-810G.pdf>

Cleared for Public Release

KEYWORDS: individual protection; respiratory protective mask; protective eyewear; lens; prescription

CBD233-003 TITLE: Real Time Physiological Status Monitor for MicroClimate Control

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

**OBJECTIVE:** The Defense Threat Reduction Agency (DTRA) seeks to develop a ruggedized non-invasive real time physiological status monitor (RT-PSM) that can control an Army microclimate cooling system to mitigate thermal stress injuries, increasing mission performance and system efficiency.

**DESCRIPTION:** Warfighters operating in non-permissive environments in Level 1/A Personal Protective Equipment (PPE) are vulnerable to heat injuries. Even at low activity levels, mission performance and user health can be severely compromised. The requirements to wear PPE further exacerbates a Warfighter's thermal strain, diminishing the rejection of metabolic heat to the ambient environment. As a result, body heat is stored, core temperature rises, and physical and cognitive function can be significantly degraded. Depending on the environmental conditions, activity level, thermal characteristics of the protective clothing, duration of exposure, and individual tolerance to the heat, personnel may experience symptoms ranging from physical discomfort to more severe life-threatening conditions. To mitigate these risks, current cooling solutions are being implemented under PPE utilizing a cooling vest and portable vapor compression system. This provides a steady state heat flux, which can be effective for shorter duration missions, but proves detrimental over longer missions due to inefficiencies in cooling the user. This is due to vasoconstriction within the skin limiting the effective heat transfer to reduce elevated core body temperatures. Utilizing heat stress biomarkers measured by a RT-PSM, a microclimate cooling system can increase cooling efficiency and time on target whilst minimizing power consumption and cognitive loading [1].

Current RT-PSMs utilize a combination of skin temperature, core temperature (typically estimated), heart rate, and skin heat flux to estimate the thermal strain [2]. When the data is fused, a general physiological strain index (PSI) can be calculated. Utilizing a generalizable modified PSI for the cooling system may not be satisfactory as individual thermal strains are so variable [3]. An innovative solution is required to ensure that reliable, valid metrics are being measured and tailored to each individual's needs based on their respective thermophysiological responses to the cooling garment.

In summary, the proposed sensor system should provide insight to the real time thermal strain of the end user using a novel combination of sensors. These sensors should then feed into an accessible algorithm that may be used for optimizing the control of a microclimate cooling system to ensure users can effectively perform their mission set while managing thermal strain.

**PHASE I:** The goal of the Phase I effort is to design and develop a RT-PSM sensor suite, algorithm, and Data Acquisition module by which thermal strain can be measured accurately. The proof of concept should demonstrate reliable signal sampling and sensor fusion in an output that is relevant for a liquid cooled vapor compression microclimate system. This includes investigation into relevant form factors by which the sensors can be implemented.

**PHASE II:** Develop integrated sensor suite and algorithm to perform cooling functions with simulated micro climate system optimizing for human performance. The proof of function system should be validated in a relevant environment. This validation should include the ability to modify algorithm outputs to tailor cooling system parameters for individual user optimization. By the end of Phase II the sensor suite and algorithm should be capable of providing relevant heat stress indicators and controlling a microclimate cooling system according to those metrics to reduce heat stress injury risk.

**PHASE III DUAL USE APPLICATIONS: PHASE III:** A Phase III effort would focus on ruggedization, reliability, and further algorithm optimization of the sensor solution for both Army and commercial

markets. Algorithms would be refined for reliability across larger subject populations and validated in simulated operational environments in conjunction with Army testing events.

PHASE III: DUAL USE APPLICATIONS: Multiple industries must contend with heat stress related injuries, such as construction, agriculture, and first responders. Coupling a reliable RT-PSM heat stress indicator with microclimate cooling system would increase safety, productivity, and mission duration.

REFERENCES:

1. Xu, Xiaojiang, et al. Simulation of a biofeedback microclimate cooling system using a human thermoregulation model. US Army Research Institute of Environmental Medicine Natick United States, 2017. ;
2. Lee, Jason KW, et al. "Biomarkers for warfighter safety and performance in hot and cold environments." *Journal of science and medicine in sport* (2022). ;
3. Buller, Mark J., Alexander P. Welles, and Karl E. Friedl. "Wearable physiological monitoring for human thermal-work strain optimization." *Journal of applied physiology* 124.2 (2018): 432-441.

KEYWORDS: Microclimate; PPE; Core Temperature; skin temperature; monitoring; cooling; control systems; algorithm

CBD233-004 TITLE: Breathable, Non-Fluorinated Chemical Barrier Materials

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

OBJECTIVE: Develop a non-fluorinated chemical protective material that meets the Class 3 requirements set forth in National Fire Protection Association (NFPA) 1994 standard.

DESCRIPTION: The Government requires ensembles that will meet the requirements for Class 3 protection as defined in NFPA 1994, Standard for Protective Ensembles for Hazardous Materials for First Responders to Hazardous Materials Emergencies and CBRN Incidents, 2018. Ensemble elements described in this standard include protective garments, protective gloves, protective hoods, and protective footwear with descriptions of all the properties and test methods required to meet Class 3 requirements. Of particular interest to this topic is the development of garment materials which are resistant to the chemical warfare agents (CWAs) and toxic chemicals listed in the standard. The threshold level of permeation resistance for Class 3 garment materials should be the cumulative permeation mass in one hour of less than 4.0 micrograms per square centimeter ( $\mu\text{g}/\text{cm}^2$ ) for distilled mustard, less than 1.25  $\mu\text{g}/\text{cm}^2$  for Soman, and less than 6  $\mu\text{g}/\text{cm}^2$  for toxic industrial chemicals when challenged with 10 grams per square meter ( $\text{g}/\text{m}^2$ ) of liquid challenge or with 40 ppm of vapor challenge.

Also of particular interest to this topic is the breathability of garment materials, as indicated by thermal and water vapor resistance measurements, with evaporative heat transfer (total heat loss) not less than 200 watts per square meter ( $\text{W}/\text{m}^2$ ) and evaporative resistance not greater than 30 pascal square meter per watt ( $\text{Pa m}^2/\text{W}$ ).

In addition to the requirements set forth in NFPA 1994, non-fluorinated ensemble materials are required. Environmental concerns with perfluoroalkyl and polyfluoroalkyl substances (PFAS) is leading to the discontinuation of numerous commercial products that have been utilized in chemical protective systems including ensemble components, coatings, and finishes. Non-fluorinated material alternatives are sought with this topic.

PHASE I: Demonstrate a fluorine-free garment material candidate that shows the NFPA 1994 required chemical resistance for one CWA simulant and two toxic industrial chemical liquids. Breathability must also be demonstrated. NFPA 1994 specified testing (ASTM F1868 and ISO 11092) may require more material than possible in the Phase I effort. Alternative methods may be proposed to provide acceptable estimates for breathability. Other physical properties are specified in NFPA 1994 (viral penetration, burst strength, puncture resistance, low temperature performance) and measured or addressed as possible in the Phase I effort to strengthen the feasibility for a Phase II effort. Chemical resistance and breathability are the key Phase I topic goals. At the end of the Phase I effort the candidate material should be able to be produced at a 6 inch by 6 inch swatch level and swatches made available for independent testing by the government. A preliminary scale-up method and a cost assessment should also be provided.

PHASE II: Optimize and scale candidate garment material to be able to produce enough material for prototype fabrication. Show chemical resistance to the CWAs and liquid and vapor challenges in NFPA 1994. Show breathability through the NFPA 1994 specified testing. Initiate garment fabrication and carry out all physical property testing (seam strength and closure strength in addition to those listed in Phase I). The Phase II effort should show a candidate garment material that meets the NFPA 1994 requirements and ready for scaling to production quantities. At the conclusion of Phase II, a sample of at least 12 inches wide and 5 yards in length of the optimized garment material should be delivered. A cost assessment for full scale production should also be provided.

PHASE III DUAL USE APPLICATIONS: PHASE III:

The successful Phase II material will be scaled to continuous production at full width (>40 inches) and integrated into Class 3 protective ensembles.

**PHASE III DUAL USE APPLICATIONS:**

In addition to military applications, Class 3 ensembles have a broad range of applications for the first responder for hazardous material and anti-terrorism situations.

**REFERENCES:**

1. NFPA 1994, “Standard for Protective Ensembles for Hazardous Materials for First Responders to Hazardous Materials Emergencies and CBRN Incidents”, 2018 ;
2. ASTM F1868, “Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate” ;
3. ISO 11092, “Textiles - Physiological effects - Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)”

**KEYWORDS:** chemical protective garment; permeation; breathable; chemical resistance; water vapor permeable; fluorine-free

CBD233-005 TITLE: Development of an early-warning biosensor based on the detection of helical structures in biomolecules

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

OBJECTIVE: Develop sensing capabilities for the detection of airborne biological aerosols. The instrumentation must be capable of rapidly and continuously identifying bioaerosol particles based on the detection of helical structures present in biomolecules and discerning bioaerosols from the larger inorganic and organic background matrix via point detection at the location of the instrument in real time. The final device should be deployable on an unmanned platform such as unmanned aerial vehicle (UAVs) or unmanned ground vehicle (UGVs).

DESCRIPTION: A robust chemical-biological defense requires a fast, reliable, specific, and inexpensive biological aerosol threat detection system to prevent deadly contamination of soldiers and the general population. This requirement is critical for urban and/or battlespace settings where the atmosphere contains inorganic, organic, and biological particles with complex physico-chemical characteristics across orders of magnitude in size ( $0.1 \square 100$  microns [ $\square$ m]). The detection of possible biological threat materials is limited by their small concentration within this ambient matrix containing materials of non-interest and interfering compounds. While sensor technology has improved over the last 20 years, threat detection remains a challenge in operational environments at mission-speed due to the complex and dynamic nature of the surrounding environmental media.

A fully operational bioterror detection system comprises trigger, rapid confirmer/identifier, sample collector, and final confirmer/identifier. Early triggers were mainly based on the detection of laser induced fluorescence (LIF) (e.g., BAWs, WIBS, UVAPS) and have become the industry standard, as they provide some level of correlation to the chemical nature of the bioaerosols, while upholding the ability of continuously operating at high throughput. However, despite decades of significant improvements, LIF-based early-warning systems exhibit shortfalls with respect to accuracy due to the existence of similar chromophores in both threat aerosols and innocuous background particles [1,2]. Furthermore, it has been shown that the fluorescence signal of a bioaerosol can be severely altered by changes in environmental conditions [3].

A recent surge in highly infectious diseases, as highlighted by the COVID-19 pandemic and respiratory syncytial virus infection (RSV), revived interest in the early detection and identification of health-threatening bioaerosols and various strategies including optical methods, such as elastic light scattering (ELS) were suggested as potential solutions. Widely used in atmospheric and planetary sciences, ELS generates the physical information useful for a particles' classification (e.g., size, morphology, refractive index) but is unsuitable for unambiguous chemical identification. However, some polarization containing elements of the scattering Mueller Matrix (S12, S34 and S14) enable retrieval of molecular conformation for complex biopolymers, and in limited instances circular intensity differential scattering (CIDS) was used to achieve characterization based on molecular or morphological chirality, without using fluorescent labels [4]. Furthering these capabilities, a recent study by Pan et al. demonstrated that CIDS measurements performed on a single airborne aerosol can distinguish particles with a helical structure (i.e., DNA and RNA) from background particles [5]. An ingenious design used in this work highlights opportunities for the development of a deployable compact device streamlining traditional bulky components, such as polarization modulator, lock-in amplifier, and rotation goniometer.

Leveraging these developments, detecting chirality in bioaerosols has the potential to generate an autonomous early-warning capability that could augment the Department of Defense's chem-bio defense effort by distinguishing biological threats from background particles. The sensing capability should overlap with the inhalable particle size and rely on contactless optical methods to sense biological



chirality. The system should have a continuous real-time monitoring (tens of thousands particles/sec) capability and, at a minimum, should be able to distinguish biological particles from inorganic or organic background.

PHASE I: Phase I entails the design of a concept for a rapid, chirality detecting early-warning biosensor. The study should lead to a laboratory demonstration that outlines major components of the system. The Phase I project should focus on the discrimination of bioaerosols from non-bioaerosols in the 0.1–100  $\mu\text{m}$  particle size range, with accuracy >80%. The accompanying architecture required to integrate fast data analysis and machine learning for particle differentiation should also be included. The Phase I should also define a clear path forward for designing a prototype with low size, weight, and power (SWaP) to enable deployment on unmanned vehicles. 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 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 10,000 particles per second and detecting biological particles 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 DUAL USE APPLICATIONS: 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 early-warning detection of biological threat aerosols.

PHASE III DUAL USE APPLICATIONS: The proposed method 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 early-warning 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, or other airborne pathogens driving highly infectious diseases for commercial applications and for use by government agencies including the U.S. Environmental Protection Agency (EPA).

#### REFERENCES:

1. Pinnick, R. G., Hill, S. C., Pan, Y.-L., and Chang, R. K., "Fluorescence spectra of atmospheric aerosol at Adelphi, Maryland, USA: Measurement and classification of single particles containing organic carbon", *Atmospheric Environment* 38, 1657-1672 (2004). ;
2. Pan, Y.-L., Pinnick, R. G., Hill, S. C., Rosen, J. M., and Chang, R. K., "Single-particle laser-induced fluorescence spectra of biological and other organic-carbon aerosols in the atmosphere: measurements at New Haven, Connecticut, and Las Cruces, New Mexico", *Journal of Geophysical Research*, 112(2007). ;

3. Kinahan, S. M.; Tezak, M. S.; Siegrist, C. M.; Lucero, G.; Servantes, B. L.; Santarpia, J. L.; Kalume, A.; Zhang, J.; Felton, M.; Williamson, C. C.; Pan, Y. L., Changes of fluorescence spectra and viability from aging aerosolized E. coli cells under various laboratory-controlled conditions in an advanced rotating drum. *Aerosol Sci Tech* 53 (11), 1261-1276 (2019). ;
4. A. L. Gratiet, L. Pesce, M. Oneto, R. Marongiu, G. Zanini, P. Bianchini, and A. Diaspro, “Circular intensity differential scattering (CIDS) scanning microscopy to image chromatin-DNA nuclear organization,” *OSA Continuum* 1(3), 1068–1078 (2018).
5. Pan, Y.-L.; Kalume; A.; Arnold J.; Beresnev, L.; Wang C.; Rivera, D.; Crown, K. and Santarpia J., “Measurement of Circular Intensity Differential Scattering (CIDS) from Single Airborne Aerosol Particles for Bioaerosol Detection and Identification”, *Optics Express* 30 (2), 1442-1451 (2022).

KEYWORDS: Biological Threat Detection; sensors; aerosols; environmental sampling; environmental surveillance

**Defense Health Agency (DHA)**  
**2023.3 Small Business Innovation Research (SBIR)**  
**Proposal Submission Instructions**

**INTRODUCTION**

The Defense Health Agency (DHA) SBIR/STTR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

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 format submission via DSIP are provided in the DoD SBIR Program Broad Agency Announcement (BAA). Proposals not conforming to the terms of this BAA will not be considered.

DHA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Only Government personnel will evaluate proposals with the exception of technical personnel from Odyssey Systems, Allied Technologies and Consulting LLC, and General Dynamics Information Technology, who will provide technical analysis in the evaluation of proposals submitted against DHA topics:

- Rapid Diagnostic for Invasive Fungal Infection
- Medical Oxygen Storage and Delivery for Deployed Joint Services' Casualty Care

Specific questions pertaining to the administration of the DHA SBIR/STTR Program and these proposal preparation instructions shall be directed to:

DHA SBIR Program Management Office (PMO) Email: [usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil](mailto:usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil)

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 the Topic Q&A: <https://www.dodsbirsttr.mil/submissions/login>.

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.

**PHASE I PROPOSAL GUIDELINES**

**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 deemed non-compliant and will not be evaluated.

### **Cost Volume (Volume 3)**

The Phase I amount must not exceed \$250,000 over a 6-month period of performance. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

Travel must be justified and relate to the project needs for direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL) increasing costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

### **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)**

Volume 5 is provided for proposing small business concerns to submit additional documentation to support the submission. All proposing small business concerns 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)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
3. Disclosure of Funding Sources (Attachment 4)

A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

### **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.

## **DIRECT TO PHASE II PROPOSAL GUIDELINES**

Each Direct to Phase II topic requires that proposing small business concerns 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 proposing small business concern and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposing small business concern 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 proposing small business concern 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.

Direct to Phase II proposals must include all volumes, not to exceed maximum page limit, and must follow the formatting requirements provided in the DoD SBIR Program BAA. Submissions that exceed the maximum page limit will be deemed non-compliant and will not be evaluated.

- a. DoD Proposal Cover Sheet (Volume 1)
- b. Technical Volume (Volume 2):
  - Part 1: Phase I Justification (20 Pages Maximum)
  - Part 2: Phase II Technical Proposal (40 Pages Maximum)
- c. Cost Volume (Volume 3)
- d. Company Commercialization Report (Volume 4)
- e. Supporting Documents (Volume 5)
- f. Fraud, Waste, Abuse (Volume 6)

### **Technical Volume (Volume 2):**

Phase I Justification: Offerors are required to provide evidence that the scientific and technical merit and feasibility have been established as described in the topic description.

Phase II Technical Proposal:

- i. Results of the current work – Discuss the objectives of your effort, the research conducted, findings or results, and estimates of technical feasibility.
- ii. Technical objectives and approach – List the specific technical objectives of the Direct to Phase II research and describe the technical approach in detail to be used to meet these objectives.
- iii. Work plan – The plan should indicate what is planned, how and where, a schedule of major events, and the final product to be developed.
- iv. 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' awareness of the state-of-the-art in the technology and associated science must be demonstrated.
- v. 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 effort in providing a foundation for a Phase III research or research and development effort.
- vi. Technology transition and commercialization strategy – Describe your company's strategy for converting the proposed SBIR research into a product or non-R&D service with widespread commercial use – including private sector and/or military markets. Note: The commercialization strategy is separate from the Commercialization Report. 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 awards.

- vii. Key personnel - Identify key personnel, including the Principal Investigator, who will be involved in the effort. List directly related education and experience and relevant publications (if any) of key personnel. A concise resume of the Principal Investigator(s) must be included.
- viii. 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. Proposing small business concerns 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 may be deemed nonresponsive if the requested information is not provided. Therefore, proposing small business concerns 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)).
- ix. Facilities/Equipment – Justify items of equipment to be purchased (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 contract negotiations. 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.
- x. Consultants – Involvement of university, academic institution, or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in the Cost Volume.

**Cost Volume (Volume 3):**

The Cost Volume must contain a budget for the entire 24-month Direct to Phase II period that reflects ‘year 1’ and ‘year 2’ and not to exceed the maximum dollar amount of \$1,300,000. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in the Cost Volume (Volume 3).

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

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.

Travel must be justified and relate to the project needs for direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL) increasing costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

**Company Commercialization Report (Volume 4):**

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

**Supporting Documents (Volume 5):** A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)  
MANDATORY
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)  
MANDATORY
3. Verification of Eligibility of Small Business Joint Ventures (Attachment 3), if applicable
4. Disclosure of Funding Sources (Attachment 4) MANDATORY
5. Other supporting documentation

**PHASE II PROPOSAL GUIDELINES**

Phase II proposals may only be submitted by Phase I awardees from this BAA. Phase II is the demonstration of the technology found feasible in Phase I. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO typically in month five of the Phase I contract.

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 shall 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 \$1,300,000.

Budget costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and shall 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.

Technical Volumes that exceed the 40-page limit will be deemed non-compliant and will not be evaluated.

## **DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)**

The DHA SBIR Program does not participate in the Technical and Business Assistance (formerly the Discretionary Technical Assistance Program). Contractors shall 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.

Non-selected companies may request feedback within 15 calendar days of the non-select notification. The Corporate Official identified in the firm's proposal shall submit the feedback request to the SBIR Office at [usarmy.detrick.medcom-usamrhc.mbx.dhpsbir@health.mil](mailto:usarmy.detrick.medcom-usamrhc.mbx.dhpsbir@health.mil). Please note feedback is provided in an official PDF via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral feedback will 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 feedback request.

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 shall be submitted to:

Ms. Samantha L. Connors SBIR/STTR Chief, Contracts Branch 8  
Contracting Officer  
U.S. Army Medical Research Acquisition Activity  
Email: [Samantha.l.connors.civ@health.mil](mailto:Samantha.l.connors.civ@health.mil)

## **AWARD AND CONTRACT INFORMATION**

Phase I awards will total up to \$250,000 for a 6-month effort and will be awarded as Firm-Fixed-Price Purchase Orders.

Phase II awards will total up to \$1,300,000 for a 24-month effort and will typically be Firm-Fixed-Price contracts. If a different contracting type is preferred, such as cost-plus, the rationale as to why must be included in the proposal.

Phase I and II awardees will be informed of contracting and Technical Point of Contact upon award.

## **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 U.S. 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 Human and Animal Research Oversight (OHARO) provides formal authorization. Written approval to begin a research protocol will be issued from the USAMRDC OHARO, under separate notification to the recipient. Written approval from the USAMRDC OHARO 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 U.S. Food and Drug Administration, Offerors shall propose a regulatory strategy for review.

Non-compliance with any provision may result in withholding of funds and or termination of the award.

## **WAIVERS**

The DHA SBIR Program highly discourages offerors from proposing a federal facility use waiver during Phase I due to the significant lead time required to prepare documentation and secure approval, which could substantially delay the performance of the Phase I award.

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.

Transfer of funds between a company and a Military Lab must meet the following APAN 15-01 requirements (the full text of this notice can be found at <https://usamraa.health.mil/SiteAssets/APAN%2015-01%20Revised%20Feb%202018.pdf>):

- (1) The DoD Intramural Researcher must obtain a letter from his/her commanding officer or Military Facility director authorizing his/her participation in the Extramural Research project. This letter must be provided to the Extramural Organization for inclusion in the proposal or application.
- (2) The DoD Intramural Researcher must also coordinate with his/her local Resource Manager Office (or equivalent) to prepare a sound budget and justification for the estimated costs. Where there are no DoD-established reimbursement rates [e.g., institution review board (IRB) fees, indirect cost rates, etc.], the Military Facility's RM office (or equivalent) must provide details of how the proposed rates were determined. The DoD Intramural Researcher must use the budget and justification form enclosed in APAN 15-01 when developing the estimated costs and provide it to the Extramural Organization for inclusion in the proposal or application.

- (3) The Extramural Research proposal or application must include a proposed financial plan for how the Military Facility's Intramural Research costs will be supported [i.e., directly funded by DoD, resources (other than award funds) provided by the Awardee to the Military Facility, or award funds provided by the Awardee to the Military Facility (in accordance with the requirements below)].
- (4) The DoD Intramural Researcher should also coordinate with his/her technology transfer office.

**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, such as Phase III, if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

**\*END\***

## **DHA SBIR 23.3 Topic Index**

DHA233-001	Rapid Diagnostic for Invasive Fungal Infection
DHA233-002	Novel Fieldable Device for Detection of Sleep Microarousals
DHA233-003	Operator State Monitoring: Minimally Invasive Monitoring of Peripheral and Cerebral Blood Oxygen as Well as Pulse and Respiratory Rates in Future Vertical Lift Aircrew
DHA233-004	Technology to Drive 60-day Runtimes in Wearable Devices
DHA233-D001	Medical Oxygen Storage and Delivery for Deployed Joint Services' Casualty Care

DHA233-001 TITLE: Rapid Diagnostic for Invasive Fungal Infection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Infectious Disease

OBJECTIVE: Develop a technical solution or device for the identification of an Invasive Fungal Wound Infections in a Military Treatment Facility or lower Role of Care within 24 hours.

DESCRIPTION: Trauma-related invasive fungal wound infections (IFIs) are associated with significant morbidity and mortality (8-12% mortality). Early identification and treatment are critical to prevent loss of limb and/or loss of life. Traditional identification methods can be delayed and insensitive and are heavily dependent on clinical and microbiological expertise. At presentation for clinical treatment, differential diagnoses for deep necrotizing wounds leans heavily towards infections caused by multi-drug resistant (MDR) bacteria. During initial wound assessment, clinicians must have a heightened sense of IFI suspicion, often requiring a high degree of expertise, in order to clinically differentiate between bacteria or fungal infections. Current clinical laboratory diagnostics involve direct examination of cultures and histopathology of collected wound tissue specimens. Fungal cultivation, the current standard diagnostic method, has numerous disadvantages including, but not limited to a low sensitivity (only 50% of the patients present positive fungal cultures) and long growth time. These factors delay patient treatment and consequently lead to longer hospital admissions and higher hospital costs. Clinical laboratory diagnosis can take, at best, between 24-72 hours or at worst, 6-8 weeks, to positively confirm and identify an IFI. The benefit of fungal isolation from tissue culture includes direct evaluation of clinically relevant characteristics such as antifungal resistance and species identification. However, fungal speciation through culture requires considerable expertise for identification.

Currently, there are no commercially available products that can quickly and accurately clinically diagnose the presence of a wound-IFI as well as quickly speciate and determine antifungal drug susceptibility. Many IFI's go undiagnosed due to the high level of clinical and microbiological experiences required. The envisioned system would employ a technology using an innovative engineering approach that enables infection identification. In addition to the primary objective of determining the causative agent of an ongoing IFI, such a device would also enable prospective monitoring of patients at risk for IFI, such as severely immunocompromised individuals, enabling early treatment before the occurrence of overt symptoms. If adapted to a DOD product the proposed technology is envisioned to be utilized at the Role 3 or potentially Role 2+ alongside analogous bacteriological diagnostics in a prolonged field care type environment occurring during Large Scale Combat Operations.

The technology is not limited to but may consider, the factors below:

- 1) The technology must include a plan for FDA clearance
- 2) Detection and identification of IFI via built-in antigen tests, nucleic acid assays, VOC sniffers, chemical/molecular detector, photonics ...etc. must be contiguous in one platform with minimal user training
- 3) Technology should have the ability to distinguish between common clinical fungal agents of infection with no downstream analysis required. Examples include, but are not limited to: Order Mucorales, Aspergillus sp, Fusarium sp., +/- Scedosporium sp., and agents of phaeohyphomycosis
- 4) Technology should be capable of operating continuously or successively in a high throughput as well as an on-demand between samples with minimal number of steps
- 5) The ability to determine antifungal drug susceptibility is preferred but optional
- 6) Engineering solutions overall should require minimum logistical support, should be compatible with applications in wet/dry environments, and stable in long term storage including hot (~100°C) and cold temperature (-20°C)

7) Ease of use, technology should be operable with little training or background with unambiguous primary output

Technologies with the following features are not the primary focus of this topic

1. Microscopy based automated or manual morphology description methods
2. Methods involving staining and/or adhesive tape
3. Established methods involving mass spectrometry workflow
4. Technologies involving radioactive agents

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 diagnostic capability requirement. Proposals may include early versions diagnostic systems that may combine “classes” of applications into different “sets” of designs. At the end of this phase, fabricated prototypes should demonstrate detection along a continuum of growth as feasibility, proof-of-concept and establish reasonable qualitative identification, using relevant testing platforms for the proposed technology. This phase should down-select promising design with sufficient performance specification superior to current standards in the laboratory. Evaluation of the product’s durability for detecting IFI and must include data for 6, 12, 18, and 24 hours of in vitro testing at a minimum. The above time points do not represent system application on subjects but used as a benchmark and quantify efficacy of detection of infection.

PHASE II: During this phase, the lead integrated system should be further refined from proof-of-concept and begin planning compatibility with CLIA standards for the clinical laboratory. Further optimization of the technology for earlier and more robust detection of infection at a traumatized wound bed should be demonstrated during this phase. Qualitative and quantitative outcomes of product with regards to quantification of spores/hyphae, identification of invading organism, and/or characteristics of such as anti-fungal susceptibility if feasible. This testing should be controlled and in rigorous conditions. Accompanying application instructions and simplified procedures should be drafted in a multimedia format for use and integration of the product into market. At this stage, offers may begin developing plans and documents for quality control material, training materials, proficiency assessment tools and materials, device verification and validation documents, supporting material for Individualized Quality Control Plan for easy adoption of technology as a nonwaived test. Price estimate and comparison analysis for new designs relative to current fielded equipment shall be provided to forecast the potential cost of the product and commercial viability. The offeror shall articulate the regulatory strategy and provide a clear plan on how FDA clearance will be obtained.

PHASE III DUAL USE APPLICATIONS: The ultimate goal of this phase is to secure an FDA approved device to commercialize a technology enabling the early detection of fungi. Additional use cases may be included in order to derive, extend, or complete the funded innovation. The growing use of immunosuppressive drugs to treat various diseases such as HIV will likely increase the incidence of IFIs in civilian populations. The global market for fungal therapeutics is expected to grow from \$7.2 Billion in 2021 to \$10 billion by 2030. The clinical diagnostic space will be critical in leveraging this growing market segment. Alternatively, further development, testing and evaluation of the product developed in phase II of this SBIR can be supported by BARDA, CDMRP, JWMP, and other DOD opportunities. Once developed and demonstrated, the technology can be used commercially in both civilian and military settings to save lives. If the product is transitioned into Acquisition Programs of Record, the Government retains the right to harmonize design with other relevant products.

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KEYWORDS: Infection, Diagnosis, Trauma, Fungal Pathogen, Clinical Device

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DHA233-002 TITLE: Novel Fieldable Device for Detection of Sleep Microarousals

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: Develop a fieldable, wearable device that detects microarousals during sleep.

DESCRIPTION: It is well known that Soldiers consistently fail to obtain the 7-9 hours of nightly sleep that is recommended by National Sleep Foundation (Watson et al., 2015). In fact, more than 62% of Soldiers average less than 6 hours of sleep per night (Troxel et al., 2015). This is over double what is found in the civilian population, as 28% of civilians average less than 6 hours of sleep per night, thus, a majority of Soldiers are chronically sleep restricted—a situation that reduces the military's competitive edge. Sleep loss of this magnitude negatively impacts virtually every aspect of performance, health, and readiness. However, even in carefully controlled laboratory studies of sleep loss in health young adults, there exists a spectrum of responses to the same amount of sleep loss, such that roughly 1/3 are resilient to sleep loss and another third are more vulnerable as measured by next day performance (Reifman et al., 2018). Therefore, total sleep time itself does not fully predict performance even in tightly controlled laboratory studies. Additionally, outside of the laboratory, military members encounter many disruptions to sleep, including noise, light, and extreme and fluctuating temperatures. These disruptions are only expected to intensify during multi-domain operations where the battlefield will be progressively more lethal and complex. However, currently available fieldable sleep measurement devices (e.g., watches from Garmin, Fitbit, Apple and rings from Oura) struggle to fully capture smaller disruptions to sleep continuity and can only provide reliable total sleep time measures (Chinoy et al., 2021). For these reasons, there exists a need for a fieldable, wearable device than can measure more than total sleep time. Both the DoD and the consumer market need an unobtrusive, wearable device that can reliably measure sleep continuity – a metric that may predict next day performance and health associated outcomes better than total sleep time.

One measure of disrupted sleep continuity is the accumulation of cortical microarousal events across a sleep period. These are moments of brief biological waking activity with a rapid return to sleep (< 15 seconds). These events are not detected with current wearable sleep tracking technology (e.g., watches and rings) but they provide an important datapoint associated with altered daytime functioning (Martin et al., 1996; Stepanski et al., 1987) and negative health outcomes including cardiovascular health and increased diabetes risk (Taylor et al., 2016; Stamatakis and Punjabi 2010). Currently microarousals can only be identified by a trained technologist using polysomnographic equipment in a laboratory setting. However, with the increasing sophistication of wearable devices, including dry electroencephalographic electrodes and increased onboard processing power, it stands to reason that consistent measurement of microarousals could be possible with a fieldable wearable device.

This proposal aims to first develop a novel wearable device that measures sleep microarousals in Phase I and then validate the device and determine if microarousals collected by the device are related to next day performance on militarily relevant outcomes in Phase II. If fielded, the technology may require secured communication methods.

PHASE I: The objective is to develop a novel wearable device that measures sleep microarousals. The current sleep measurement devices that are on the market can only accurately predict total sleep time and struggle to capture issues with sleep continuity. No current wearable devices can measure microarousals during sleep to our knowledge. Therefore, there is a need for a fieldable device that can measure this important aspect of sleep that is associated with negative health outcomes and altered daytime functioning. This phase will demonstrate the feasibility of producing a demonstration of microarousal detection on a wearable device.

Requirements for Phase I device:

- Wearable on the body (e.g., placed on the forehead or on a limb)
- Comfortable and unobtrusive – should not interfere with sleep
- No user interaction needed (e.g., prepping skin, adding electrodes, adding gel) – device should be able to put on by user and then left alone
- Wireless – small rechargeable battery lasting at least 12 hours (lithium ion is minimum standard)
- Ability to toggle between saving data on device or wirelessly transmitting to local device using military telecommunication standards
- Onboard detection of microarousals in real-time – preliminary design and validation can be completed with simulated data

PHASE II: The objective is to demonstrate that sleep microarousals can be detected with a novel wearable device and determine feasibility for prediction of next day cognitive performance. This phase will involve testing of the microarousal device created in Phase I to prove it can be used to reliably measure microarousals during sleep. Additionally, performers should determine if microarousals measured during sleep by the device are found to relate to next day cognitive performance.

During this phase, performers will build off the results from Phase I and execute human subject research prototype development where participants wear the novel microarousal detection device overnight and then perform militarily relevant tasks the next day.

Requirements for Phase II human subject research prototype development:

- Overnight PSG recordings collected during sleep while individual is wearing device developed in Phase I
  - Cognitive performance must be tested the next day following the sleep recording
  - Cognitive performance datasets should include at least one militarily relevant outcome metric and must contain a measure of vigilance (can count as militarily relevant outcome)
  - Data should come from healthy adults under 50 (i.e., surrogates of the active duty population including leaders)
  - Data should be collected on at least 20 individual adults
  - Data from the device should be able to detect American Academy of Sleep Medicine (AASM) defined microarousals with 85% accuracy compared to polysomnography (<https://aasm.org/clinical-resources/scoring-manual/>)
  - Data from the device should be tested to ascertain if it can predict next day cognitive performance with 85% accuracy and is significantly better at predicting performance than using total sleep time alone.
- Performers should provide a statement assessing the feasibility of the device for the prediction of next day performance and any recommendations for follow-up validation studies.

Following the conclusion of Phase II, four prototype devices and associated datasets containing the requirements listed above should be delivered to the DoD.

PHASE III DUAL USE APPLICATIONS: Following successful completion of Phase II, a fieldable device that can measure sleep microarousals will be available. If preliminary feasibility testing in Phase II indicates that the device has the potential to predict next day cognitive performance, further validation testing will occur in Phase III to verify that the device can reliably predict next day cognitive performance.

This device holds great utility in both the commercial market and within the DoD. Commercially a device of this nature would be a game changer for companies that rely on the current state of performance modeling to schedule workers with high risk jobs such as pilots, truck drivers, and law enforcement. Current performance models rely on total sleep time which does not accurately reflect the quality of sleep and therefore does not accurately predict performance. These companies could easily give workers the



microarousal detection device to wear during sleep and utilize data from the device to make scheduling decisions. Indeed, employee tracking to increase productivity is becoming more and more accepted in industry (<https://www.nytimes.com/interactive/2022/08/14/business/worker-productivity-tracking.html>). Additionally, outside of industry commercialization, the rapidly growing sleep device consumer market would embrace this device as a more accurate way to measure sleep and also test the efficacy of different sleep interventions within the home. Software and algorithms developed under this SBIR could also potentially be applied to existing wearable devices and sold and licensed as a severable entity. Applications within the DoD are similar to industry but also the information provided by this device could potentially be incorporated into the MRDC-developed 2B-Alert Performance Prediction algorithm to replace the current app's onboard reaction time test (i.e., the Psychomotor Vigilance Test, PVT) that provides individualized performance prediction. This would be a large improvement because the PVT requires the user to interface with the app directly to take the test multiple times a day. The device proposed here is a non-invasive and passive wearable. The technology created with this SBIR could also potentially be integrated into existing wearables and scheduling tools, such as 2B-Alert.

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KEYWORDS: Sleep, Performance, Wearable, Device, Total Sleep Time, Microarousal

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DHA233-003      TITLE: Operator State Monitoring: Minimally Intrusive Monitoring of Peripheral and Cerebral Blood Oxygen as Well as Pulse and Respiratory Rates in Future Vertical Lift Aircrew

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: Develop and demonstrate noninvasive technology to monitor cerebral blood oxygen, pulse oximetry, pulse rate, respiration rate, and possible impact trauma of Army aviators during flight.

DESCRIPTION: The Army's Future Vertical Lift (FVL) program, which includes SOCOM, is developing aircraft with dramatically expanded performance envelopes that will increase environmental stress on aircrew personnel during flight (1). The enhanced performance capabilities of FVL aircraft and their consequent stresses on the Army aviator will require near real-time actionable information characterizing the aviator's physiological status, information that must be obtained without adversely impacting aviator performance in any way for the duration of the mission (3). With the increased speed, agility, and altitude of the FVL aircraft, blood oxygen levels are an increasingly crucial parameter to monitor.

The literature identifies well-established differences in the spectra of arterial (i.e., oxygenated) blood verses venous (i.e., deoxygenated) blood (5). This difference in spectra underlies conventional pulse oximetry, which is widely used to monitor the percent oxygen saturation of peripheral blood. Such conventional pulse oximetry measurements are typically limited to measuring blood oxygen in tissue that can be transilluminated, such as the finger or earlobe. However, it has been well established that, for any of a large number of reasons, peripheral blood oxygen saturation can differ markedly from the blood oxygen saturation in the central nervous system (5). Thus, current pulse oximetry technology, limited to peripheral blood oxygen saturation, is incapable of monitoring cerebral blood oxygen levels. Moreover, the increased physiological stresses that FVL aircraft will impose make peripheral blood oxygen saturation an even less reliable and trustworthy indicator of cerebral blood oxygen. Clearly, for the FVL aviator, precise monitoring of central blood oxygen is far more important than approximations extrapolated from peripheral oxygen saturation measurements. Thus, there is a need for technology that provides reliable measures of central blood oxygen. Recent developments in near infrared transcranial spectroscopy (NIRS) suggest a way forward to meet this need.

Furthermore, the capabilities of FVL aircraft make it essential to determine quickly and reliably whether the pilot is in some way compromised, traumatized, incapacitated, unresponsive, or possibly even dead. Because of these contingencies, there is a need for technology to monitor respiration rate, pulse rate, as well as physiological transients such as the possible occurrence of 'hydrostatic shock,' a pressure wave that can indicate the occurrence of a blunt force trauma or even a penetrating wound. While the hydrostatic shock may not itself produce tissue damage, the detection of such a shock would be important for operator state monitoring (OSM) and interpreting the ensemble of OSM signals. Thus, the technology being developed here should support potential integration with current and projected near-term OSM innovations (4).

To meet specific Army aviation requirements and to integrate with existing Army kits and equipment, significant engineering and algorithm development is anticipated. Additionally, the technology will need to be hardened to mitigate the rotary-wing vibration environment. Furthermore, software enhancements are likely necessary to integrate with the Army's specific software frameworks and possible fusion and/or comparison with other OSM data, flight information, and other factors. If fielded, the technology may require secured communication methods.

PHASE I: Given its short duration, Phase I will not incorporate human testing but will focus on the identification, design and development of an initial proof-of-concept prototype to record such essential physiological OSM parameters as peripheral blood oxygen saturation, cerebral blood oxygen, respiration rate, heart rate and other relevant metrics as well as the identification of pathways for the implementation of hydrostatic shock detection consequent to blunt force or penetrating trauma. To accelerate product development during this phase, an expert workshop targeting OSM in military and civilian aviation will clarify current and emerging near term needs and technology. The proposed prototype Phase I designs should have a compact, low profile, minimally intrusive footprint potentially compatible with the Army helicopter pilot's current helmet.

PHASE II: Phase II will be devoted to the construction, refinement, characterization, and demonstration of the functionality of prototypes designed in Phase I. During Phase II, hydrostatic shock detection capability will be incorporated into the candidate prototype form factors. Essential signal processing, database management, analysis, and display software will be designed and developed. Norms, standards, or 'Red Lines' for the prototype's physiological signals will be demonstrated. Simultaneous displays of cerebral blood oxygen, pulse oximetry, heart rate, and respiration rate for near-real time aviator self and supervisory monitoring will be developed. Additionally, during Phase II, functionality during surrogate mission simulations lasting up to 8 hours in at least 6 Warfighters will be demonstrated. A strategy and plan for FDA approvals will be developed and initiated, and a plan for self and crewmate monitoring will be formulated. Additional candidate OSM variables to interface with the prototype will be identified. Four copies of the prototype devices are to be delivered to USAARL for further test and evaluation.

PHASE III DUAL USE APPLICATIONS: The end-state of this work is an FVL-enabling technology that monitors, in real-time, the medical and physiological status of the pilot and aircrew. This goal is closely aligned with initiatives and goals within the PEO Aviation office to improve aviator safety and situational awareness by reducing cockpit workload and stress. As the technology developed here demonstrates capability within FVL aircraft, it will be integrated into PEO Aviation's enduring fleet aircraft, and more broadly into aircraft platforms across the DoD. Notably, this technology supports the achievement of a validated requirement for FVL aircraft to include operator state monitoring interfaces that enable supervised autonomy. The developer will identify public and private sector funding to support additional necessary R&D as well as the FDA approval plan as required. The developer will be encouraged to coordinate with USAARL to acquire a limited air worthiness certification to enable flight tests and evaluations of the viable prototype(s) as this technology is transitioned to the Army, other DoD partners, and to the private sector, including commercial aviation.

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Note: USAARL publications are available for the USAARL Science Information Center: usarmy-usaarl-sic@health.mil, 334-255-6067

KEYWORDS: Future Vertical Lift, Army Aviators, Physiological monitoring, Cerebral oximetry, Respiration, Pulse oximetry, Operator state monitoring

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DHA233-004 TITLE: Technology to Drive 60-day Runtimes in Wearable Devices

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

**OBJECTIVE:** Invent and/or develop hardware and embedded software technologies integrated onto a self-powered on-body sensor. The wearable device should include physiological and environmental sensing, recording, and processing that should operate off a non-AC/DC power supply. The device shall be capable of a minimum of 60-day runtime and be able to operate in disconnected, i.e., no cloud or SaaS support, military relevant environments. The developed wearable devices will require additional DoD relevant security measures.

**DESCRIPTION:** Wearable devices offer the DoD novel information to support readiness of Service Members, informing health and safety risks (1,2). The DoD lacks the ability for continuous remote physiological monitoring to inform readiness metrics under austere military conditions due to power supply limitations of commercially available wearable devices. Addressing this gap will support feedback to the individual Service Member for improved individual performance and resilience, personnel wellness across the unit, and ultimately, to inform and support decisions affecting training, readiness, and mission planning (3).

This funding opportunity announcement solicits applications that address the development of a hardware and software technology to extend the runtime of wearable devices through the development of a self-powered on-body sensor that collects physiological data and operates in a disconnected military relevant environment. The development of this innovative technology will greatly improve the ability to field wearable devices for long periods of time where recharging may not be operationally feasible. While the innovation is within the development of a self-powering approach to extend wearable devices to a 60-day runtime, this must be done in conjunction with a robustly tested sensor suite so to ensure the data collected are high quality. Additionally, operational environments that involve movements, such as maritime, where induced environmental motion make detection of activity levels or sleep periods especially challenging should be addressed in sensor selection. If fielded, the technology may require secured communication methods.

**PHASE I:** Phase I proposals should present a plan for the design, development, and fabrication of an on-body wearable, physiological sensor that operates on a non-AC/DC power source with up-to-date sensors for data capture and analysis. The proof-of-concept should demonstrate a 60-day or greater runtime without the need to connect and recharge from a power source. The proof-of-concept device should include emerging sensing innovations, numerous sensor transducers, and sufficient processing to extract multivariate/multimodal sensing biomarkers and health status summary information. Applicants should also present a clearly defined plan to improve any existing capabilities to support disconnected military relevant environments. Phase I will result in a proof of concept for testing and refinement in Phase II. Preference for made in U.S.A. compliance. A detailed definition of the device requirements will be provided to the successful Phase I demonstrations to proceed to Phase II.

**PHASE II:** Phase II will focus on prototype development and refinement of the proof-of-concept on-body sensor developed in phase I. The accomplishment of a 60-day runtime will be demonstrated in Phase II. Additionally, the developed wearable will need to be interoperable with existing DoD wireless infrastructure. The wearable devices will need to manage wireless transmission of health and readiness status information over a wireless link while maintaining an extended runtimes of 60-days or greater. Interface specifications will need to be provided to the DoD to define and develop appropriate wireless interfaces in existing data infrastructure. The prototype devices should have sufficient on-device memory storage to retain weeks' worth of summary information and synchronize the saved information to the DoD support infrastructure. Applicants should also provide a detailed plan that will outline the

verification and validation of the wearable device and sensing capabilities. The wearable device should provide at a minimum but not limited to, heart-rate, heart-rate variability, activity/motion, and asleep/awake health status information. Applicants should also provide a detailed plan that will occur for testing and evaluation (to include data type, frequency, and structure).

**PHASE III DUAL USE APPLICATIONS:** Phase III will focus on the best performing prototype with intent to inform commercialization and future DoD procurement. Proposals should lay out a plan for longitudinal evaluation of their Phase II product in an operational environment. For Phase III, 50 prototypes will be delivered for testing in ongoing demonstrations with Navy Surface Force ships. This evaluation will consist of a cross comparison of the prototype function across two (or more) ships of different class and where appropriate include Marines and other service members embarked on warships (e.g., Destroyer vs. Amphibious Assault Ship) across the Operational Deployment Cycle/Optimized Fleet Response Plan Cycle. In Phase III performers shall outline the ability to mass produce, support, and service the developed wearable devices.

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**KEYWORDS:** Wearable monitoring, biometrics, remote data capture, self-powered sensor, energy storage, physiological sensors, military readiness, non- AC/DC power source

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DHA233-D001 TITLE: Medical Oxygen Storage and Delivery for Deployed Joint Services' Casualty Care

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: Develop a composite, or other, lightweight, low ballistic hazard oxygen cylinder/tank for medical grade oxygen in deployed environments. Meet/exceed D Cylinder volume; improve upon logistics by reducing weight and making cylinders self-stackable and interlocking.

DESCRIPTION: The ability to store and deliver oxygen to patients requiring supplemental oxygen is an essential capability for deployed medical facilities and personnel that provide treatment primarily to combat casualties who incur traumatic injuries. Oxygen storage is a necessity to successful battlefield medicine, but also presents some of the largest logistical challenges and combustible hazards. The U.S. military's current oxygen storage capability is to use oxygen cylinders that are made primarily from metal. The current oxygen cylinders are heavy, highly combustible, and require a large cube space for storage and transportation. These characteristics limit the organizations' ability to support far-forward combat operations in multi-domain operations where supply and resupply operations are anticipated to be greatly hindered. Due to these constraints, the U.S. military seeks to develop a composite (or of similar material), lightweight, low ballistic hazard oxygen storage and delivery cylinder. The desired cylinder must meet the size and valve/regulator connector specifications of a standard D cylinder, while meeting or exceeding the volume capability; the cylinder meet FDA requirements for medical use. The cylinder should be a reduced weight compared to that of a D cylinder and feature a stackable and/or an interlocking feature. The valve/regulator connector may be of the same material as used in current D cylinders or may be of novel material so long as oxygen quality/purity, and both cylinder functionality and durability are uncompromised. The desired cylinder should also be fitted with connections that are compatible with existing U.S. military oxygen refilling equipment for a D cylinder. The characteristics of the desired oxygen storage capability will greatly improve weight, logistic, and ballistic hazard considerations.

PHASE I: This topic is intended for technology proven ready to move directly into Phase II. Therefore, the offeror must be able to demonstrate that its desired oxygen storage and delivery device has already met the scientific, technical, and feasibility accomplished for a Phase I-like effort.

Proof of feasibility shall include:

- Description of all relevant information including, but not limited to: technical objectives and reports, test data, product demonstrations, prototype designs/models, patents, and performance goals/results.
- Test and analysis results that the device meets or will meet all parameters (size, weight, volume, lower ballistic hazard, stack/interlock capability as an integrated or add-on feature, compatibility with existing refilling capability, etc.).
- Commercialization strategy including costs and schedule; regulatory strategy and status; FDA plan; transition to government roadmap; preliminary materials selection including MSDSs.
- Effectiveness in a deployed setting which includes static, dismounted medical units as well as medical transportation vehicles (ground and rotary-, tilt-rotor or fixed-wing).

PHASE II: Phase II will consist of further development, refinement, and optimization of the desired oxygen storage and delivery device to demonstrate its utility and validating the prototype(s) through relevant testing. The offeror shall test the prototypes in simulated environments in accordance with relevant standards for transportation, safety, and quality. For example, MIL-STD-810H is used by the military to determine viability in harsh environments. The initial phase of testing shall also include analysis to ensure the prototype meets size, weight, and ability to stack/interlock as described by the offeror. Once met, testing and evaluation shall involve refinement and more rigorous testing in laboratory studies to determine probability of ballistic hazard, and to ensure there is no degradation of oxygen purity

over time. All testing must be conducted in compliance with all applicable standards and regulations in a qualified facility. The offeror shall define and document all relevant regulatory strategies based on the regulatory body (e.g., FDA, DOT, OSHA), demonstrating a clear plan for approvals. Additionally, the offeror will identify appropriate commercialization partners (ex. manufacturing, marketing, etc.) to facilitate technology transition into the commercial market after approval is attained. Seven (7) prototype devices shall be delivered to the Government for environmental testing and user evaluations.

Deliverables will include:

- Design drawings and schematics
- Material Safety Data Sheets (MSDSs) for planned manufacturing materials
- Scientific analysis of ballistic hazard
- Regulatory strategy and pathway, as needed, to include a clear plan of how all regulatory body requirements will be achieved
- Prototype devices, quantity seven (7), for Government evaluation

**PHASE III DUAL USE APPLICATIONS:** The technology developed under this SBIR effort will have applicability to both civilian and military emergency medicine, and commercialization strategies should be developed to ensure both markets are being addressed. Phase III will consist of finalizing the device design and delivering manufactured devices (in their final form) for military-relevant testing such as airworthiness/performance testing (e.g., Joint Enroute Care Equipment Test Standards [JECETS], AR 70-62) and other Regulatory Body-related testing (ex. FDA, DOT, OSHA) under design freeze. The device will be functional for use by medics, physician assistants, nurses, and physicians in far forward environments (roles 1-3 of care and en route care, including ambulances), as well as civilian first responders, Life Flight teams, and others requiring transportable oxygen to care for patients. In addition to regular monthly reporting, the performer will be required to provide status updates to the Government team, apprising of commercialization efforts, highlighting potential interest from the civilian marketplace. Phase III will also include developing and finalizing training methods and protocols for the new device. Additionally, the regulatory package should be in its final form ready for submission to the Regulatory Agency(ies) including all relevant test data, where applicable.

#### REFERENCES:

1. D cylinder specifications, including size, weight and volume; D cylinder, National Stock Number (NSN) 6505-00-132-5181
2. MIL-STD-810H and delineation of relevant thresholds
3. [https://quicksearch.dla.mil/qsDocDetails.aspx?ident\\_number=35978](https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=35978)

**KEYWORDS:** Medical oxygen, Oxygen storage, Oxygen delivery, Oxygen storage safety, Oxygen ballistic hazard, D cylinder, Composite D cylinder, FDA, Combat Casualty Care

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**Defense Logistics Agency (DLA)**  
**23.3 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 Broad Agency Announcement (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.

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.

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](mailto:DLASBIR2@DLA.mil)**

This release contains an open topic. As outlined in section 7 of the SBIR and STTR Extension Act of 2022, innovation open topic activities—

- (A) Increase the transition of commercial technology to the Department of Defense;
- (B) Expand the small business nontraditional industrial base;
- (C) Increase commercialization derived from investments of the Department of Defense; and
- (D) Expand the ability for qualifying small business concerns to propose technology solutions to meet the needs of the Department of Defense.

Unlike conventional topics, which specify the desired technical objective and output, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities.

**A small business concern may only submit one (1) proposal to each open topic.** If more than one proposal from a small business concern is received for a single open topic, only the most recent proposal

to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for the same open topic will be marked as nonresponsive and will not receive an evaluation.

## **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. <https://www.dodsbirsttr.mil/submissions/login>

### **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 20 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.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DLA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

### **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 Program BAA for full details on this requirement. Information contained in the CCR will be considered by DLA during proposal evaluations.

### **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 proposing small business concerns 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
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

Additional DLA-specific supporting documents:

- Optional, A qualified letter of support is from a relevant commercial or government agency procuring organization(s) working with DLA, articulating their support 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 Post Award Conference (PAC).
- The Technical Point of Contact (TPOC) and the Program Manager (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).

## **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 Program Management Office (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.

### **DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)**

DLA is not authorizing TABA at this time.

### **EVALUATION AND SELECTION**

#### **Use of Support Contractors in the Evaluation Process**

Only government personnel with active non-disclosure agreements will officially 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.

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.

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.

Final Selection may require an oral presentation. This may include an in-person meeting or a Zoom.gov meeting.

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.

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.

## **AWARD AND CONTRACT INFORMATION**

Typically, the contract period of performance for Phase I should be up to 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 \$1,000,000 unless approved by the DLA Program Manager, and the duration should not exceed 24 Months. Proposals in excess of \$1,000,000 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 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](mailto: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 External Certificate Authority (ECA) certificates to send and receive encrypted email if they do not have a Common Access Card (CAC) or Personal Identity Verification (PIV) issued. The cost is approximately \$100 per year per user. This will be a Cybersecurity Maturity Model Certification (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.



- (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 SBIR 23.3 Phase I Topic Index**

DLA233-P001	Phase I Open Call for SMALL BUSINESS CLOSING SUPPLY CHAIN GAPS FOR AGING WEAPON SYSTEMS
DLA233-002	Engaging the Aerospace Bearing Manufacturing Industrial Base in Support of DLA's Critical Supply Chains
DLA233-003	Production of Battery Grade Graphite Flakes

DLA233-P001 TITLE: Phase I Open Call for SMALL BUSINESS CLOSING SUPPLY CHAIN GAPS FOR AGING WEAPON SYSTEMS

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear, Mission Readiness & Disaster Preparedness

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 expand and develop new Small Business Manufacturer (SBM) industrial base partners to grow participation in support of manufacturing parts managed by DLA and the Services for Aging Weapon Systems in support of DLA's mission described in Ref. 1.

DESCRIPTION: DLA SBIR Program has a legacy of success in the advancement of critical manufacturing technologies that support our national security, along with a growing small business manufacturing network that fortify DLA supply chains. These efforts together with our Service partners are helping the DLA to build a resilient SBM base to reduce the acquisition and supportability costs of defense weapons systems, reduce manufacturing and repair cycle times across the life cycles of such systems, and transition manufacturing research and development processes into production. Competitive proposals should originate from small business manufacturing firms and include their process for manufacturing a National Stock Number (NSN) or component for specific weapon platform. Proposals with software or integrated manufacturing solutions will not be evaluated.

Projects of this open topic can develop in several ways:

- a) SBMs can identify NSNs on the DLA Internet Bid Board System (DIBBS). More details are available at Ref. 2. JCP Certification required as described in Ref. 3.
- b) SBMs can identify NSNs through partnerships with the Air Force, Navy, Army or Marine Corps or Original Equipment Manufacturer (OEM).
- c) SBMs can propose advanced manufacturing methods for existing NSNs to improve cost, reduce lead time and/or improve quality.

None of these projects can proceed without appropriate sponsorship from the DLA or one of the military Services. Identify specific partnerships and points of contact to strengthen your proposal. A specific NSN must be identified to participate in the open topic through independent SBM research. NSN's will not be provided. The Offeror must fully understand the path to becoming an approved source for the proposed NSN and describe it in their proposal.

PROJECT DURATION and COST:

PHASE I: Not to exceed a duration of 6 months and cost of \$50,000.

PHASE II: Not to exceed a duration of 24 Months and cost of \$1,000,000.

DLA intends to make 4 awards against this topic. **A small business concern may only submit one (1) proposal to this open topic.** If more than one proposal from a small business concern is received for this open topic, only the most recent proposal to be certified and submitted prior to the submission deadline

will receive an evaluation. All prior proposals submitted by the small business concern for this open topic will be marked as nonresponsive and will not receive an evaluation.

**PHASE I:** The project schedule should plan to perform all tasks necessary to become an approved source including but not limited to completing the TDP if applicable and/or Source Approval Request (SAR) within the period of performance.

The goal of phase I is for the SBM to develop the appropriate documentation to qualify as a source of supply for a DLA managed NSN which will demonstrate their capability to be added to a list of DLA SBIR SBM network. In this phase, manufacturers will submit a Technical Data Package and/or Source Approval Request via DLA to the applicable Engineering Support Activity (ESA), as required, for approval. The benefit to the SBM for qualifying for DLA's SBM network is eligibility for non-competitive SBIR Phase II awards and DLA NSN procurements.

All Phase I Proposals should demonstrate an understanding of the NSN and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the NSN will be rejected. JCP Certification is required to access Government drawings and data. Please see reference 2. A review of references 4, 5, and 6 is highly recommended.

**PHASE II:** Typically, Phase II advances the project into production when representative articles are required to support validation and/or testing for source approval. Secondly, if a complete solution is not apparent by the end a Phase I, additional research may be required and funded in Phase II. Finally, in some cases the path to Low-Rate Initial Production may require funding for pre-production, test equipment and/or test services. The goal being to transition the NSN to a program or record as an approved manufacturing source.

**PHASE III DUAL USE APPLICATIONS:** A successful Phase III is an award(s) from DLA or the Services for the NSN proposed.

**PHASE III DUAL USE APPLICATIONS:** This NSN or related technology and manufacturing processes developed under this award could be used in a broad range of military and commercial applications.

**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 Strategic Plan 2021-2026: <https://www.dla.mil/Info/Strategic-Plan/>
1. Access the web address for DIBBS at <https://www.dibbs.bsm.dla.mil>, then select the "Tech Data" Tab and Log into c-Folders.
2. JCP Certification: <https://www.dla.mil/Logistics-Operations/Services/JCP/>
3. DLA Aviation SAR Package instructions. DLA Small Business Resources: <http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx>
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:** Manufacturing, National Stock Number, Commercialization, Weapon System, Reverse Engineering, Technical Data Package

DLA233-002 TITLE: Engaging the Aerospace Bearing Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear, Mission Readiness & Disaster Preparedness

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 for aerospace bearing applications 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 must have the manufacturing capability to produce ball bearings and roller bearings for aerospace applications along with appropriate quality credentials (AS9100, Nadcap, ISO 9001). We are not looking for engineering firms, distributors, or system integrators. In addition, the manufacturer 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.

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.

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. JCP Certification is required to access Government Drawings and Data. Please see reference 2.

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.

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 "SBIR233C". If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE III DUAL USE APPLICATIONS: 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://www.dla.mil/Logistics-Operations/Services/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 “SBIR233001”
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

DLA233-003      TITLE: Production of Battery Grade Graphite Flakes

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced 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 Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies of related materials consistently to our Department of Defense (DoD) customers and other DoD stakeholders. 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 higher levels of innovation in current and future systems combined with benefits to other commercial and government technology applications. In an effort to reduce costly foreign reliance and/or single points of failure, DLA is looking for domestic production of battery-grade graphite. The end goal of the project would be for the development of a domestic source that would produce industrial quantities of material with a fully domestic or friendly supply chain. New and novel ideas that would allow for competitive pricing with imported graphite and/or novel feedstocks will have preference. Ideally, the production process would be modular and scalable.

Advanced technology demonstrations for increasing production capacity, affordability and supply chain resiliency for critical materials and processing are of high interest to DoD. These areas of materials and manufacturing technology provide potential opportunities toward achieving breakthrough advances for national defense. Proposed efforts funded under this topic may encompass diverse feedstock and processing at any level that will result in increasing production capacity, affordability, 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:** The Department Of Defense (DoD) has a need for robust battery-grade graphite supply chain to support operational requirements. To this end DLA is looking for domestic capabilities and capacity to produce graphite with purity (>99.95%) and properties appropriate for advanced battery manufacturing. Novel techniques that increase the domestic availability of technology for supply chain resiliency of strategic materials will have preference. Both natural and synthetic processing methods are of interest. A desire for the process to use friendly sources of feed materials is preferred but not required. The ideal production process will be both modular and easily scalable.

**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 18 months and cost of \$1,000,000.



PHASE I: Phase I will consist of a full process flow including energy usage and waste generation. Then a lab-scale process should be used to confirm the estimates and provide preliminary cost and pricing data. 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. Collaboration with a relevant DoD Component organization (e.g., DoD lab and/or defense system program office) and one or more relevant DoD weapon system supply chain participants or other suitable organization is highly desirable.

PHASE II: Phase II will consist of making a pilot/ low-rate production plant. Material produced will be characterized for purity, density, shape, etc. Two (2) or more sources of raw materials will be identified and tested in this process. Pricing and cost information will be validated. A business case will be generated using both DoD and commercial markets. Collaboration with a relevant DoD Component organization (e.g., DoD lab and/or defense system program office) and one or more relevant DoD weapon system supply chain participants or other suitable organization 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: At this point, no specific funding is associated with Phase III. Progress in Phase I and Phase II should result in the ability to produce to DoD orders and organic growth of business from there.

#### REFERENCES:

1. Olsen, D. (2022). Mineral Commodity Summaries 2022 - Graphite. United States Geological Survey
2. Zhang, J., Liang, C., Dunn, J. (2023) Graphite Flows in the U.S.: Insights into a Key Ingredient of Energy Transition. Environ. Sci. Technol. 2023, 57, 8, 3402-3414

KEYWORDS: battery-grade graphite, flake graphite, spherical graphite (SPG), natural graphite, synthetic graphite, advanced battery technology, Li-ion battery

**Defense Human Resources Activity (DHRA)**  
**23.3 DoD 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 in the field of Advanced Computing and Software and Integrated Network Systems-of-Systems.

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD SBIR Program BAA. DHRA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.

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](mailto:tammy.j.proffitt2.civ@mail.mil).

**PHASE I PROPOSAL GUIDELINES**

The Defense SBIR Innovation Portal (DSIP) is the official portal for DoD SBIR 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.

**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 10th page. Information beyond the 10th 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 (Volume 2)**

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 amount must not exceed \$200,000.00.

Please review the updated Percentage of Work (POW) calculation details included in the DOD Program BAA. DHRA will not accept any deviation to the POW requirements.

#### **Company Commercialization Report (CCR) (Volume 4)**

Completion of the CCR in 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 DHRA during proposal evaluations.

#### **Supporting Documents (Volume 5)**

All proposing small business concerns 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
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

#### **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. Phase II will be a 12 month base duration with a 6 month option, not to exceed a total value of \$1,250,000.

#### **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 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](mailto: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.

**DHRA**  
**SBIR 23.3 Topic Index**

OSD233-005

Service Member and Veteran Journey Map

OSD233-005 TITLE: Service Member and Veteran Journey Map

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Integrated Network Systems-of-Systems

OBJECTIVE: Leveraging person centric metadata, create a means to visualize, model and understand these data within the context of the Service Member / Veteran journey map.

DESCRIPTION: DHRA is seeking solutions to visualize and model the data within the Service Member / Veteran Journey Map [1] to improve the understanding of data at each moment that matters, improve the curation of data for decision makers, research and analytics purposes, understanding of the data in context of the service member journey and positioning DoD and VA to gain insights on the metadata.

While each individual's military experience is unique, there are common moments that matter throughout a Service Member's career. These moments that matter are visualized in the Service Member / Veteran Journey Map created by the Department of Veterans Affairs (VA). Tying this visualization to actual data will help our customers discover the metrics, data products and individual data elements corresponding with these moments that matter. This link will include the detailed sub-journeys a Service Member / Veteran can take throughout their lifetime, with the ability to drill down for the key moments that matter in order to view specific metadata and data products as well as contact data stewards.

Relevant Definitions:

- User Groups: Broad audience categories interested in using the metadata and data products behind the Service Member / Veteran Journey Map
- Moments that matter: Within the Service Member / Veteran Journey Map, these are the key points in the career and / or life of a Service Member or Veteran including joining the military, separation, retirement, birth of a child, etc.
- Personas: The different types of Service Members / Veterans each with specific moments that matter

PHASE I: Within 6 months the contractor shall design a concept for the creation of a link between the existing Service Member / Veteran journey map, the moments that matter and the relevant metadata and data products within a data catalog in a DoD accredited platform. The contractor will use the Service Member / Veteran journey map, the moments that matter within it and defined user groups as the foundation of Phase I work.

Required Phase I deliverables:

- Identify and define the different persona types within the Service Member / Veteran journey map and the moments that matter for each
  - Within each persona, understand and document the different sub-journeys 'through' the Service Member / Veteran journey map
- Refine different types of user groups depicted in the Service Member / Veteran journey map
- Define specific moments that matter within the Service Member / Veteran journey map for each user group with the ability to view the relevant metadata and data products
  - Perform an analysis to understand and document moments that matter relevant to all types of user groups
- Define for each user group the levels of granularity and types of metadata and data products required for each
- Provide a recommended high-level plan and timeline for prototype implementation

PHASE II: Upon successful completion of Phase I, contractor shall develop, demonstrate, and validate the prototype for the following:

- A single user group and corresponding moments that matter for that user group
- Complete views for 1-2 personas (across user groups) with relevant views, moments that matter, metadata details and specific data product recommendations
- Visualize the Service Member / Veteran journey map with the moments that matter, associated metadata, and relevant data products and data stewards

The expectation is for the data to be kept current in a multi-user environment, with activities and processes defined and executed to maintain the journey map, underlying data, and supporting integrations. Contractors must:

- Technically link metadata and data products to the Service Member / Veteran journey map leveraging existing interfaces
- Provide architecture documentation for how the prototype components and supporting tools integrate together
- Provide a functional specification and technical specification for the prototype
- Provide security evaluation documentation to support an eventual Authority to Operate (ATO) issuance and IL4/FedRAMP High accreditation (as part of potential Phase III activities), and identify any security ramifications of solution design choices (such as linking to metadata using sensitive URLs or IP addresses)

All members of the contractor team (prime, subcontractors, etc.) providing personnel, including supervisory personnel, to perform the work must comply with the applicable security clearance levels (facilities/personnel) based on the sensitivity of the task/work requiring a clearance.

Additional considerations:

- Coordinate Authority to Connect or MOU requirements for integration with a DoD accredited platform
- Provide a CAC/PIV enabled solution and user provisioning process
- Provision a subset of users to use the prototype and collect feedback (including both DoD and VA users)

The contractor must provide a final report on solution value, user feedback, and overall feasibility within 60-90 days before conclusion of performance

The contractor is required to be present in person for the following Phase II events:

- Initial Phase 2 Kickoff Meeting
- Mid-Year Review 6 months into the 12 month initial period of performance
- Final demonstration of capability upon prototype completion

### PHASE III: DUAL USE APPLICATIONS:

Corporations and government entities often produce graphics depicting core businesses, operations or customers to present to their executives, employees or the public. These graphics are often static and require viewers to manually research what they see should they desire further information or have questions. The technology built to link the Service Member / Veteran Journey Map (a graphic) to live data will drastically reduce the time it takes an individual to understand the graphic and allow deep exploration of the data behind the graphic to enable better insights and decisions. This technology is widely applicable to commercial and government entities who need to enrich their graphics, socialize the

data behind these graphics and improve customer experiences.

REFERENCES:

1. Service Member / Veteran Journey Map. March 5, 2020.  
[https://www.defensesbirsttr.mil/Portals/122/Documents/baa\\_docs/dhra\\_service\\_member\\_veteran\\_journey\\_map.pdf](https://www.defensesbirsttr.mil/Portals/122/Documents/baa_docs/dhra_service_member_veteran_journey_map.pdf).
2. Automated Extract of Active Duty Military Personnel Records. August 26, 2021. Online at  
[https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/133605p.pdf?ver=uOa\\_ZL1P51zqOd6seJeBLg%3d%3d0j](https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/133605p.pdf?ver=uOa_ZL1P51zqOd6seJeBLg%3d%3d0j)
3. Reserve Components Common Personnel Data System (RCCPDS). August 26, 2021. Online at  
<https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/773054p.pdf>

KEYWORDS: Service Member, Veteran, Military, Army, Navy, Marine Corps, Air Force, Space Force, Coast Guard, Visualization, Data Steward, Data Stewardship, Data Product, Business Intelligence, BI, B.I., Metadata

**National Geospatial-Intelligence Agency (NGA)  
23.3 Small Business Innovation Research (SBIR)  
Proposal Submission Instructions**

**INTRODUCTION**

NGA is a Department of Defense (DoD) combat support agency and a member of the U.S. Intelligence Community (IC). NGA develops imagery and map-based intelligence solutions for U.S. national defense, homeland security, and safety of navigation. NGA's mission is to "provide timely, relevant, and accurate geospatial-intelligence in support of national security." Today, NGA manages the National System for Geospatial-Intelligence (NSG), which provides the foundation for correlating U.S. intelligence activities to the location of the Earth.

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. Additional information pertaining to the NGA mission and high-level course can be obtained by viewing the agency's website at <https://www.nga.mil> and NGA's strategy documents at <https://www.nga.mil/about/strategy.html>.

NGA Research supports the NSG and National Security Strategy by solving hard defense and intelligence problems for the IC and DoD in three broad areas: Foundational GEOINT; Advanced Phenomenologies; and Analytic Technologies. NGA Research works with customers on early concepts through to advanced developments in operating systems and environments.

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD SBIR Program BAA, as applicable. 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 NGA 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](mailto:SBIR@nga.mil)

Proposers responding to a topic in this BAA must follow all general instructions provided in the DoD SBIR Program BAA. NGA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

**Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.**

- The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.

Specific questions pertaining to the administration of the NGA Program and these proposal preparation instructions should be directed to: [sbir@nga.mil](mailto: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 limitation. Number all pages of your proposal consecutively.

### **Content of the Technical Volume**

The offeror shall not propose option period(s).

**Commercialization Strategy.** In addition, the Commercialization Strategy shall also address Section 508 compliance as noted below:

#### 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 offeror's proposal, the offeror should include an outline of specifically how Section 508 compliance will be achieved in the design of the ICT product. The proposal for Phase II 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.

### **Cost Volume (Volume 3)**

The Phase I amount must not exceed \$100,000 for up to a nine (9)-month period of performance. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. NGA will not accept any deviation to the POW requirements.

**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 NGA during proposal evaluations.

**Supporting Documents (Volume 5)**

All proposing small business concerns 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
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

Additionally, submission of Standard Form 328, "Certificate Pertaining to Foreign Interests," is required in order to be considered for award. The form can be found at <https://www.gsa.gov/forms-library/certificate-pertaining-foreigninterests>.

**PHASE II PROPOSAL GUIDELINES**

Phase II proposals may only be submitted by Phase I awardees. Small business concerns shall provide a proposal no later than 30 calendar days prior to the expiration of their NGA Phase I contract period of performance to be considered for a Phase II award. For improved continuity, NGA encourages Phase I awardees to submit their Phase II proposals 60 days prior to the expiration of their NGA Phase I contract period of performance.

Sequential Phase II proposals (for related work after completion of the initial NGA Phase II or Direct to Phase II contract) will normally be required within 30 calendar days of: 1) NGA's review of the provider's prototype and final report, 2) NGA's determination that additional work is desired and funding is available; and 3) NGA's determination that the required work is not suitable for a Phase III contract. NGA expects to complete these actions within 30 calendar days of final report receipt. The precise proposal due date will be annotated in Section F of the original Phase II or Direct to Phase II contract.

NGA may entertain Phase II proposals to continue related work on non-NGA Phase I contracts of interest, subject to the original government contracting entity's approval. There are no pre-established due dates for these proposals.

Phase II proposal format, content, and submission instructions are identical to those described in the "DIRECT TO PHASE II PROPOSAL INSTRUCTIONS" above, except that the Technical Volume will only contain a Technical Proposal of up to 40 pages. Do not submit Part A – Feasibility Documentation.

**DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TAB A)**

NGA does not provide TAB A.

**EVALUATION AND SELECTION**

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the NGA Contracting Officer/Specialist with their official notification of

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proposal selection or non-selection within 90 days of the closing date of the BAA or the timely submission date of their Phase II proposal. 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 in response to this BAA with the award designation of “Award if Additional Funding Becomes Available” will receive consideration for award through October 17, 2024. Phase II proposals with this award designation will receive consideration for award for a period of one year following the timely submission date of the Phase II proposal.

An unsuccessful offeror has three (3) days after notification that its proposal was not selected to submit a written request for a debriefing to the Contracting Officer (CO).

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: Emely Winnert at [Emely.E.Winnert@nga.mil](mailto:Emely.E.Winnert@nga.mil).

### **AWARD AND CONTRACT INFORMATION**

Phase I awards are capped at \$100,000 each over a maximum nine (9)-month period of performance.

Phase II awards are capped at \$1,000,000 each over a maximum 24-month period of performance.

NGA caps sequential Phase II contracts (those proposed near the completion of the initial Phase II or Direct to Phase II contract) at the then current Small Business Administration (SBA) “without seeking SBA approval” ceiling over a maximum 24-month period of performance. See <https://www.sbir.gov/about> for the most recent information.

NGA typically provides a firm fixed price contract for its awards within 180 days of the proposal due date. The type of contract is at the discretion of the Contracting Officer.

### **ADDITIONAL INFORMATION**

#### **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.

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During performance of this contract, if the government provides the offeror a dataset that is not publicly released, the offeror must be CUI Compliant to receive it. For more information on this compliance please see DFARS Clauses 252.204.7008 and 252.204-7012, NIST Special Publication SP 800-171 and the National Archives and Records Administration (NARA) website (<https://www.archives.gov/cui/about>).

See each individual topic for guidance.

### **NON-DISCLOSURE AGREEMENTS (NDA)**

Subject to any vetting of uncleared individuals involved in the project per the DoD SBIR Program BAA, all eligible contractor and subcontractor personnel requiring access to Protected Information and Computer Software shall sign an NDA prior to accessing such information. See 5X52.209-9003, Protection of Information and Nondisclosure Agreements (JUN 2009) below for additional details.

### **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 UNCLASSIFIED ONLY contracts)**

Contractor personnel performing Top Secret/Sensitive Compartmented Information (TS/SCI) work on the SBIR 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.

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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.

### **DISCLOSURE OF INFORMATION**

(1) 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-

- (a) The Contracting Officer has given prior written approval;
- (b) The information is otherwise in the public domain before the date of release; or
- (c) 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

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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).

(2) 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.

(3) 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.**

### Clauses

#### **52.204-7 System for Award Management.**

As prescribed in 4.1105(a)(1), use the following provision:

#### SYSTEM FOR AWARD MANAGEMENT (OCT 2018)

(a) Definitions. As used in this provision—

"Electronic Funds Transfer (EFT) indicator means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management records for identifying alternative EFT accounts (see subpart 32.11) for the same entity.

*Registered in the System for Award Management (SAM)* means that—

(1) The Offeror has entered all mandatory information, including the unique entity identifier and the EFT indicator, if applicable, the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see subpart 4.14) into SAM

(2) The offeror has completed the Core, Assertions, and Representations and Certifications, and Points of Contact sections of the registration in SAM;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record "Active".

*Unique entity identifier* means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See [www.sam.gov](http://www.sam.gov) for the designated entity for establishing unique entity identifiers.

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(b)

(1) An Offeror is required to be registered in SAM when submitting an offer or quotation, and shall continue to be registered until time of award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The Offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "Unique Entity Identifier" followed by the unique entity identifier that identifies the Offeror's name and address exactly as stated in the offer. The Offeror also shall enter its EFT indicator, if applicable. The unique entity identifier will be used by the Contracting Officer to verify that the Offeror is registered in the SAM.

(c) If the Offeror does not have a unique entity identifier, it should contact the entity designated at [www.sam.gov](http://www.sam.gov) for establishment of the unique entity identifier directly to obtain one. The Offeror should be prepared to provide the following information:

- (1) Company legal business name.
- (2) Tradestyle, doing business, or other name by which your entity is commonly recognized.
- (3) Company physical street address, city, state, and Zip Code.
- (4) Company mailing address, city, state and Zip Code (if separate from physical).
- (5) Company telephone number.
- (6) Date the company was started.
- (7) Number of employees at your location.
- (8) Chief executive officer/key manager.
- (9) Line of business (industry).
- (10) Company headquarters name and address (reporting relationship within your entity).

(d) Processing time should be taken into consideration when registering. Offerors who are not registered in SAM should consider applying for registration immediately upon receipt of this solicitation. See <https://www.sam.gov> for information on registration.

(End of Provision)

**52.204-27 Prohibition on a ByteDance Covered Application.**

As prescribed in 4.2203, insert the following clause:

PROHIBITION ON A BYTEDANCE COVERED APPLICATION (JUN 2023)

(a) *Definitions.* As used in this clause—

*Covered application* means the social networking service TikTok or any successor application or service developed or provided by ByteDance Limited or an entity owned by ByteDance Limited.

*Information technology*, as defined in 40 U.S.C. 11101(6)—

(1) Means any equipment or interconnected system or subsystem of equipment, used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency, if the equipment is used by the executive agency directly or is used by a contractor under a contract with the executive agency that requires the use—

(i) Of that equipment; or

(ii) Of that equipment to a significant extent in the performance of a service or the furnishing of a product;

(2) Includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including support services), and related resources; but

(3) Does not include any equipment acquired by a Federal contractor incidental to a Federal contract.

(b) *Prohibition.* Section 102 of Division R of the Consolidated Appropriations Act, 2023 (Pub. L. 117-328), the No TikTok on Government Devices Act, and its implementing guidance under Office of Management and Budget (OMB) Memorandum M-23-13, dated February 27, 2023, “No TikTok on Government Devices” Implementation Guidance, collectively prohibit the presence or use of a covered application on executive agency information technology, including certain equipment used by Federal contractors. The Contractor is prohibited from having or using a covered application on any information technology owned or managed by the Government, or on any information technology used or provided by the Contractor under this contract, including equipment provided by the Contractor’s employees; however, this prohibition does not apply if the Contracting Officer provides written notification to the Contractor that an exception has been granted in accordance with OMB Memorandum M-23-13.

(c) *Subcontracts.* The Contractor shall insert the substance of this clause, including this paragraph (c), in all subcontracts, including subcontracts for the acquisition of commercial products or commercial services.

(End of clause)



**5X252.204-7000-90 PUBLIC RELEASE OF INFORMATION (MAR 2023)**

(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 completing an NGA Form 5230-1 and without Contracting Officer approval, when submission of such information is 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.

(End of Clause)

**5X52.209-9003: PROTECTION OF INFORMATION AND NONDISCLOSURE AGREEMENTS (JUN 2009)**

(a) Definitions. As used in this clause only:

(1) Protected Information and Computer Software means, unless specifically excluded by paragraph below, all information and computer software, in any form or media, that in the course of performing work under this contract are disclosed to the Contractor, its subcontractors, or their employees, or to which those persons otherwise are given access to, by:

(i) NGA,

(ii) Other government agencies,

(iii) Foreign governments, or

(iv) Other contractors while directly supporting NGA, which is accompanied by written legends identifying use or disclosure restrictions or disclosed under circumstances that the Contractor knows are subject to use or disclosure restrictions established in writing by the Government.

(2) Protected Information and Computer Software does not include information that:

(i) Has been released to the general public through no action of the undersigned in breach of this agreement or through no action of any other party in breach of any other obligation of confidentiality owing to the Government or the owner of the protected information or computer software;

(ii) Has been lawfully obtained by the recipient outside the course of the performance of this contract;

(iii) Has been properly licensed or provided directly by the owner (or other authorized source) of the information or computer software to the recipient to the extent so licensed or provided;

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(iv) Is owned by the recipient or was developed independently of the disclosure hereunder;  
or

(v) Has been disclosed to the recipient by the Government with explicit authorization to use or disclose the information for another purpose, to the extent so authorized.

(b) Use and disclosure restrictions. The Contractor shall use and disclose Protected Information and Computer Software only as necessary for the performance of the requirements of this contract. Protected Information and Computer Software may not be used or disclosed for any other purpose, including bid or proposal preparation or business marketing, without the written approval of the Contracting Officer. Furthermore, unless otherwise directed by the Contracting Officer, the Contractor shall comply with all restrictions set forth in any legends, licenses or instructions provided to the Contractor or accompanying Protected Information and Computer Software or other written directives of the Government known to the Contractor. The use and disclosure obligations imposed by this paragraph shall expire as follows:

- (1) There shall be no expiration date for the following Protected Information and Computer Software:
  - (i) Technical data or computer software containing Limited Rights, Restricted Rights, Government Purpose Rights, Special License Rights, or Unlimited Rights legends;
  - (ii) information or software marked Limited Distribution (LIMDIS);
  - (iii) information or software marked Source Selection Information;
  - (iv) contract proposal information marked pursuant to FAR 52.215-1(e) limiting its use for proposal evaluation purposes only;
  - (v) information and computer software marked Contractor Proprietary or a similar legend;
  - (vi) data known by the Contractor to be protected by the Privacy Act; and
  - (vii) information and software marked Controlled Unclassified Information (CUI) or For Official Use Only (FOUO).
- (2) For other information or software accompanied at time of disclosure by a written legend identifying use or disclosure restriction time periods, the expiration date shall be as stated in or derived from the legend.
- (3) For all other Protected Information and Computer Software, the expiration date shall be 3 years from the date the information or software is first disclosed to the Contractor.

Notwithstanding the above obligations, the Contractor is not in breach of this agreement if the Contractor uses or discloses Protected Information and Computer Software in response to an order of a court or administrative body of competent jurisdiction, but only to the extent permitted by that authority and only if the Contractor gives the Contracting Officer, to the extent practical, notice of the tribunal's order before the use or disclosure is made that allows NGA a reasonable time to object to the order.

(c) Unauthorized Use or Disclosure. The Contractor shall immediately notify the Contracting Officer of any unauthorized use or disclosure known by the Contractor of Protected Information and Computer Software in violation of the obligations contained in this clause.

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(d) Disposition. At the conclusion of performance of work under this contract, the Contractor shall immediately return to the Government all Protected Information and Computer Software in its possession. Furthermore, if an employee of the Contractor who has had access to Protected Information and Computer Software is terminated or reassigned and thus is no longer performing work under this contract, the Contractor shall immediately return all Protected Information and Computer Software in the employee's possession. Moreover, if a Contractor's employee is dedicated to support a specific NGA Office or Directorate or NGA program under this contract, but is subsequently reassigned to support another NGA Office or Directorate or NGA program under this contract, the Contractor shall immediately return all Protected Information or Computer Software in the employee's possession previously furnished by the prior NGA Office or Directorate or NGA program. In lieu of returning Protected Information and Computer Software, the Contracting Officer or Contracting Officer's representative may authorize the destruction of the information or the transfer of the information to another employee of the Contractor working under the contract. Finally, this clause shall not be interpreted as preventing the Contractor from retaining records required by statutes or other clauses of this contract, such as FAR 52.215-2 Audit and Records--Negotiations.

(e) Third party beneficiaries. This clause is executed for the benefit of the Government and the owners of Protected Information and Computer Software. The Government and the owners of Protected Information and Computer Software (and their delegates, successors and assignees) are third party beneficiaries of the obligations contained in this clause who, in addition to any other legal rights they may have, are intended to have the rights of direct action against the Contractor or any person to whom the Contractor has disclosed or released Protected Information and Computer Software, to seek damages from any breach of this clause, or to otherwise enforce this clause.

(f) Duration. The above obligations imposed by this clause shall survive the termination or completion of this contract.

(g) Classified Information. This clause is in addition to and in no manner abrogates requirements, obligations or remedies regarding the protection of classified information and does not supersede the requirements of any laws, regulations, other directives or nondisclosure agreements regarding classified information.

(h) Other Restrictions. This agreement does not abrogate any other obligations currently placed upon the Contractor or which may be imposed upon the Contractor in the future by the Government or other persons; or remedies afforded those persons regarding those obligations.

(i) Nondisclosure agreements. The Contractor shall require and ensure that each of its employees who may receive or be given access to Protected Information and Computer Software signs the nondisclosure agreement provided by attachment to this contract prior to the employee performing work under this contract covered by the nondisclosure agreement. The Contractor shall maintain copies of signed nondisclosure agreements for a period of at least three years after final payment under this contract. At the direction of the Contracting Officer, the Contractor shall make those agreements available for inspection by the Contracting Officer and will furnish the Contracting Officer copies of those agreements at no additional cost to the Government if requested by the Contracting Officer.

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(j) The Contractor shall include the substance of this clause in all subcontracts under this contract in which subcontractors may be disclosed or granted access to Protected Information and Computer Software.

(End of Clause)

**5X52.227-9000 UNAUTHORIZED USE OF NGA NAME, SEAL AND INITIALS (JUN 2006)**

(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 of Clause)

**5X52.232-9000: Submission of Invoice-Federal Payment Center (FPC) (OCT 2017)  
– For use in contracts paid by the FPC vendor pay office.**

(a) The contractor shall prepare each invoice in accordance with the Prompt Payment Act and email one copy of the invoice to the DOD/FPC Scott AFB, IL at FMFOINSP@nga.mil. The DOD/FPC at Scott AFB, IL requires an email copy, but will accept a hard copy that is mailed to Federal Payment Center, P.O. Box 25767, Scott AFB, IL 62225.

(b) At the same time of submission of the invoice to the FPC vendor pay office, the contractor shall fax or email one copy to [**Contracting Officer**], and one copy to [**Contracting Officer Representative**]. The contractor shall ensure that the invoice submitted to the payment office is the same invoice that is submitted to the CO and the COR without alteration.

(c) Upon receipt of the invoice, the COR will complete the receiving report and submit via the RRPT database tool. A copy of the completed receiving report shall also be provided to the Contracting Officer shown on the face of this contract/order.

(d) Contractors wishing to check the payment status of their vouchers may do so by calling FPC Vendor Support at 636-321-5251. In addition, questions may be directed to the Contracting Officer’s Representative (COR). In the absence of a COR, contact the Procurement Contracting Officer (PCO), whose name and contact information appear

on the face page of this contract/order.

(End of Clause)

**5X52.237-9001 CONTRACTOR IDENTIFICATION (JAN 2012)**

The contractor shall ensure that contractor personnel, including their sub-contractor personnel, identify themselves as contractor personnel, by introducing themselves or being introduced as contractor personnel when:

- (1) attending meetings with Government personnel or contractors performing under a contract awarded to support NGA requirements,
- (2) answering government telephones,
- (3) providing any type of written or electronic mail correspondence, and
- (4) working in any other situation where their actions could be construed as an official Government act or representation of the Government.

The contractor shall ensure that contractor personnel possess and properly display Government-issued identification badges when on NGA property or when attending NGA meetings not located on NGA property.

The contractor will ensure that contractor personnel, when performing in a contractor capacity, refrain from using their retired or reserve component military rank or title in all written and verbal communications.

The Government may include the results of the contractor's ability to adhere to this clause in quality assurance surveillance plans and award fee plans as part of the overall administration of this contract.

(End of Clause)

**5X52.37-9000 Contractor Employee Data for Access to NGA Facilities or Sensitive Systems (OCT 2005)**

1. This clause defines the contractor's responsibilities for providing accurate contractor data, and providing updates to that data, for NGA's Human Capital Management System (HCMS). NGA requires that all contractors provide initial and timely updates to HCMS data for all personnel performing under this contract who have access to NGA facilities or sensitive systems, as determined by the contracting officer.

2. The Contractor shall:

a. Provide the Contracting Officers Representative (COR) a Point of Contact (POC) for providing and maintaining contractor personnel data for the HCMS database. The POC shall be provided to the COR, in writing, within 10 days of contract award (or modification inserting this clause). For contracts with an on-site Project Lead or Program Manager, this person shall serve as the POC.

b. Provide the COR initial HCMS data for their personnel within 10 days of contract award or modification. The information that is to be provided for HCMS shall include: persons full legal

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name, social security number, citizenship status, NGA contract number, prime contractor name, NGA location and organization where the person will be working, and a 24/7 emergency contact point for the contractor.

c. Notify the COR of all contractor data changes within 10 days of the change. Changes include new or departing contractor personnel and any change to information provided in paragraph b above. If the contract number under which a contractor or its personnel work changes, the POC for the contract receiving the personnel shall notify the COR within 10 days of the change.

d. Provide response to all inquiries made by NGA as to the validity and completeness of contractor data records in the HCMS database within two weeks of date of request.

e. Ensure all employees attend in-processing and out-processing briefings.

(End of Clause)

**5X52.246-9000 - Contractor Compliance with all applicable National Geospatial-Intelligence Agency (NGA) and U.S. Government installation regulations, directives, instructions, rules, policies and procedures. (MAR 2023)**

A. The Contractor shall comply with, and shall ensure that its personnel, to include subcontractors, comply with all applicable NGA regulations, directives, instructions, rules, policies and procedures. The Contractor may request copies from the Contracting Officer's Representative (COR), the Contracting Officer or their designated representative(s).

B. The Contractor shall comply with, and shall ensure that its personnel, to include subcontractors, comply with regulations, directives, instructions, rules, policies, procedures and other applicable requirements issued by the U.S. Government Installation Commander where NGA is a tenant activity, including, but not limited to, those relating to force protection, security, health and safety. The Contractor may request copies from the Contracting Officer's Representative (COR), the Contracting Officer or their designated representative(s).

C. The Contractor shall institute and implement an effective program to ensure their employees and subcontractors, comply with all applicable requirements in accordance with paragraphs A and B above as well as paragraphs E and H below.

D. The specific requirements covered in paragraphs A, B, E, and H may be specified in the Performance Work Statement, elsewhere in the contract, or in NGA and/or Government installation regulations, directives, instructions, rules, policies and procedures. Specific requirements may include, but are not limited to categories such as:

- Security in/out processing
- Personnel in/out processing
- Facility access, parking, and in/out processing
- Information technology access and in/out processing
- PeopleSoft access, updates and in/out processing
- Periodic and special training requirements

E. Facility Access and Badging. The following criteria must be met in order to be issued an NGA IC badge and to gain access to an NGA-controlled facility:

## VERSION 2

(1) NGA IC badges will only be issued to those contractors who provide direct charge support on an active TS/SCI NGA contract, even when seated at corporate locations outside of NGA Government facilities. Green badges must be used at least once during a one-month period at an NGA Government facility. Failure to use an NGA IC badge may result in suspension or termination of the badge for lack of activity. The badges will expire at the end of the supported contract. Note: NGA IC badges will not be issued to any contractor who does not need access to an NGA facility, i.e., Corporate VIPs, etc. Infrequent visitors must report to the Visitor's Center.

(2) Notwithstanding the above, NGA badges will be issued to contractors, who are required by contract, to gain access to an NGA facility in the event of an emergency or when after-hours access is required. The Government POC or Contracting Officer's Representative (COR) coordinates the submission of an application for an NGA badge; establishment of a PeopleSoft record of SCI accesses; completion of NGA Form 5212- 7A, "Request for Identification/Building Access Picture Badge"; and submission of the application to the appropriate Site Security Office for approval. (Reference NGA Instruction 5210.8, Physical Security Program)

F. The Contracting Officer may direct the Contractor, at its own expense, to remove and replace any Contractor personnel who fail to comply with or violate applicable requirements of this clause. Such action may be taken at the Government's discretion without prejudice to its rights under any other provision of this contract, including the Termination for Default clause.

G. The Contracting Officer may include the results of the Contractor's ability to adhere to this clause in past performance reports, quality assurance surveillance plans and award fee plans as part of the overall administration of this contract.

H. NGA Inspector General.

(1) The contractor must report to the NGA Inspector General (IG), DoDIG, or Intelligence Community IG any and all possible violations of federal law or illegal intelligence activities related to this contract by individuals charging directly or indirectly to this contract.

(2) The IG shall have access to any individual charging directly or indirectly to this contract whose testimony is needed for the performance of the IG's duties. In addition, the IG shall have direct access to all records, reports, audits, reviews, recommendations, documents, e-mails, papers, or other material that relate to this contract with respect to which the IG has responsibilities. Failure on the part of any contractor to cooperate with the IG shall be grounds for administrative action by the Director, Office of Contract Services, including contractual remedies.

(3) NGA contractors and contractor personnel may report suspected instances of improper conduct through the NGA IG Hotline. Contractors shall make their employees aware of this Hotline: 571-557-4849, secure 578-4849, or toll free 1-800-380-7729 or by contacting the OIG at IG@nga.mil or secure at IG@nga.ic.gov.

(4) The contractor agrees to include the substance of this clause in all subcontracts exceeding the simplified acquisition threshold except those for commercial products or commercial services and those where the NGA association must be protected.

(5) This requirement is supported in the Federal Acquisition Regulation (FAR) clause 52.203-13, which requires timely disclosure to the Government of credible evidence of violation of law, and timely and complete response to OIG requests for documents and access to employees and information.

VERSION 2

(6) This requirement is supported in NGA policy. NGAI 7410.1 requires all personnel, to include contractors, to cooperate fully with NGA OIG audits, inspections, and investigations.

(End of Clause)

**\*END\***



**OSD-NGA SBIR 23.3 Phase I Topic Index**

OSD233-001	Deep Rational 3D Geospatial Analytics for Generative AI
OSD233-002	Solar Blind UV Detector for Space Object Detection
OSD233-003	Specialized Crystal Growth and Material Characterization
OSD233-004	Advanced Single-Photon Avalanche Diode for 1030 nm (SPAD-1030)

## VERSION 2

OSD233-001 TITLE: Deep Rational 3D Geospatial Analytics for Generative AI

OUUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop advanced AI/ML algorithms that combine generative AI with discriminative AI to enhance 3D geospatial analytics.

DESCRIPTION: DESCRIPTION: Current artificial intelligence and machine learning (AI/ML) techniques for geospatial analysis use pixel or voxel information for semantic segmentation, detection, and classification tasks, but do not exploit the rich contextual relational information in the scene (e.g., cars drive on roads, ships/boats sail on water, etc.). Scenes are fundamentally compositional, adhering to relational rules, which can be exploited to improve geospatial analytics. We seek approaches that combine generative AI, which can describe relations between objects, with discriminative AI to improve multi-task geospatial analysis. Specifically, this topic seeks approaches that leverage generative AI in the form of large language models capable of generating relationships between objects while capturing the relational diversity present in the real world (e.g., cars drive on roads, cars park in drive ways, drive ways connect houses to roads). The proposed approaches must combine generative AI with discriminative AI such as deep convolutional neural network models for segmentation and classification in an end-to-end system. The relations from the generative AI can be considered as constraints and regularization that aid the discriminative AI in solving highly under-constrained problems in 3D geospatial analysis. NGA anticipates that Phase II work will involve input data that may be Controlled Unclassified Information (CUI) or classified.

PHASE I: Demonstrate proof-of-concept approach capable of combining generative AI with discriminative AI using open source 3D datasets derived from commercial satellite (COMSAT) imagery and full motion video (FMV). For a given set of classes (buildings, houses, cars, roads, trees), demonstrate that approach is able to improve multi-task performance in semantic segmentation and object detection beyond baseline approaches that utilize only discriminative AI. Develop a Phase II plan that includes integration, test, and validation of the end-to-end system.

PHASE II: Realize the optimization and implementation of the selected generative AI and discriminative AI into an end-to-end model. Demonstrate the proposed model is trainable with an expanded class/target set, and is able to perform inference on 3D datasets derived from COMSAT and FMV. Develop a technology transition plan and business case assessment.

PHASE III DUAL USE APPLICATIONS: 3D geospatial analytics software leveraging generative AI capable of supporting DoD use cases including scene segmentation, classification, and target detection; civil engineering missions such as surveying, urban mapping and city planning; commercial robotics applications such as route planning.

### REFERENCES:

1. Zhao, Wayne Xin, et al. "A survey of large language models." arXiv preprint arXiv:2303.18223 (2023);
2. Xiao, Aoran, et al. "Unsupervised Point Cloud Representation Learning with Deep Neural Networks: A Survey." IEEE Transactions on Pattern Analysis and Machine Intelligence (2023).

KEYWORDS: 3D geospatial analytics; generative AI; AI/ML

## VERSION 2

OSD233-002 TITLE: Solar Blind UV Detector for Space Object Detection

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop novel systems to expedite detection of unknown objects.

DESCRIPTION: New methods are needed to exploit the increased availability of space imagery, to predict and to track questionable technology movement robustly over tactical time scales, and help to understand future direction for space-based technologies. To address the threat of questionable technologies, modern defense aircrafts or even satellites need to be equipped with a suite of self-protection sensor systems, which includes warning sensors operating in the ultraviolet (UV) part of the spectrum, especially the Ultraviolet-C (UVC) region spanning from 200 – 280 nm wavelength because the UVC is completely absorbed by the atmospheric ozone layer. A source of UVC in the atmosphere below the ozone layer is the plumes, which can be detected with solar blind UVC sensors. The detection range of these sensors is limited, on the order of several km, against comparable technologies, but their false-alarm rate is low. The use of infrared (IR) sensors, which can offer much longer detection range, is limited, and requires more complex image processing methodologies. The low false-alarm rate of the UV sensors is due to absence of background radiation and the absence of sources of UV radiation, especially in the UVC region.

For this topic, foreign nationals shall be restricted from participating in all phases. Phase I work shall be conducted on NIST SP 800-171 compliant information systems. Phase II work is expected to be classified.

PHASE I: Research, develop, and demonstrate concepts for high sensitivity (>100 mA/W) wide bandgap based solar blind detector with a UV/V rejection ratio of >105.

PHASE II: Build prototype systems with various form factors. Deliver a minimum of two of these prototypes to the sponsor for evaluation. Perform detailed analysis to ensure materials are rugged and appropriate for sponsor's application. Perform analysis to understand environmental, shock, and vibration effects on system. Evaluate prototype against provided performance goals.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to build an advanced sensor, suitably configured for mission application, including flight spares and interface electronics, and characterize its performance in the UV & V range requirements. Market research and analysis shall identify the most promising technology areas and the company shall develop manufacturing plans to facilitate a smooth transition.

### REFERENCES:

1. Monroy, E.; Omnes, F.; Calle, F. Wide-bandgap semiconductor ultraviolet photodetectors. *Semicond. Sci. Technol.* 2003, 18, R33;
2. Omnes, F.; Monroy, E.; Muñoz, E.; Reverchon, J. Wide bandgap UV photodetectors: A short review of devices and applications. *Proc. SPIE Gallium Nitride Mater. Devices II 2007*, 64730E, 111–125;
3. Shi, L.; Nihtianov, S. Comparative study of silicon-based ultraviolet photodetectors. *IEEE Sens. J.* 2012, 12, 2453–2459;
4. Narayanan, D. L.; Saladi, R. N.; Fox, J. L. Ultraviolet radiation and skin cancer. *Int. J. Dermatol.* 2010, 49, 978–986.

VERSION 2

KEYWORDS: Space-based sensing; Space object detection; Tracking

## VERSION 2

OSD233-003 TITLE: Specialized Crystal Growth and Material Characterization

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Advanced Materials

OBJECTIVE: Develop advanced Material and process for quality crystal growth to aid mission support effort.

DESCRIPTION: The objective of this topic is to develop innovative crystals that are transparent in the vacuum ultraviolet (VUV) region of the electromagnetic spectrum and host thorium dopants at a concentration of  $10^{16}$ - $10^{17}$  thorium atoms per cubic centimeter. The thorium-doped crystals should be either thorium doped into CaF<sub>2</sub> and/or thorium doped into MgF<sub>2</sub>. The ability to produce both CaF<sub>2</sub> and MgF<sub>2</sub> crystals is preferred. The crystals must transmit VUV light down (>99% bulk transmission to at least 140 nm which would require very low levels of impurities, such as oxygen). Also exploring other large bandgap crystals and showing their capability is highly encouraged with this request.

For this topic, foreign nationals shall be restricted from participating in all phases. Development and demonstration of crystal growth under Phase II will likely involve Controlled Unclassified Information (CUI), which requires application of technical and non-technical controls described in DoDI 5200.48 and NIST SP 800-171.

PHASE I: Demonstrate a proof-of-concept that one can grow/develop a crystal that is transparent in VUV region of the electromagnetic spectrum and able to host radioactive dopants. Also, a clear indication of growing low-impurity, VUV crystals i.e. MgF<sub>2</sub>, CaF<sub>2</sub>, purification of material as well as show property characterization of the crystal material. Develop a Phase II plan that includes the ability to handle radioactive material in the facility that foresee future crystal development with such dopants.

PHASE II: Demonstrate and develop a method to grow crystal from ~1mg of dopant as starting materials for the crystal and less quantity in some cases. Clearly present an example and prototype of crystal with exact amount of dopant in the first 6 months. As part of this phase a method for sectioning and polishing for example (two 3 mm x 3 mm faces of the crystal and one of the 3 mm x 10 mm) must be demonstrated and developed.

- Methods for ascertaining the amount of thorium dopant in the crystals must be verified
- The ability, now or planned, to handle thorium isotopes in the SBIR facility must be verified
- The capability to deliver thorium doped crystals as part of the phase II.
- Grow and provide prototype crystals with roughly 3 mm x 3 mm x 10 mm dimensions with surface polish of at least  $\lambda/4$ .

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to grow and distribute this specialized quality doped material for DOD and other commercially interested partners of this development. A manufacturing plan to facilitate a smooth transition would be ideal.

### REFERENCES:

1. Peik, E. & Tamm, C. Nuclear laser spectroscopy of the 3.5 eV transition in <sup>229</sup>Th. Euro. Phys. Lett. 61, 181 (2003);
2. Campbell, C. J., Radnaev, A. G. & Kuzmich, A. Wigner crystals of for optical excitation of the nuclear <sup>229</sup>Th isomer. Phys. Rev. Lett. 106, 223001 (2011);
3. Rellergert, W. G. et al. Constraining the evolution of the fundamental constants with a solid-state optical frequency reference based on the <sup>229</sup>Th nucleus. Phys. Rev. Lett. 104, 200802 (2010);
4. Kazakov, G. A. et al. Performance of a <sup>229</sup>Thorium solid-state nuclear clock. New J. Phys. 14, 083019 (2012).

VERSION 2

KEYWORDS: Advanced Materials; Crystal Growth; Radioactive Dopant

OSD233-004 TITLE: Advanced Single-Photon Avalanche Diode for 1030 nm (SPAD-1030)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

OBJECTIVE: Develop a single-photon avalanche detector for mm-accurate multi-kHz satellite and lunar laser ranging at 1030 nm.

DESCRIPTION: High-accuracy satellite and lunar laser ranging (SLR/LLR) stations have heavily relied upon the availability of short pulse, frequency-doubled Nd:YAG and Yb:YAG lasers. This has driven SLR/LLR receive-detector development toward fairly wide-use of gated, large-area ( $\square 100 \square m$ ) Si-based single-pixel sensors having peak photon sensitivity ( $\square 30\%$ ) near 532 nm, with quenching circuits and time-walk compensation for  $<18$  picosecond (ps) timing jitter at multi-kHz repetition rates. Operating at 1030/1064 nm, however, provides significant advantages over green systems, including improved eye safety (flash blindness and dazzling) and better atmospheric transmission that manifest in gains in link margin and ranging precision. The aim of this effort is to design and develop a single-photon detector (single pixel, or array) optimized for for 1030 nm SLR/LLR applications according to notional specifications outlined in Table 1.

**Table 1. Performance Metrics**

Parameter Description	Other Detail	Notional Specifications			Unit
		Min	Typical	Max	
Spectral response range		$\leq 950$ to $\geq 1150$			nm
Peak sensitivity wavelength			1030		nm
Effective photosensitive diameter			100		$\square m$
Photon detection efficiency (PDE)	Single photon		$\geq 30$		%
Time walk		-10		+10	ps
Dark count			$\leq 2500$		Hz
Internal/external gating frequency		1		$10^7$	Hz
Gate duration range		0.5		1000	ns
Gate duration step			$\leq 100$		ps
Reference output	Required		TTL*		
Gate output	Required		TTL*		
Detection output	Required		TTL*		
External gate trigger input	Required		TTL*		
Operating temperature		-20		35	$^{\circ}C$
Detection head dimension	LxWxH 137x50x50				mm
Control unit dimension	LxWxH 225x170x50				mm
Cooling Time			5		min
Connector type	Preferred		SMA**		

\*Transistor-Transistor Logic

\*\*SubMiniature version A

PHASE I: Trade study and design of a gated, Geiger-mode single-photon avalanche diode detection head and signal conditioning electronics, including quenching circuit and time-walk compensation logic according to Table 1. Details of the temperature stability and cooling architecture (i.e. thermoelectric cooler stages) shall be articulated. Develop a Phase II plan to build and test the “SPAD-1030” prototype

that includes schedule, cost, milestones and a device characterization plan. Deliver detailed trade study, analysis and initial design documentation in a Phase I technical data package.

PHASE II: Design, fabricate, and integrate an engineering development unit of SPAD-1030, that is consistent with performance identified in notional parameters in Table 1, and with Phase I trade study results and design activities. Characterize the PDE over the spectral response range. Work with a Government Laboratory partner to conduct an evaluation of the engineering development unit SPAD-1030 on an active laser ranging system.

Upon successful developmental test and evaluation of the engineering unit, complete a final design incorporating lessons learned for optimized mission use and performance. Complete a comprehensive Phase III integrated schedule and unit cost estimate for the development, fabrication, and unit test of six (6) prototype SPAD-1030. Deliver engineering development unit, design documentation, and characterization plan, raw data, and analysis of results in a Phase 2 technical data package.

PHASE III DUAL USE APPLICATIONS: Complete final design documentation, performance characterization and factory acceptance test plan. Complete fabrication, integration, updated prototype packaging and comprehensive performance characterization of six (6) SPAD-1030 prototype units according to the plan developed in Phase II. Work with Government Laboratory partner to integrate prototype SPAD-1030 with existing laser ranging system to verify performance for target mission. Deliver all prototypes and Phase III technical data package.

#### REFERENCES:

1. Kirchner, G. & Koidl, F. Compensation of SPAD time-walk effects. *J. Opt. A: Pure Appl.* 1, 163 (1999);
2. Procházka, I., Kodet, J. & Blažej, J. Note: Solid state photon counters with sub-picosecond timing stability. *Rev. Sci. Instr.* 84, 046107 (2013);
3. Michálek, V., Procházka, I. & Blažej, J. Twenty years of Rad-Hard K14 SPAD in Space Projects. *Sensors* 15, 18178-18196; doi:10.3390/s150818178 (2015)

KEYWORDS: Time-Walk Compensation; SPAD; 1064 nm; 1030 nm; Satellite Laser Ranging