AMENDMENT 2

DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
STTR 23.B Program Broad Agency Announcement (BAA)

April 19, 2023: DoD BAA issued for pre-release
May 17, 2023: DoD begins accepting proposals
June 14, 2023: Deadline for receipt of proposals no later than **12:00 p.m. ET**

The purpose of Amendment 2 is to provide additional information in sections 4.3, 5.3.f, 5.3.h and 5.3.i.

The purpose of Amendment 1 is to incorporate the following:

a. **Add Section 4.3 Disclosures Regarding Ties to People's Republic of China and Other Foreign Countries.**
b. **Replace Attachment 2: Foreign Ownership or Control Disclosure with Attachment 2: Disclosures of Foreign Affiliations or Relationships to Foreign Countries**
c. **Add Section 5.3.i (previously section 4.3), and corresponding Attachment 4: Disclosure of Funding Sources**
d. **Revisions to Section 2.2 & 5.3.h.**
e. **Removal of section 8.1.bb. (DFARS 252.209-7002, Disclosure of Ownership or Control by a Foreign Government).**
f. **Various text updates, as highlighted below.**

Participating DoD Components:

- Department of Army (Army)
- Department of Navy (Navy)
- Defense Health Agency (DHA)
- Defense Threat Reduction Agency (DTRA)
- Missile Defense Agency (MDA)
- Office of the Secretary of Defense – Basic Research Office (OSD – BRO)
- United States Special Operations Command (USSOCOM)

IMPORTANT

Deadline for Receipt: Complete proposals must be certified and submitted in DSIP no later than **12:00 PM** ET on **June 14, 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 STTR 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.

AMENDMENT 2

IMPORTANT (continued)

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.

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. Small business concerns are highly encouraged to review the full BAA to remain apprised of any additional recent programmatic changes.

Questions: Please refer to the DSIP Customer Support Document for general information regarding the DoD SBIR/STTR process in DSIP. For additional assistance with the DSIP application, please visit the Learning & Support section of the DSIP at https://www.dodsbirsttr.mil/submissions/learning-support/. Email DSIP Support at DoDSBIRSupport@reisystems.com only for further assistance with issues pertaining directly to the DSIP application. Questions submitted to DSIP Support will be addressed in the order received during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). **See section 4.15 for further information on where to direct questions regarding instructions and topics in this BAA**.

TABLE OF CONTENTS

AMENDMENT 2

AMENDMENT 2

1.0 INTRODUCTION

Army, Navy, DHA, DTRA, MDA, OSD – BRO, USSOCOM, hereafter referred to as DoD Components, invite proposing small business concerns and research institutions to jointly submit proposals under this BAA for the Small Business Technology Transfer (STTR) 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.

The STTR Program, although modeled substantially after the Small Business Innovation Research (SBIR) Program, is a separate program and is separately financed. Subject to availability of funds, DoD Components will support high quality cooperative research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector. Partnerships between small businesses and Historically Black Colleges and Universities (HBCUs) or Minority Institutions (MIs) are encouraged, although no special preference will be given to STTR proposals from such proposers.

This BAA is for Phase I proposals only. 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.

2.0 PROGRAM DESCRIPTION

2.1 Objectives

The objectives of the DoD STTR 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 SBA revisions to the Policy Directive are in effect as of May 3, 2023. The Federal Register Notice is available at: https://www.federalregister.gov/documents/2023/04/03/2023-06870/small-business-innovation-research-

program-and-small-business-technology-transfer-program-policy. 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".

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 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
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.

2.3 OUSD(R&E) Critical Technology Areas

Each DoD Component develops SBIR and STTR topics that are mission-oriented to their programs, however 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.

AMENDMENT 2

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
- Space Technology
- Renewable Energy Generation and Storage
- Advanced Materials
- Human-Machine Interfaces

Below are additional technology areas supporting DoD Component-specific mission-critical areas:

- Advanced Infrastructure & Advanced Manufacturing
- Combat Casualty Care
- Emerging Threat Reduction
- Military Infectious Diseases
- Military Operational Medicine
- Mission Readiness & Disaster Preparedness
- Nuclear
- Sustainment & Logistics

Full descriptions of the above technology areas can be reviewed here: https://media.defense.gov/2023/Mar/21/2003183351/-1/-1/1/OUSDRE_SBIR_STTR_CRITICAL_TECH_AREAS.PDF.

2.4 Three Phase Program

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

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

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

AMENDMENT 2

2.5 Program on Innovation Open Topics

Section 7 of the SBIR and STTR Extension Act of 2022 requires the Department of Defense to establish innovation open topic activities in order to—

(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.

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.

AMENDMENT 2

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.

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.

AMENDMENT 2

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 DoD or 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 STTR Program training related to Fraud, Waste and Abuse is available at: https://www.sbir.gov/tutorials/fraud-waste-abuse/tutorial-1. See Section 4.17 for reporting Fraud, Waste and Abuse.

Funding Agreement

Any contract, grant, or cooperative agreement entered into between any Federal Agency and any small business concern for the performance of experimental, developmental, or research work, including products or services, funded in whole or in part by the Federal Government. Only contracts and other transaction authority (OTA) agreements will be used by DoD Components for all STTR 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 or research institution 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 concern or research institution. 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/.

AMENDMENT 2

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. Recombinant DNA is defined as (i) molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in living cells or (ii) molecules that result from the replication of those described in (i) above.

Service-Disabled Veteran-Owned Small Business (SDVOSB)

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

Small Business Concern (SBC)

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

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

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

Subcontract

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

Subcontractor

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

AMENDMENT 2

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.

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 CFR §§ 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 and Section 4.4 of this BAA).
b. A minimum of 40% of each STTR project must be conducted by the small business concern and a minimum of 30% of the effort performed by the single research institution, as defined in Section 3. The percentage of work is measured by both direct and indirect costs. Deviations from these STTR requirements are not allowed, as the performance of work requirements are specified in statute at 15 USC 638(e). 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 small business firm or the research institution at the time of award and during the conduct of the proposed effort. At the time of award of a Phase I or Phase II contract, the small business concern must have at least one employee in a management position whose primary employment is with the small business and who is not also employed by the research institution. 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

f. A small business concern must negotiate a written agreement between the small business and the research institution allocating intellectual property rights and rights to carry out follow-on research, development, or commercialization (see Model Agreement for the Allocation of Rights).

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 Attachment 2 in Volume 5 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, 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. Therefore, 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 STTR 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 & 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.

AMENDMENT 2

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 a given topic. It also may elect to fund several or none of the proposed approaches to the same topic.

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

b. **Type of Funding Agreement**. Each Phase I proposal selected for 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 therefore 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. However, across DoD, the median time between the date that the STTR BAA closes and the award of a Phase I contract is approximately four months.

4.15 Questions about this BAA and BAA Topics

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

(1) **DSIP Support**:
Email DSIP Support at DoDSBIRSupport@reisystems.com only for assistance with using the DSIP application. Questions regarding DSIP can be emailed to DSIP Support and will be addressed in the order received, during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). Please include information on your 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 **April 19, 2023 – May 17, 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 **May 17, 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. However, 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 **April 19, 2023**, and closes to new questions on **May 31, 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. 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 STTR 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 into contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible. See Section 5.3.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.

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 STTR Program. These services vary from state to state, but may include:

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

Contact your State SBIR/STTR Support office at https://www.sbir.gov/state_services?state=105813# for further information. Small 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 (TABA)

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

5.0 PHASE I PROPOSAL

5.1 Introduction

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. 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.

AMENDMENT 2

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.

AMENDMENT 2

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, the small business concern will not be able to proceed with proposal submission. Deviations from the POW minimum requirements for STTR proposals are not allowed.

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. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained (see Sections 4.9 - 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 STTR 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 STTR 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 STTR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(9) **Facilities/Equipment.** Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(10) **Subcontractors/Consultants.** Involvement of a research institution in the project is required and the institution should be identified and described to the same level of detail as the prime contractor costs. A minimum of 40% of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. STTR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposers must certify their use of such facilities on the Cover Sheet of the proposal.

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

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

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

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

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

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

(2) While special tooling and test equipment and material cost may be included under Phases I, the inclusion of equipment and material will be carefully reviewed relative to need and

appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Component Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

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

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

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

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

When a proposal is selected for 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.

If 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.

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

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights
7. 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. Therefore, 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 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**, **utilizing the "Other" category for document type.**

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 ahead and leave ample time to complete this training based on the proposal submission deadline. FWA training must be completed by one DSIP firm user with read/write access (Proposal Owner, Corporate Official or Firm Admin) on behalf of the proposing small business concern.

AMENDMENT 2

6.0 PHASE I EVALUATION CRITERIA

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

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

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

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the 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 into contracts or grants requiring essentially equivalent effort. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies as early as possible. If a proposal submitted for a Phase II effort is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Cover Sheet and provide the information required in Section 5.4.c(11).

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular 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.

AMENDMENT 2

7.4 Phase II Evaluation Criteria

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

7.5 Phase II Award Information

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

7.6 Adequate Accounting System

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

7.7 Phase II Enhancement Policy

To further encourage the transition of STTR 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 STTR funding if the proposing small business concern can match the additional STTR funds with non-STTR 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.

AMENDMENT 2

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 (that is, receives overtime pay).
h. **Equal Opportunity**. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
i. **Affirmative Action for Veterans**. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran.
j. **Affirmative Action for Handicapped**. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
k. **Officials Not to Benefit**. No member of or delegate to Congress shall benefit from the contract.
l. **Covenant Against Contingent Fees**. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.
m. **Gratuities**. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.
n. **Patent Infringement**. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
o. **Military Security Requirements**. The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.
p. **American Made Equipment and Products**. When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.

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

q. **Unique Identification (UID)**. If your proposal identifies hardware that will be delivered to the government, be aware of the possible requirement for unique item identification in accordance with DFARS 252.211-7003.

r. **Disclosure of Information.** In accordance with FAR 252.204-7000, Government review and approval will be required prior to any dissemination or publication, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract except within and between the Contractor and any subcontractors, of unclassified and non-fundamental information developed under this contract or contained in the reports to be furnished pursuant to this contract.

s. **Animal Welfare**. Contracts involving research, development, test, evaluation, or training on vertebrate animals will incorporate DFARS clause 252.235-7002.

t. **Protection of Human Subjects**. Effective 29 July 2009, contracts that include or may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02 and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b), will incorporate DFARS clause 252.235-7004.

u. **E-Verify**. Contracts exceeding the simplified acquisition threshold may include the FAR clause 52.222-54 "Employment Eligibility Verification" unless exempted by the conditions listed at FAR 22.2803.

v. **ITAR**. In accordance with DFARS 225.7901-4, Export Control Contract Clauses, the clause found at DFARS 252.225-7048, Export-Controlled Items (June 2013), must be included in all BAAs/solicitations and contracts. Therefore, all awards resulting from this BAA will include DFARS 252.225-7048. Full text of the clause may be found at https://www.govinfo.gov/content/pkg/CFR-2013-title48-vol3/pdf/CFR-2013-title48-vol3-sec252-225-7048.pdf.

w. **Cybersecurity**. Any 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. 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.

AMENDMENT 2

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 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 STTR contract is subject to STTR Data Rights which allow for protection under DFARS 252.227-7018 Class Deviation 2020-O0007 (see Section 8.5, Technical Data Rights). The sponsoring DoD activity, after reviewing the 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

(3) Block 14 (Abstract) of the SF 298, "Report Documentation Page" must include as the first sentence, "Report developed under STTR 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 "STTR 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/STTR)
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 STTR Data Rights protected under DFARS 252.227-7018 Class Deviation 2020-O0007.

AMENDMENT 2

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:

AMENDMENT 2

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)

AMENDMENT 2

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: _____

AMENDMENT 2

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;

AMENDMENT 2

(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).

AMENDMENT 2

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-

AMENDMENT 2

(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:* __.]

AMENDMENT 2

(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.

AMENDMENT 2

(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)

AMENDMENT 2

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: _____

AMENDMENT 2

☐ 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:	

AMENDMENT 2

[Additional space as needed]

VERSION 3

ARMY
23.B Small Business Technology Transfer (STTR)
PROPOSAL SUBMISSION INSTRUCTIONS

The approved 23.B Broad Agency Announcement (BAA) topics for the Army Small Business Technology Transfer (STTR) Program are listed below. Offerors responding to this BAA must follow all general instructions provided in the Department of Defense (DoD) Program BAA. Specific Army STTR requirements that add to or deviate from the DoD Program BAA instructions provided in the Preface are provided below.

The STTR Program Management Office (PMO), located at the Combat Capabilities Development Command (DEVCOM) Army Research Laboratory (ARL) Army Research Office (ARO), manages the Army's STTR Program. The Army STTR Program aims to stimulate a partnership of ideas and technologies between innovative small business concerns (SBCs) and research institutions (RIs) through Federally-funded research or research and development (R/R&D). To address Army needs and opportunities, the PMO relies on the vision and insight of science and engineering workforce across eight (8) participating Army organizations to put forward topics that are consistent with their mission, as well as command and STTR program goals. More information about the Army STTR Program can be found at https://www.armysbir.army.mil.

See DoD Program Announcement Preface for Technical questions and Topic Author communications. Specific questions pertaining to the Army STTR Program should be submitted to:

Army STTR Program Manager usarmy.rtp.devcom-arl.mbx.sttr-pmo@army.mil	DEVCOM-ARL-Army Research Office P.O. Box 12211 Research Triangle Park, NC 27709 (919) 549-4200

In addition to the formal announcement period, the Army STTR Program Office will be hosting virtual Army STTR Industry Days on 25-26 April 2023 to further delineate Army requirements, provide opportunity for interested parties to engage topic authors, and enable small business/research institute partnership-building to expand participation. Please visit: www.armysttr.com for more information.

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

Phase I proposals should address the feasibility of a solution to the topic. The Army anticipates funding two (2) STTR Phase I contracts to small businesses with their research institution partner for each topic. The Army reserves the right to not fund a topic if the proposals received have insufficient merit. Phase I contracts are limited to a maximum of $197,000.00 over a period not to exceed six (6) months. **PLEASE**

VERSION 3

NOTE THAT THE MAXIMUM DOLLAR AMOUNT HAS BEEN INCREASED COMPARED TO PREVIOUS PHASE I's. Army STTR uses only government employee reviewers in a two-tiered review process unless otherwise noted within the topic write-up. Awards will be made on the basis of technical evaluations using the criteria described in this DoD BAA Preface and availability of Army STTR funds.

The DoD SBIR/STTR Proposal Submission system (https://www.dodsbirsttr.mil/submissions/login) provides instruction and a tutorial for preparation and submission of your proposal. Refer to DoD BAA Preface for detailed instructions on Phase I proposal format. The Company Commercialization Report (CCR) must be uploaded in accordance with the instructions provided in the DoD Program BAA. Information contained in the CCR during will be considered during proposal evaluations.

The Army requires your entire proposal to be submitted electronically through the DoD-wide SBIR/STTR Proposal Submission Web site (https://www.dodsbirsttr.mil/submissions/login). STTR Proposals consist of six required volumes: (1) Proposal Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report (CCR), (5) Supporting Documents, and (6) Fraud, Waste, and Abuse Training. Proposals not conforming to the terms of this BAA will not be considered.

The Army has established a **10-page limitation** for Technical Volumes submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), the Cost Volume, or the CCR. The Technical Volume includes but is not limited to: technical approach and objectives, key personnel background and qualifications, facility information, the relationship of the proposed work to any prior, current, or pending support of similar proposals or awards, commercialization strategy, references and letters of support, appendices, and all attachments.

The Army requires that small businesses complete the Cost Volume form on the DoD Submission site versus submitting it within the body of the uploaded Technical Volume. It is the responsibility of submitters to ensure that the Technical Volume portion of the proposal does not exceed the 10-page limit. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent in other sections of the proposal as these will count toward the 10-page limit.

Army STTR Phase I proposals submitted containing a Technical Volume over 10 pages will be deemed NON-COMPLIANT and will not be evaluated. It is the responsibility of the Small Business to ensure that once the proposal is submitted and uploaded into the system that the technical volume .pdf document complies with the 10-page limit. If you experience problems uploading a proposal, email DSIP Support at DoDSBIRSupport@reisystems.com.

Companies should plan carefully for research involving animal or human subjects, biological agents, etc. as noted in the DoD BAA Preface. The short duration of a Phase I effort may preclude plans including these elements unless coordinated before a contract is awarded.

If the offeror proposes to employ a foreign national, refer to the DoD BAA Preface for definitions and reporting requirements. Please ensure no Privacy Act information is included in this submittal.

If a small business concern is selected for an STTR award, they must negotiate a written agreement between the small business and their selected research institution that allocates intellectual property rights and rights to carry out follow-on research, development, or commercialization (see DoD BAA Preface for more information).

PHASE II PROPOSAL GUIDELINES

All Phase I awardees may apply for a Phase II award for their topic – i.e., no invitation required. Please note that Phase II selections are based, in large part, on the success of the Phase I effort, so it is vital for SBCs to discuss the Phase I project results with their Army Technical Point of Contact (TPOC). Army STTR does not currently offer a Direct-to-Phase II option. Each year the Army STTR Program Office will post Phase II submission dates, 30-day window, on the Army SBIR/STTR web page at https://www.armysbir.army.mil/schedule/. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the Army STTR PMO via subsequent notification of Phase I awardees. The SBC may submit a Phase II proposal for up to three years after the Phase I selection date, but not more than twice. The Army STTR Program *cannot* accept proposals outside the Phase II submission dates established. Proposals received by the DoD at any time other than the submission period will not be evaluated.

Phase II proposals will be evaluated for overall merit based upon the criteria in the DoD BAA Preface of this BAA. STTR Phase II proposals have six required Volumes: Proposal Cover Sheet, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse Training. The Technical Volume has a **20-page limit** including: table of contents, pages intentionally left blank, technical references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. However, offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in others sections of the proposal submission as these will count toward the 20-page limit. ONLY the electronically generated Cover Sheets, Cost Volume and CCR are **excluded** from the 20-page limit. As instructed in the DoD BAA Preface, the CCR is generated by the submission website based on information provided by you through the "Company Commercialization Report" tool. **Army STTR Phase II proposals submitted containing a Technical Volume over 20 pages will be deemed NON-COMPLIANT and will not be evaluated.**

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

Army Phase II Cost Volumes must contain a budget for the entire 24-month period not to exceed the maximum dollar amount of $1,315,000.00. **PLEASE NOTE THAT THE MAXIMUM DOLLAR AMOUNT HAS BEEN INCREASED COMPARED TO PREVIOUS PHASE II's**). Costs for each year of effort must be submitted using the Cost Volume format (accessible electronically on the DoD submission site). The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year. Phase II proposals are generally structured as follows: the first 12 months (base effort) should be approximately $657,500.00; the second 12 months of funding should also be approximately $657,500.00. The entire Phase II effort should not exceed $1,315,000.00. The Phase II contract structure is at the discretion of the Army's Contracting Officer, and the PMO reserves the option to reduce an annual budget request of greater than $657,000.00 if program funds are limited.

Any Sequential Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by Army STTR PM in advance.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), offerors are encouraged to request technical and business assistance. The objective of this effort is to increase Army STTR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth. Details related to TABA are described in the DoD STTR Program BAA. All such requests must be made in accordance with these instructions. TABA may be proposed in the Base and/or Option periods, but the total value may not exceed $6,500 in Phase I and $25,000 per year in Phase II (for a total of $50,000 for two years). All details of the TABA agency and what services they will provide must be listed in the technical proposal under "consultants." **The request for TABA must include details on what qualifies the TABA firm to provide the services that you are requesting, the firm name, a point of contact for the firm (email address and phone number), and a website for the firm. List all services that the firm will provide and why they are uniquely qualified to provide these services.** The award of TABA funds is not automatic and must be approved by the Army STTR Program Manager.

NOTIFICATION SCHEDULE OF PROPOSAL STATUS AND DEBRIEFS

Once the selection process is complete, the Army STTR Program Manager will send an email to the "Corporate Official" listed on the Proposal Coversheet with an attached notification letter indicating selection or non-selection. Small Businesses will receive a notification letter for each proposal they submitted. The notification letter will provide instructions for requesting a proposal debriefing. The Army STTR Program Manager will provide ***written*** debriefings upon request to offerors in accordance with Federal Acquisition Regulation (FAR) Subpart 15.5.

PROTEST PROCEDURES

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

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: usarmy.rtp.devcom-arl.mbx.sttr-pmo@army.mil

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

Please review the checklist below to ensure that your proposal meets the Army STTR requirements. You must also meet the general DoD requirements specified in the BAA. **Failure to meet all the requirements may result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$197,000.00** for up to six-month duration).

2. The proposal is addressing only **ONE** Army BAA topic.

3. The technical content of the proposal includes the items identified in the DoD BAA Preface.

4. STTR Phase I Proposals have six volumes: Proposal Cover Sheet, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse.

5. The Cost Volume has been completed and submitted for Phase I effort. The **total cost should match** the amount on the Proposal Cover Sheet.

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

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

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

9. If applicable, Foreign Nationals are identified in the proposal. Include country of origin, type of visa/work permit under which they are performing, and anticipated level of involvement in the project.

ARMY STTR PROGRAM COORDINATORS (PCs) and Army STTR 23.B Topic Index

Participating Organizations	PC	Email
DEVCOM-Armaments Center	Benjamin Call Peter Susberich	Benjamin.d.call.civ@army.mil Peter.a.susberich.civ@army.mil
DEVCOM-Aviation and Missile Center	Dawn Gratz	Dawn.m.gratz.civ@army.mil
DEVCOM-ARL/Army Research Office	Michael Caccuitto	Michael.j.caccuitto.civ@army.mil
DEVCOM-C5ISR Center	Tamarisk Gillespie	Tamarisk.d.gillespie.ctr@army.mil
DEVCOM- Chemical Biological Center	Martha Weeks	Martha.g.weeks.ctr@army.mil
CoE-Environmental Research and Development Center (ERDC)	Melonise Wills	Melonise.r.wills.civ@army.mil
DEVCOM-Soldier Center	Cathy Polito	Cathryn.a.polito.civ@army.mil
DEVCOM-Ground Vehicle Systems Center	Scotty Vincent Eric Johnson	Scott.h.vincent4.civ@army.mil Eric.s.johnson212.ctr@army.mil

VERSION 3

Army STTR 23.B Topic Index

A23B-T001	Passive Ranging for Fire Control under Day and Night Conditions
A23B-T002	Thermal Protection Coating for Artillery Projectiles
A23B-T003	Optical Computing Network
A23B-T004	Metal Powder Based Additive Manufacturing for use in Portable System in an Expeditionary Environment
A23B-T005	Joining of Dissimilar Materials for Hypersonic Applications
A23B-T006	Modeling Tools for Hypersonic Flight
A23B-T007	Precision Control of High-speed Autonomous Vehicles under High Disturbances
A23B-T008	Bright Blue Semiconductor Laser Arrays for Military Applications
A23B-T009	Small Unmanned Aerial System for Surveying the Electromagnetic Spectrum
A23B-T010	Uncertainty and Model Predictive Control During Discontinuous Events in Autonomous Legged Robots
A23B-T011	Development of pyrolysis optimization methodology for carbon/carbon materials
A23B-T012	Environmentally Stable Perovskite Solar Cell Module
A23B-T013	Method of Developing Helicopter Source Noise Models using Parameter Identification Techniques
A23B-T014	Improving the Thermal Conductivity (TC) of Enhanced Performance Coolants (EPC) with inorganic additive nanotechnology
A23B-T015	Solid-State Large Aluminum Additive Manufacturing Replacements
A23B-T016	Lower Temperature Methanol Steam Reforming Catalyst for Fuel Cells
A23B-T017	Polymer, Solid Electrolyte, and Lithium Anode Battery to Enhance Kinetics
A23B-T018	Highly conductive brominated graphitic fibers for infrared and centimeter-wave electromagnetic attenuation
A23B-T019	Aerosol Particle Collectors for Microsensor Platforms
A23B-T020	Use of Satellite Observations for Analog Ensemble Predictions to Contribute to Decision Advantage

VERSION 3

A23B-T021	Ultrawide Transmission Range for Variable Transmission Eyewear (VTE)
A23B-T022	Soldier Personnel Protective Equipment from High Energy Lasers
A23B-T023	Laser Power Beaming to Sustain Small UAVs
A23B-T024	Food and Water Sensor for Sustainment of the Joint Expeditionary Force

VERSION 3

A23B-T001 TITLE: Passive Ranging for Fire Control under Day and Night Conditions

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: Design and build a system that can passively range to operationally relevant distances in daylight, low light, overcast and night conditions.

DESCRIPTION: To date much work has been invested in active ranging. However, laser-based probes are detectable and will leave the operator vulnerable, particularly at night.
Commercial applications, particularly those for self-driving vehicles, use a combination of both active and passive sensors. Low light imagers have been recently announced, that span both the VNIR, and SWIR and some are even capable of single photon detection. These low-light detectors are likely intended for the automotive market. Many, but not all have resolutions approaching HDTV. They offer, either through correlation or key-point signature comparisons a way to determine range covertly in what until now has been consider challenging situations. Passive ranging is a desired new capability for our individual soldiers and for military platforms. It is not in any currently fielded system. Providing a measured range accuracy of +/- 20 meters at 300 meters is adequate for a proof-of-concept demonstration.

PHASE I: Develop overall system design that includes specifications for ranging to distances of 100 meters, 300 meters and 1km. State the possibilities and challenges to achieving those ends including estimates of uncertainties in range. Consider both GPS and GPS denied regions of operations. Accuracy goals should be approximately +/- 20 meters at 300 meters with a linear increase to +/- 60 meters at 1000 meters.

PHASE II: Develop and demonstrate a prototype system in a realistic environment. Conduct testing to prove feasibility over extended operating conditions. Accuracy goals should be approximately +/- 20 meters at 300 meters with a linear increase to +/- 60 meters at 1000 meters.

PHASE III DUAL USE APPLICATIONS: This system could be used in abroad range of military and civilian applications where ranging and tracking are necessary. Optimize system design for size, weight and power, to include ruggedization to survive in a military environment.

REFERENCES:

1. Fitzgibbon, A. (2001). Simultaneous linear estimation of multiple view geometry and lens distortion. CVPR, IEEE Computer Society Conference on Computer Vision and Pattern Recognition. Kauai, HI Dec8-14: IEEE. doi:0.1109/CVPR.2001.990465

2. Hartley, R. (2003). Multiple View Geometry in Computer Vision. Cambridge, England: Cambridge University Press. doi:isbn-13 978-0-521-54051-3
3. Yang, J. (2020) Z. Lu, Y.Y. Tang, Z. Yuan and Y. Chen; Quasi Fourier-Mellin Transform for Affine Invariant Features; IEEE Transactions on Image Processing, Vol. 29, 2020
4. Reilly, P. (1999) T. Klein, and H. Ilves; "Design and Demonstration of an Infrared Passive Ranger"; Johns Hopkins APL Technical Digest, Vol 20, No. 2, pp. 220-235, 1999.
5. Tomasi (1992), Carlo and Kanade, Takeo; Shape and Motion from Image Streams under Orthography: a Factorization Method"; International Journal of Computer Vision; Vol 9, no 2, pp. 137-154.
6. Pelegris, Gerasimos (1994); "A triangulation Method for Passive Ranging"; Master's Thesis Naval Postgraduate School; Monterey California. DTIC AD-A284 180
7. Range finders and Tracking; Summary Technical Report of Division 7, National Defense Research Committee; V. Bush, Director; J.B. Conant, Chairman; H.L. Hazen, Division 7 Chief; 1947

KEYWORDS: passive ranging, low-light, key-points, correlation.

VERSION 3

A23B-T002 TITLE: Thermal Protection Coating for Artillery Projectiles

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

OBJECTIVE: Develop innovative conformal, ruggedized solutions for thermal protection of extended range artillery rounds.

DESCRIPTION: The Army's Long Range Precision Fires mission expands the current portfolio of conventional artillery to advanced munition technologies with extended range capability (>70km). Extended range requires the projectile to fly to higher velocities and altitudes as well as longer flight times. At high Mach speeds the projectiles may be exposed to high temperatures and heat fluxes up to 3500°C and 1000 W/cm2 respectively. These are new environments to which conventional gun launched ammunition has not been subjected to. Along with qualifying artillery for new weapons platforms such as Extended Range Cannon Artillery (ERCA), they also have to survive the extended range environment. The Army is currently looking for novel thermal protection coatings for artillery shells in an effort to extend the capability of conventional ammunitions and enable integration of other aero-structural materials such as polymer matrix composites and high strength alloys. The proposed solution must be able to protect the underlying base material against high heat flux and high temperature damage. The technology should be capable of surviving typical artillery gun launch loads and should conform to the geometry of an artillery projectile.

PHASE I: During the Phase I contract, successful proposers shall conduct a proof-of-concept study that focuses on thermal protection coating technologies that can withstand and operate within varying thermal loads ranging from 5 W/cm2 to 700 W/cm2 and temperatures ranging from ambient to 2000°F (objective) for up to 5 minutes (objective). Coating thickness should not exceed 5mm (objective) and can be ablative in nature so long as sufficient thermal protection is sustained to meet the objectives. Investigations should include analysis of material performance under transient thermal loading and thermos-structural performance of a coated Inconel steel substrate. A final proposed concept design, including a detailed description and analysis of potential candidate coating technology is expected at the completion of the Phase I effort.

PHASE II: Using the data derived from Phase I, in Phase II the proposer shall fabricate and integrate a prototype of the technology into a nominal projectile form-factor. The proposer shall further their proof-of-concept design and determine the applicability of the coating for different surface materials. Upon evaluation of the design through a critical design review, the prototype hardware's survivability shall be demonstrated via high G testing (35,000 G objective) in an air launched munition and aerothermal ground testing. Information and data collected from these tests will be used to validate operational performance.

PHASE III DUAL USE APPLICATIONS: Phase III selections shall identify large scale production alternatives and fabricate 20 prototypes that can be integrated into a nominal projectile form-factor to be identified by the SBIR: Army 20 Topics and Concepts Government. Live fire tests will be conducted, and the prototype integrated with projectile form-factor will have to withstand shock loads approaching 35,000g's. Phase III selections will develop of a cost model of expected large scale production to provide estimates of non-recurring and recurring unit production costs. Production concept for commercial application will be developed addressing commercial cost and quality targets. Phase III selections might have adequate support from an Army prime or industry transition partner identified during earlier phases of the program. The proposer shall work with this partner (TBD) to fully develop, integrate, and test the

performance and survivability characteristics of the design for integration onto the vendor's target platform.

REFERENCES:

1. Abdul-Aziz A. Durability Modeling Review of Thermal- and Environmental-Barrier-Coated Fiber-Reinforced Ceramic Matrix Composites Part I. Materials (Basel). 2018;11(7):1251
2. Eugenio Garcia,Reza Soltani,Thomas W. Coyle,Javad Mostaghimi,Angel De Pablos,Maria Isabel Osendi,Pilar Miranzo, Thermal Behaviour of Thermal Barrier Coatings and Steel/Thermal Barrier Coatings Structures, Advances in Ceramic Coatings and Ceramic-Metal Systems: Ceramic Engineering and Science Proceedings, Volume 26, Ceramic Engineering and Science Proceedings, 2005
3. Padture N. P.; Gell M.; Jordan E. H. (2002). "Thermal Barrier Coatings for Gas-Turbine Engine Applications". Science. 296 (5566): 280–284.
4. Clarke, D.R.; Oechsner, M.; Padture, N.P. Thermal-barrier coatings for more efficient gas-turbine engines. MRS Bull. 2012, 37, 891–898

KEYWORDS: Thermal Protection System, Advanced Materials, Artillery, Conformal Coatings, Hypersonics, Extreme Environments

VERSION 3

A23B-T003 TITLE: Optical Computing Network

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy, Microelectronics, 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 section 3.5 of 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 build a programable optical network equivalent to an electrical network to solve Markovian graphs with cycles. Forney-style factor graphs can be solved while avoiding the creation of trees.

DESCRIPTION: The use of digital image processing to enable target detection, classification, recognition and identification, as well as targe state estimation for fire control solutions is computationally intensive. It requires significant processing power, which in turn requires significant electrical power. A programable optical network can be used to perform these computations at reduced Size weight and power and at faster speeds. Factor graphs have been used to describe Bayesian networks (Pearl, 1988) and were applied to SLAM (Simultaneous Location and Mapping) by Dellaert (2017). These problems tend to be decomposed into trees for solution.

The most general graph, and the one that is most difficult to solve, is the undirected graph with cycles. This is related to quantum computing and such difficult logistical problems such as the travel salesman conundrum.

It is desirable to try to develop a room temperature solution, based on optical networks, that can at least reliably solve all convex Kalman filter problems.

PHASE I: Design and develop programable optical circuit elements that map the nodes in a factor graph to those of an optical network much as Vontobel did for electrical components.

PHASE II: Develop and demonstrate a prototype system consisting of the optical elements to create a network that can solve a problem.

PHASE III DUAL USE APPLICATIONS: Build an integrated optic that can be deployed that can implement a Kalman filter with real world application.

REFERENCES:

1. Dellaert, F. (2017). Factor Graphs for Robot Perception; Foundations and Trends in Robotics, Vol 6. No. 1-2 (2017) 1-139; DOI: 10.1561/2300000043
2. Pearl, J. (1988), Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference; Morgan Kaufmann Publishers Inc. San Francisco Calf; ISBN 1-55860-479-0

3. Vontobel, P.O.; Factor Graphs, Electrical Networks, and Entropy; http://www.isiweb.ee.ethz.ch/papers/arch/pvto-dlip-aloe-2002-mtns.pdf
4. Vontobel, P.O.; Kalman Filtering, Factor Graphs and Electrical Networks. http://www.isiweb.ee.ethz.ch/papers/arch/pvto-dlip-aloe-2002-mtns.pdf
5. Wang,S. (2020); A Factor Graph-Based Distributed Consensus Kalman Filter; IEEE Signal Processing Letters, Vol 27, 2020.

KEYWORDS: Graphs, networks, Kalman Filter, trees, cycles.

VERSION 3

A23B-T004 TITLE: Metal Powder Based Additive Manufacturing for use in Portable System in an Expeditionary Environment

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Infrastructure & Advanced Manufacturing, Sustainment & Logistics

OBJECTIVE: Develop a metal powder based additive manufacturing system suitable for deployment in expeditionary environments to manufacture complex metal components with minimal post processing requirements to support contested logistics scenarios.

DESCRIPTION: The current state of the art utilizes conventional manufacturing technologies such as computer numerical controlled (CNC) machine tools such as mills, lathes, and plasma cutters, which are augmented by various manually operated metal working machines to fabricate metal components. Depending on the component, this process can involve numerous steps to achieve complex features necessary to meet specifications. Additionally, operators require significant skill levels to operate these machines effectively and efficiently in order to rapidly produce components. This all adds up to cumbersome, inefficient approaches to sustain materiel in the field.

Compared to conventional manufacturing technologies, additive manufacturing (AM) is the revolutionary process of creating three-dimensional objects by the successive addition of material which starts with a digital model, usually generated by computer-aided design (CAD)1. AM introduces a new design paradigm that allows the fabrication of geometrically complex parts that cannot be produced by traditional manufacturing and assembly methods2. Furthermore, AM can expedite fabrication of complex components which require extensive skills and many operations to achieve using conventional methods, reducing time to product and therefore the buy-to-fly ratio3. One particular AM process is Metal Powder Bed Fusion (PBF), which, per internal government research, may be ideal to manufacture complex metal components to enable agile sustainment of armaments systems in expeditionary environments.

While metal PBF may be the optimal AM process for DoD mission needs, it comes with many risks and challenges. First and foremost, the high surface-to-volume ratio of powder particles coupled with the reactive nature of these metals means that special care must be taken when handling them. Powder explosions are unfortunately still a regular occurrence internationally and these often result in serious injury and loss of life4. Therefore, minimizing handling of powdered metal materials is essential to safe operations. Possible approaches include but are not limited to automation of part excavation and powder reclamation and/or use of material cartridges to eliminate manual powder loading. Another challenge is the requirement for an inert atmosphere for the PBF process. The role of the inert atmosphere during powder bed fusion (PBF) is to remove the process by-products and the air that is initially present in the process chamber5. By today's standard, Argon is most common with laser processing. Nitrogen is also an option which could minimize logistical burdens by allowing use of a Nitrogen generator but, thus far, this option limits print quality for certain materials5. One possible approach to overcome this challenge might entail process development to utilize vacuum in place of gas to achieve the inert atmosphere, which has had success with electron beam processing.

PHASE I: Research, modeling, and simulation of novel approaches to improve PBF machine processes, design, and other considerations including but not limited to safe powder storage, handling, and processing to reduce or eliminate exposure to powder materials during material loading or unloading and part excavation, alternative strategies to inert chambers to decrease dependence on process gases, and

increased survivability of equipment during transport over rugged terrain (MIL-STD 810). Collaboration between government, industry, and academia will further develop and refine requirements. Develop a test plan for mechanical properties and metallurgy to establish a baseline upon which improvements can be made through process development in follow-on work.

PHASE II: Development and engineering of metal PBF AM equipment resulting in a functional prototype which meets requirements developed during Phase I and is proven through extensive testing. Test results must prove that the developed machine can operate in austere conditions with maximum operator/facility safety and minimal logistics requirements while surviving exposure to the military field environment. Testing of materials to determine baseline mechanical and metallurgical properties should be executed and well documented.

PHASE III DUAL USE APPLICATIONS: The development of metal PBF AM machines to meet this mission requirement will augment sustainment capabilities in austere conditions with more rapid technologies able to produce a broader spectrum of components when compared to the current state of the art. Additionally, this effort has potential for applications in the oil and gas industry to enable enhanced facility and equipment sustainment on-site which can allow continued operations and sustained production rates. Follow-on work should focus on certifying materials through process development to produce qualified application-critical weapon system components.

REFERENCES:

1. American Society for Testing and Materials, ASTM ISO/ASTM52900-21 Additive Manufacturing – General Principles – Fundamentals and Vocabulary, https://www.astm.org/f3177-21.html (accessed 31 OCT 2022).
2. McCarthy, D.L. & Williams, C.B.. (2012). Creating complex hollow metal geometries using additive manufacturing and electro forming. 23rd Annual International Solid Freeform Fabrication Symposium – An Additive Manufacturing Conference, SFF 2012. 108-120.
3. Rasiya, Gulnaaz & Shukla, Abhinav & Saran, Karan. (2021). Additive Manufacturing-A Review. Materials Today: Proceedings. 47.
4. Benson, J.M.. (2012). Safety considerations when handling metal powders. Journal of the Southern African Institute of Mining and Metallurgy. 112. 563-575.
5. Pauzon, Camille & Hryha, Eduard & Forêt, Pierre & Nyborg, Lars. (2019). Effect of argon and nitrogen atmospheres on the properties of stainless steel 316 L parts produced by laser-powder bed fusion. Materials & Design. 179. 107873.

KEYWORDS: additive, manufacturing, laser, electron, beam, metal, powder, expeditionary

VERSION 3

A23B-T005 TITLE: Joining of Dissimilar Materials for Hypersonic Applications

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 section 3.5 of 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: A methodology or methodologies to join ultra-high temperature ceramics to a variety of dissimilar substrate materials such as carbon-carbon, ceramic matrix composites and lightweight metals.

DESCRIPTION: The U.S. Army must develop highly maneuverable hypersonic weapons that can survive high-G shock loads and harsh aerothermodynamic environments in a GPS-denied environment. To enable these requirements new materials and new manufacturing methods must be developed. There has been increasing desire to develop vehicles and projectiles that travel at the speed of sound and beyond. Materials with melting temperatures of 2000C and higher, ceramics based on silicon carbide (SiC) and silicon nitride (Si3N4) as well as carbon-carbon (C-C) composites, were developed and investigated to handle the aerothermal heating experienced at nose tips and leading edges of vehicles traveling at these velocities. The desire to push velocities into the hypersonic regime requires the development of materials with oxidation resistance and thermomechanical properties that can handle aerothermal heating to 3000C. The temperature requirement alone severely limits the available materials. Carbides and/or borides of hafnium (Hf), zirconium (Zr), titanium (Ti) and tantalum (Ta) fall into this category as do composites based on these materials and potentially high-entropy ceramics (HEC) that are multicomponent ceramics. While these materials meet the necessary temperature requirement and significant effort has been made in improving the properties at these temperatures the geometric complexity of the components as well as the cost associated with the manufacturing these materials it is currently impractical to expect these materials to be employed as monoliths in this application. What is more likely is the development of components comprised of multiple materials. Ceramic matrix composites (CMCs), C-C, and lightweight metals could be used as the structural component and can be produced cost-effectively and with the necessary geometric complexity while a UHTC layer on top of the component will protect the structural material from the extreme environments experienced during hypersonic flight. This will only work if these dissimilar materials are properly joined together to take fully take advantage of the benefits of these vastly different materials. The need to join dissimilar materials is not new. Methods such as welding, brazing and solid-state joining have been explored to create innovative ceramic/metal systems that result in improved impact resistance or that can function in advanced diesel and turbine engines as well as a variety of other applications. Success has been limited as a major challenge has been overcoming the residual stresses that develop at the interface due to the significant difference in thermal expansion of the materials. These residual stresses, if not property controlled, lead to generated of cracks and damage that lead to property degradation and reduced reliability of the joint. The focus of this effort will be the development of cost-effective methodologies to join these dissimilar materials to produce multi-material components that can survive the extreme environments encountered during launch and hypersonic flight. The focus will be on joining an ultra-high temperature ceramic to a carbon-carbon composite. A potential

advantage over previous joining attempts is that the thermal expansion coefficient of these materials can be tailored to minimize or control the level of residual stress in the system increasing the likelihood of the success.

PHASE I: The offerer will demonstrate a method or methods of joining a UHTC (preferably a ZrB2-SiC composition) to a C-C composite and/or a Zr metal substrate. Treating the UHTC and/or substrate surface and/or the use of a filler material(s) between the UHTC and substrate to promote joining are permitted. At a minimum the following will be performed:

- Microstructural characterization of the joint area to determine the extent and quality of the interface including the edges of the interface as well as identifying any damage to the UHTC or substrate that may have occurred due to the joining process,
- Measurement of residual stresses that develop at the interface as well as in the UHTC and the substrate material,
- Mechanical characterization of the UHTC/substrate joints at room temperature to determine the interfacial tensile and shear strength,
- Perform fracture analysis of the mechanically tested specimens to assess joint quality and identify the failure process,
- Determine the oxidation resistance of joined UHTC/substrate materials at temperatures up to 1200C, and
- Perform thermal shock testing by heating the joined material to 1200C followed by a rapid quench to room temperature in water.

A successful joining method will be one where the room temperature interfacial shear and tensile strength are $\geq$ 150MPa and $\geq$ 70MPa, respectively. Any joined material that meets these strength metrics must also survive thermal shock testing, material remains joined with minimal to no damage of either material or the joint, in order to be considered a success.

PHASE II: Utilizing the successful fabrication techniques developed in Phase I the Phase II effort will have two primary tasks. One will be focused on the optimizing the joining procedure to achieve higher interfacial properties as well as increased oxidation and thermal shock resistance plus expansion of the material selection for the UHTC (inclusion of Hf-based compositions and/or high entropy alloys) and if appropriate the substrate material. The other objective will be the development and testing of procedures and methodologies to fabricate near-net shape and net shape components with complex geometries, such as leading edges and curved surfaces, needed for hypersonic flight.

The characterization tasks from Phase 1 will be repeated on any joined materials fabricated with an optimized joining techniques or any newly developed material combinations with the following changes:

- Characterization of the UHTC/substrate joints to determine interfacial mechanical properties such as shear and tensile strength from room temperature to 2000C,
- Oxidation resistance of the joined UHTC/substrate material will be determined from room temperature to 2000C, and
- Thermal shock resistance of the joined UHTC/substrate material will be determined by heating the joined material to 2000C followed by a rapid quench to room temperature.

Additional testing and evaluation will include:

- Conduct burner rig tests at temperatures up to 2000C in an oxidizing environment to determine the performance and lifetime of the joined material,

- Determine the performance of the joined material at high G shock loads (up to 25000G), and
- Determine the performance of near-net and net shape components with appropriate complex geometries by exposing them to the harsh aerodynamic environments experienced during hypersonic flight.

Success will be determined if the joined material system with a complex geometry has an interfacial shear and tensile strength of ≥ 150MPa and ≥ 70MPa, respectively at 2000C, survive thermal shock testing with the material system remaining intact with minimal to no damage of either material or the joint.

PHASE III DUAL USE APPLICATIONS: It is envisioned that the R&D conducted as part of this STTR will provide the foundation of a commercially available method for joining the dissimilar materials needed for military weapons systems to survive and provide maximum performance in the extreme environments experienced in hypersonic flight. Of specific interest will be the development of material systems that can handle the environments experienced by a nose cone and other leading edge applications.

REFERENCES:

1. F.A. Mir, N.Z. Khan and S. Parvez, "Recent Advances and Development in Joining of Ceramics to Metals," Mat. Today: Proceedings, 46 [15] 6570-6575 (2021)
2. M.B. Uday, M.N. Ahmad-Fauzi, A.M. Noor and S. Rajoo, "Current Issues and Problems in Joining of Ceramic to Metal," in Joining Technologies, M. Ishak, ed., (2016)
3. E. Wuchina, E. Opila, M. Opeka, W. Fahrenholtz and I. Talmy, "UHTCs: Ultra-High Temperature Ceramic Materials for Extremen Environmental Applications," Elec. Chem. Soc. Interface, 30-36 (2007)
4. W.G. Fahrenholtz and G.E. Hilmas, "Ultra-High Temperature Ceramics: Materials for Extreme Environments, Scripta Mat., 129, 94-99 (2017)
5. R. Loehman, E. Coral, H.P. Dumm, P. Kotula and R. Tandon, "Ultra High Temperature Ceramcis for Hypersonic Vehicle Applications," Sandia National Laboratories, SAND 2006-2925 (2006)
6. F. Monteverde and L. Scatteia, "Resistance to Thermal Shock and to Oxidation of Metal Diborides-SiC Ceramics for Aerospace Applications, J. Am. Ceram. Soc., 90 [4] 1130-1138 (2007)
7. W.G. Fahrenholtz, G.E. Hilmas, I.G. Talmy and J.A. Zaykoski, "Refractory Diborides of Zirconium and Hafnium," J. Am. Ceram. Soc., 90 [5] 1347-1364 (2007)
8. S.A. Alvi, H. Zhang and F. Akhtar, "High-Entropy Ceramics," IntechOpen
9. J. Gild, Y. Zhang, T, Harrington, S. Jiang, T. Hu, M.C.Quinn, W.M. Mellor, N. Zhou, K, Vecchio and J. Lou, "High-Entropy Metal Diborides: A New Class of High-Entropy Materials and a New Type of Ultrahigh Temperature Ceramics," Sci. Rep. 6, 37946 (2016)

KEYWORDS: Hypersonic Flight; Ultra High Temperature Ceramics; Joining; Bonding; Thermomechanical Properties

VERSION 3

A23B-T006 TITLE: Modeling Tools for Hypersonic Flight

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 section 3.5 of 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 incorporate new mathematical constructs and high-fidelity design tools to predict time-accurate aerothermodynamics of hypersonic vehicles.

DESCRIPTION: The United States Army has a need to develop high-fidelity, computationally efficient solvers for the aerodynamic analysis and design of vehicles ranging from rotary-wing aircrafts to medium/long-range hypersonic projectiles. The CREATETM -AV Kestrel team has been developing a comprehensive suite of codes with a combined on-body/off-body computational approach for the prediction of flows around such vehicles for over a decade. The Army has unique gaps in understanding the flight characteristics (e.g., flow structures, pressure distribution, thermal loading) of hypersonic vehicles at high Reynolds numbers, in small physical scales with geometrical uncertainty, and with configurational asymmetries. While robustness and accuracy of Kestrel computational fluid dynamic (CFD) solvers is under continuous improvement [2,4,5], recent advancements in hypersonic boundary layer transition and turbulence modeling [6] for on-body solvers and sub-filter-scale (SFS) vorticity-preserving methods for off-body solvers [3] are yet to be incorporated into Kestrel. Correct prediction of hypersonic boundary layer transition locations, turbulent heat fluxes and vortical structures of high-speed wakes are of paramount importance in enabling the prediction of a next generation Army hypersonic vehicle's performance.

For the near-body analysis, several mesh options are available in Kestrel including strand, structured, and unstructured meshes. The off-body dynamics of freely evolving vortical wakes are handled in Kestrel via a high-order block-Cartesian Adaptive Mesh Refinement (AMR) approach. In both the on-body and off-body domains, numerical dissipation decreases the effective resolution and overall fidelity of computations, in exchange for high degrees of robustness, especially with complex vehicle geometries [2,4].

The fidelity of the Kestrel suite needs to be augmented specifically to capture key features of hypersonic flight, namely: (a) boundary layer transition locations and hypersonic turbulent heat-fluxes and shear-stresses (on-body); (b) high-Reynolds-number high-speed vortex dynamics in the wake (off-body). More specifically:
(a) In the near-body region, key fluid dynamic features to capture include ultrasonic acoustic waves trapped in the boundary layer responsible for hypersonic boundary layer transition to turbulence under canonical flow conditions. To improve Kestrel's hypersonic transition modeling capabilities, verification and validation against high-fidelity numerical approaches capable of shock capturing and dynamic turbulence modeling [6], and experimental data from hypersonic quiet wind tunnels [1], respectively, are required.

(b) In the off-body region, compressible coherent vortex structures, and their interactions with shocks, affect aerodynamic forces and moments of projectiles and lifting bodies. Kestrel's off-body solver currently lacks adequate SFS -- or large-eddy-simulation (LES) -- closures for high-Reynolds-number compressible vorticity. Classic LES models rely on a local isotropic turbulent eddy viscosity closure for the SFS stresses; however, such approach is overly dissipative [4] if not equipped with a dynamic procedure [3].

This should leverage any related investments from partners such as the Air Force or NASA. This applies broadly to the energy category of efficiency because the utilization of hypersonic weapons may reduce the timeline of conflicts which ultimately reduces energy.

PHASE I: The Phase 1 effort shall carefully assess the current hypersonic flow prediction capabilities of modern multi-physics solvers (e.g., Kestrel) [5] against benchmark-quality hypersonic quiet wind tunnel experiments [1] and state-of-the-art high-fidelity calculations [3,6] for flow conditions and geometries of interest to the Army. An uncertainty analysis of the predicted boundary layer transition location, and the on-body and off-body turbulent shear-stress and heat- flux levels, should also be carried out by exploring the currently available multi-physics solvers (e.g., Kestrel) model parameter space. Focus of the work will be with unstructured, finite-volume solver, KCFD, for near- and off-body predictions and the high-order, finite-volume Cartesian solver, e.g., SAMAIR, for off-body only predictions. However, methods developed will be applicable to other modern CFD solvers (e.g., Kestrel).

Wind tunnel data should replicate natural transition dynamics under quiet conditions over the full extent of an Army reference vehicle, including on-body pressure sensor data and off-body wake surveys, for canonical flow conditions (e.g. low enthalpy and zero angle of attack). Reference boundary-layer-attached high-fidelity simulations need to capture the full range of boundary layer dynamics, from the modal transition process to the turbulent breakdown including the intermittency of the transitional region. One of the Phase 1 outcomes will be outline of Phase 2 schedule for implementation of augmented hypersonic transition and turbulence models in Kestrel, developed in coordination with the CREATE^TM-AV team.

PHASE II: Phase 2 should involve direct modifications to the on-body and off-body source codes of the Kestrel solvers (or utilization of the external Python-API) executed under close supervision by the CREATE^TM-AV team. Once new functionalities are integrated and tested, re-assessment of Kestrel's performance on the Phase 1 canonical benchmark cases should be completed to highlight and quantify improvements made. After re- assessment, the new implementation should be tested against larger-scale and more complex hypersonic test cases, which may include non-zero angles of attack and aerothermochemistry effects.

PHASE III DUAL USE APPLICATIONS: Collaborate with model, software developers, and users on integration of products into a Long Range Precision Fires application. Optimize toolset to accommodate new advances in the technology delivering high-speed weapons in anti-access/area-denial environments. Transition the technology to an appropriate government agency or prime defense contractor for integration and testing. Integrate and validate the functional aerothermodynamic tools into a real-world development or acquisition program.

REFERENCES:

VERSION 3

1. T. J. Juliano, S. P. Schneider, S. Aradag, and D. Knight. "Quiet-flow Ludwieg tube for hypersonic transition research"". AIAA Journal, 46(7):1757–1763, July 2008
2. D. R. McDaniel, R.H. Nichols, T. A. Eymann, R.E. Starr and S. A. Morton, "Accuracy and Performance Improvements to Kestrel's Near-Body Flow Solver". AIAA SciTech Forum, p.1051, 2016.
3. J.-B. Chapelier, B. Wasistho and C. Scalo, "A Coherent vorticity preserving eddy-viscosity correction for Large- Eddy Simulation," Journal of Computational Physics, vol. 359, pp. 164--182, 2018.
4. R. H. Nichols, "A Summary of the Turbulence Models in the CREATE-AV Kestrel Flow Solvers," AIAA SciTech Forum, p. 1342, 2019.
5. R.H. Nichols, "Modification of the Turbulence Models in the CREATETM-AV Kestrel Flow Solvers for HIgh-Speed Flows, AIAA SciTech Forum, p. 1174, 2022
6. V. C. Sousa and C. Scalo, "A unified Quasi-Spectral Viscosity (QSV) approach to shock capturing and large-eddy simulation," Journal of Computational Physics, vol. 459, p. 111139, 2022.

KEYWORDS: Hypersonics, aerothermodynamics, modeling, design, tools, air vehicles

VERSION 3

A23B-T007 TITLE: Precision Control of High-speed Autonomous Vehicles under High Disturbances

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy, Integrated Network System of Systems

OBJECTIVE: This project seeks the development and demonstration of algorithms that support near-optimal control of autonomous high speed aerial vehicles in real time, with precision, and in challenging and adversarial environments.

DESCRIPTION: Unmanned Aerial Systems (UAS) used by the Army may be subject to harsh conditions in hostile environments. They need to be able to sense heavy disturbances in their environment that affect their operations, instantaneously adjust to overcome their impact. Furthermore, they should form and track a mission supporting trajectory in real time with speed and agility.

Control systems that directly integrate feedback from complex inertial sensors, such as high-end inertial measurement units, or novel odometry systems, and semantic feedback from exteroceptive sensors, such as cameras have the potential to substantially increase the maneuvering capability of high-speed vehicles used or envisioned by the Army. Such measurements can be used in the feedback loop to instantaneously adjust controls to overcome disturbances, as well as predicting abrupt changes in the disturbances and issue predictive control mechanisms. This approach could enable safe and effective operation of for small UASs under excessive wind, abrupt changes in atmospheric pressure due to effects such as blast waves, and occurrence of obstacles which may not be known in advance. This project seeks the development and demonstration of algorithms that can control autonomous aerial vehicles with precision in challenging and adversarial environments listed above, using integrated real-time information from precision inertial sensors and high-frame-rate cameras. The trajectories are pre-determined by the mission in terms of a sequence of waypoints, but they can be subject to small changes based on real-time information acquired by sensors. In general, models describing such systems are complex, and real-time generation of time optimal control policies is challenging. Incorporation of data driven approaches using innovative machine learning algorithms could provide acceptable near-optimal solutions. The research also involves integration of information from a variety of sensors into a from that can be used by the controllers to ensure the stated goals. The proposed algorithms should be implementable over computing hardware that can fit the platform of choice for the demonstration. Sensors that can provide the required information should be specified and the impact of possible gaps in their commercial availability should be identified. It is expected that the computed control laws can provide a performance within 20% of is preselected values of the trajectories and the instantaneous velocities as obtained from simulations and analysis. The demonstration should produce tracking errors no larger than 20 centimeters over the planned trajectory with wind conditions less than 20 miles/hour and have the errors stay bounded under more challenging conditions. A UAS of four vehicles should be able to perform agile movements as required by the control law at a speed more than 15 miles/hour, while reaching the maximum speed of the platform in favorable parts of the trajectory.

PHASE I: During Phase I effort, the proposed control algorithms will be completely specified and validated using simulations over realistic scenarios. The theoretical underpinnings of the proposed algorithms should be discussed with technical rigor, accompanied with their analysis of stability, safety and convergence conditions.

VERSION 3

PHASE II: Four or more or small-scale prototype vehicles with sensor, computation and control units will be designed based on the numerical model and design methodology developed in Phase I, technologies. The prototype devices can be built on commercially available state of the art small rotary wing quadcopters. If applicable, performers are encouraged their own designed crafts with comparable or better performance than commercially available units. Technical risks will be identified and plans for minimizing these risks will be devised.

PHASE III DUAL USE APPLICATIONS: Phase III effort will explore opportunities for integrating developed technologies into various UAS and weapon systems used by the Army.

REFERENCES:

1. W. Sun, G. Tang, and K. Hauser. Fast UAV trajectory optimization using bilevel optimization with analytical gradients. In 2020 American Control Conference (ACC), pages 82–87.
2. D. Mellinger and V. Kumar. Minimum snap trajectory generation and control for quadrotors. In 2011 IEEE International Conference on Robotics and Automation, pages 2520–2525
3. S.Meyn. Control Systems and Reinforcement Learning, Cambridge University Press, 2022.

KEYWORDS: UAS, Trajectory Planning, Time Optimal Control, Reinforcement Learning

VERSION 3

A23B-T008 TITLE: Bright Blue Semiconductor Laser Arrays for Military Applications

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

OBJECTIVE: Develop compact chip-scale blue laser systems with high beam quality useful for machining and propagation. Advances based upon the coherent beam combining of diode lasers of high brightness are sought.

DESCRIPTION: Laser systems in the infrared have a long history of development for both DoD and commercial applications. Blue laser diode systems have been developed with improved performance over the past 2 decades; however, their brightness and power levels are much less than the best infrared systems. Of particular interest is GaN based blue laser diodes which have superior brightness and power scaling potential over the current state-of-the-art. Blue light at wavelengths around 450 nm is of particular interest due to the increased absorption in many materials, particularly metals. The laser energy can thus be transmitted into the material more quickly for more precise machining with less power. The Army would like to develop superior blue laser systems to assess applications in machining and directed energy where more compact and high performing systems may be possible. Diode systems are of interest due to their compact size and GaN is known as a high thermal conductivity material so may be amenable to significant power scaling if coherent combining architectures can be developed. Finally, high beam quality and brightness are of interest for the applications and may require consideration of the laser diode architecture itself, and not just the beam combining architecture. However, the desired metrics for this topic allow for flexibility in the device approach.

PHASE I: Pursue chip-scale directed energy beam combining techniques using high efficiency diode lasers exceeding 30% wall-plug efficiency each with 0.4-0.46 micron wavelengths. Design coherent beam combining architecture for either surface emitting arrays or in-plane laser beam combining. Use of monolithic cavities or chip-scale solutions should be pursued both to demonstrate minimal footprint and show a path toward combining larger numbers of lasers. Additional design considerations should be investigated for the incorporation of effective liquid cooling of arrays to explore maximum power levels. Brightness levels of 200 MW/cm2*sr should be shown to be feasible along with power scaling to > 100 W power levels/cm2 – without coherent combining, but to show thermal heat dissipation design considerations. A demonstration of high-brightness, single mode, Watt-level single emitters should be made along with designs for coherent combining of arrays to reach at least 15 W.

PHASE II: Continue implementation of coherent beam combining designs. Pursue 15 - 100 W peak power, uncooled coherently combined arrays and designs for higher power, cooled arrays. Brightness levels of 1000 MW/ cm2*sr should be demonstrated that achieve combining efficiencies of 70% or more for the chip-scale architecture.
Optimization of the arrays and studies on minimal spacing between individual lasers for the nominal power target level and within the beam combining architecture should continue along with needed studies to explore power scaling with larger arrays. Demonstration of chip-scale DE systems that achieve > 15 W peak power with designs that can scale to over 100 W and potential to achieve kWs. An assessment of cooling for the array to achieve continuous wave operation should be made toward phase III demonstrations. Eventually, cooled arrays of 100 W or more per square centimeter average power are desired.

VERSION 3

PHASE III DUAL USE APPLICATIONS: Pursue further optimization of array cooling and power scaling with refined chip-scale designs. In addition, multi-stage architectures should be pursued to combine lower power arrays to achieve kW power level output. Monolithic cavities should be pursued for at least the first stage of combining with secondary combining by either external cavities or secondary monolithic cavities. Other consideration to utilize techniques to create lower power arrays (still multi-Watt) for additive manufacturing, under-water laser communications, and beam scanning and surveillance lidar should be made. Particular consideration for phased arrays should be considered for beam steering and adaptive optical beam control to mitigate atmospheric turbulence to achieve maximum power on target.

REFERENCES:

1. J.A. Davis, “HEL Wavelengths & Platform Locations! What are the Impacts?” 2020 DEPS Systems Symposium, November 2020.
2. M. S. Zediker, "Blue laser technology for defense applications," Proc. SPIE 12092, Laser Technology for Defense and Security XVII, 1209207 (30 May 2022).
3. Inoue, T., Yoshida, M., Gelleta, J. et al. General recipe to realize photonic-crystal surface-emitting lasers with 100-W-to-1-kW single-mode operation. Nature Communications 13, 3262 (2022).
4. M. Ali et al., "Recent advances in high power blue laser diodes," 2017 IEEE High Power Diode Lasers and Systems Conference (HPD), 2017, pp. 47-48, doi: 10.1109/HPD.2017.8261094.
5. R. Liu, Y. Liu, Y. Braiman, “Coherent beam combining of high power broad area laser diode array with a closed-V-shape external Talbot cavity,” Optics Express, Vol. 18, No. 7, 29 March 2010.
6. D. Zhou, J.-F. Seurin, G. Xu, P. Zhao, B. Xu, et al, “Progress on high-power high brightness VCSELs and applications,” Proc. SPIE Vol. 9381, Vertical-Cavity Surface-Emitting Lasers XIX,9 3810B (4 March 2015); doi: 10.1117/12/2080145.

KEYWORDS: blue laser diodes, additive manufacturing, brightness, gallium nitride, directed energy, coherent beam combining

VERSION 3

A23B-T009 TITLE: Small Unmanned Aerial System for Surveying the Electromagnetic Spectrum

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

OBJECTIVE: Develop a UAS mountable sensor and transmit package that will provide a standalone low-cost survey, including geolocation, of the electromagnetic spectrum without the need for corporate support.

DESCRIPTION: Many military and civilian applications require rapid survey of the electromagnetic spectrum for identification and the geolocation of electromagnetic emitters. A UAS provides an ideal platform for rapid surveys in possibly hazardous environments. For example, in a natural disaster Emergency Management Services (EMS) require a rapid means of surveying the electromagnetic spectrum that will identify cell phone signals and locate the sources of those signals. The small tactical military unit has a similar need. The technical challenges are developing a low weight sensor that will detect signals, provide geolocation from a small platform, and in real time relay the geolocation information back to decision makers. In the operational scenarios envisioned there cannot be the expectation of external technical support that would aid in the identification and classification of signals. In addition, the form factor of the UAS should be one that enables a single person to carry and deploy, e.g. a quadcopter drone.

With the recent development of lightweight, high fidelity RF components through advanced manufacturing techniques and advanced genetic algorithm design provide a new technology to enable the precision, range and SWAP needed for electromagnetic spectrum surveying in battlefield environments. As an example, application specific electrically small antennas can be manufactured with minimal time, cost and weight. In addition, RF shielding for high-dynamic range measurements can be enabled through light-weight artificial materials acting as shields and directors, separating the electrically noisy components of a UAS from sensitive RF electronics.

Traditionally, communication signals have been identified through correlation of integrated emissions over a period of time. Civilian and military communications have evolved so that the frequencies use short duration pulsed communications and each emission at subsequent intervals can be centered at different frequencies. Technology is required to efficiently capture the presence of signals rather than the content of the actual signals. Thus, it is more important to know that there is a signal and locate the source of the signal than to know details about the signal. Details such as operating frequency and modulation characteristics are not as important but would of course be of interest. Geolocation is also important and possible solutions include using multiple UAS platforms, using synthetic aperture techniques, time of arrival, or possibly even signal strength determinations as the UAS flies in a formation.

This topic shall be manufactured and/or assembled within the continental United States.

PHASE I: Develop a system design for a Class I or Class II UAS platform or platforms to map electromagnetic signal emitters including signal type and geolocation. The system should meet threshold values of a payload capacity of up to 10lbs and a minimum operational time of 15 minutes with a minimum observational range of 1 km and an objective payload weight of 5 lbs, operation time of 30 minutes, and observational range of 5km. This should include a spectrum sensing algorithm for use on a UAS and a corresponding system hardware architecture. The objective for spectral sensing should be

between 3MHz-6 GHz, able to sense RF power below -90 dBm and produce an accuracy of < 100 meter of signal emitter location.

PHASE II: Design and fabricate a UAS electromagnetic sensing system including the algorithms developed in Phase I. The system sensitivity will be improved to below -100dBm. The design of RF shielding and directionality for signal enhancement through custom antenna design and shielding will be demonstrated. The system should then be integrated with a UAS platform that meets or exceeds PHI standards with an improved flight time of no less than 30 minutes and range > 10km supporting maximum payload. Data can be stored locally for retrieval upon return, however the ability to transmit data concurrently with spectrum and location mapping is desired. The UAS should be launchable from a single person. The sensing system should be able to: identify signal emitters by frequency and power, sense RF power below -100 dBm, and provide geolocation with <25m resolution.

PHASE III DUAL USE APPLICATIONS: The UAS platform demonstrated in Phase II will be developed for specific mission targets in collaboration with Army needs. It is expected that the payload capacity should increase to >15lbs, range should be increased to > 50 km with a flight time > 60 minutes and multiple sensing frequency bands can be concurrently sensed. The UAS system should be able to sense RF power below -100 dBm and also geolocate with < 10 m resolution.

REFERENCES:

1. Martian, A. Real-time spectrum sensing using software defined radio platforms. Telecommun Syst 64, 749–761 (2017). https://doi.org/10.1007/s11235-016-0205-z
2. Zhao, Xiaoyue & Pu, Fangling & Wang, Hangzhi & Chen, Hongyu & Xu, Zhaozhuo. (2019). Detection, Tracking, and Geolocation of Moving Vehicle from UAV Using Monocular Camera. IEEE Access. PP. 1-1. 10.1109/ACCESS.2019.2929760.

KEYWORDS: UAS, UAV, electromagnetic spectrum, sensing, geolocation

VERSION 3

A23B-T010 TITLE: Uncertainty and Model Predictive Control During Discontinuous Events in Autonomous Legged Robots

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy, Integrated Network System of Systems

OBJECTIVE: An autonomous legged robotic control system capable of navigating highly uneven, obstructed, and uncertain terrain.

DESCRIPTION: The future Warfighter will require autonomous robotic systems to traverse highly uneven, obstructed, and uncertain terrain at speed. Legged platforms are clear frontrunners to meet this requirement, but the control of such systems presents a substantial engineering challenge. However, recent developments in hybrid dynamical systems (the branch of control engineering science that effectively models legged systems) and computational capability suggest that the time to address this challenge has arrived. New techniques in signal filtration and uncertainty characterization may be refined to create a controller capable of guiding a robotic platform across terrain that, up until now, has been impassable by an autonomous agent. Successful performers will have to prove the validity of novel physics-based models and control frameworks for a quadruped robot in question for wide arrays of tasks and demonstrate superiority of this paradigm over learning-based control in specific situations. The results will be further streamlined and tested on current quadruped robots.

PHASE I: Design, develop, and validate improved techniques for state estimation and uncertainty propagation in model predictive control of hybrid dynamical systems - specifically quadruped robots in dynamic and uncertain environments. Demonstrate proof-of-concept of this new control paradigm, and quantify its efficacy over the current state-of-the-art. This demonstration should illustrate the ability of a quadruped robot to successfully autonomously navigate a test environment featuring sharply uneven terrain (roots and rocks whose characteristic length are on the order of, and slightly larger than, that of the quadruped foot) hidden underneath grass or grass-like obstructions whose height is on the order of the robot's. A successful demonstration will permit a quadruped to traverse ten body lengths at 0.5 body lengths per second over flat but uneven terrain featuring ground level variance and grass-like obstructions not exceeding 20% of the robot's height.

PHASE II: Design, develop, and validate broad techniques for state estimation and uncertainty propagation across a wide array of physical environments in which a quadruped robot may operate. Demonstrate integration with existing novel perception and sensing capability in a path-planning exercise whose terrain includes obstructions like those in the demonstration of Phase I. Phase II should extend the methodologies of proprioception developed in Phase I to enable increased performance. Compare the efficacy of this new controller against that of traditional techniques such as deep reinforcement learning (DRL) controllers or Model Predictive Control (MPC). A successful demonstration will permit a quadruped to traverse a five body-length incline of +/- 20 degrees with root-like obstructions and slippery surfaces at 0.3 body lengths per second.

PHASE III DUAL USE APPLICATIONS: The end-state control architecture should be mature enough to extrapolate locomotor performance to any number of scenarios, environments, and robotic platforms. The ideal resulting controllers will feature selective frameworks (such as a framework that could choose between MPC, DRL, etc.), and the inherent ability to determine what control technique is most effective

for the task at hand. Production-ready controllers will also enable a robotic platform to extract itself from a ”stuck” position in brush, soft soil, and/or rocky terrain.

REFERENCES:

1. Christopher Allred, Mason Russell, Mario Harper, and Jason Pusey. Improving methods for multi-terrain classification beyond visual perception. In 2021 Fifth IEEE International Conference on Robotic Computing (IRC), pages 96–99. IEEE, 2021.
2. Berk Altın and Ricardo G Sanfelice. Model predictive control for hybrid dynamical systems: Sufficient conditions for asymptotic stability with persistent flows or jumps. In 2020 American Control Conference (ACC), pages 1791–1796. IEEE, 2020.
3. Taylor Apgar, Patrick Clary, Kevin Green, Alan Fern, and Jonathan W Hurst. Fast online trajectory optimization for the bipedal robot cassie. In Robotics: Science and Systems, volume 101, page 14, 2018.
4. Max Austin, John Nicholson, Jason White, Sean Gart, Ashley Chase, Jason Pusey, Christian Hubicki, and Jonathan E Clark. Optimizing dynamic legged locomotion in mixed, resistive media. In 2022 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM), pages 1482–1488. IEEE, 2022.
5. Yanran Ding, Abhishek Pandala, Chuanzheng Li, Young-Ha Shin, and Hae-Won Park. Representation- free model predictive control for dynamic motions in quadrupeds. IEEE Transactions on Robotics, 37(4):1154–1171, 2021.
6. Wei Gao, Charles Young, John Nicholson, Christian Hubicki, and Jonathan Clark. Fast, versatile, and open-loop stable running behaviors with proprioceptive-only sensing using model-based optimization. In 2020 IEEE International Conference on Robotics and Automation (ICRA), pages 483–489. IEEE, 2020.
7. Philip Holmes, Robert J Full, Dan Koditschek, and John Guckenheimer. The dynamics of legged locomotion: Models, analyses, and challenges. SIAM review, 48(2):207–304, 2006.
8. Donghyun Kim, Jared Di Carlo, Benjamin Katz, Gerardo Bledt, and Sangbae Kim. Highly dynamic quadruped locomotion via whole-body impulse control and model predictive control. arXiv preprint arXiv:1909.06586, 2019.
9. Daniel E Koditschek. What is robotics? why do we need it and how can we get it? Annual Review of Control, Robotics, and Autonomous Systems, 4:1–33, 2021.
10. Nathan J Kong, J Joe Payne, George Council, and Aaron M Johnson. The salted kalman filter: Kalman filtering on hybrid dynamical systems. Automatica, 131:109752, 2021.
11. Matthew D Kvalheim, Paul Gustafson, and Daniel E Koditschek. Conley’s fundamental theorem for a class of hybrid systems. SIAM Journal on Applied Dynamical Systems, 20(2):784–825, 2021.
12. Hai Lin and Panos J Antsaklis. Modeling of hybrid systems. In Hybrid Dynamical Systems, pages 11–64. Springer, 2022.
13. Yuan Lin, John McPhee, and Nasser L Azad. Comparison of deep reinforcement learning and model predictive control for adaptive cruise control. IEEE Transactions on Intelligent Vehicles, 6(2):221–231, 2020.
14. David M Mackie. Analysis of army doctrine documents with respect to artificial muscle and robotic mules. Technical report, CCDC Army Research Laboratory, 2020.
15. Takahiro Miki, Joonho Lee, Jemin Hwangbo, Lorenz Wellhausen, Vladlen Koltun, and Marco Hutter. Learning robust perceptive locomotion for quadrupedal robots in the wild. Science Robotics, 7(62):eabk2822, 2022.
16. Marion Sobotka. Hybrid dynamical system methods for legged robot locomotion with variable ground contact. PhD thesis, Technische Universit¨at Mu¨nchen, 2007.

17. Arjan J Van Der Schaft and Hans Schumacher. An introduction to hybrid dynamical systems, volume 251. springer, 2007.

KEYWORDS: Robotics, Control, Dynamical Systems, Hybrid Dynamical Systems, Model Predictive Control, Perception, Proprioception, Exteroception, Path Planning, Nonlinear Systems

VERSION 3

A23B-T011 TITLE: Development of pyrolysis optimization methodology for carbon/carbon materials

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 section 3.5 of 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 a methodology for design and optimization of pyrolysis schedules to generate desirable carbon matrices for carbon-carbon composites.

DESCRIPTION: Carbon-carbon composites (CCCs) have been utilized for hypersonics applications for decades. For much of that time, the state of the art in source materials, particularly for the matrix phase, has advanced slowly or not at all. Recently, however, a spate of new potential materials (particularly polymer resins) have been developed and are being evaluated as possible precursors for CCCs. The development and commercialization of these polymers represents an exciting opportunity to meaningfully advance the state of the art in CCC fabrication. However, to date, the manufacture of CCCs is still a long and expensive process, and the urgent and increasing DoD need for these materials in the short and medium term necessitates efforts to bring article lead times and cost down. Since CCC costs are primarily driven not by precursor material costs, but by processing costs, it is important to assess new potential precursor material solutions by the impact of their use on the efficiency of downstream processing steps, i.e., densification cycles.

However, the efficacy of a given potential material solution is driven not only by the chemistry of the matrix precursor material, but by how that chemistry behaves during the pyrolysis cycle to which the material is subjected to render a carbon matrix [1]. The nature of the pyrolysis cycle determines several important factors of the resulting matrix and composite. First, the details of the pyrolysis cycle can affect the resulting char yield [2], which is a metric that receives a large amount of attention from polymer developers as they develop new materials. Second, the differences in pyrolysis cycle can influence the microstructure of the resulting voids left behind after pyrolysis [3], which can be large drivers of the efficiency of subsequent densification cycles. That is, for the purposes of redensification, it is desirable to have voids which are 1) of a size which can be efficiently filled by the carbon medium used downstream, and 2) highly connected throughout the part rather than closed and isolated. Third, the pyrolysis cycle parameters should allow for volatiles generated during the pyrolysis to leave the material quickly enough to avoid generating excessive pore pressures [4], which can lead to undesirable outcomes including destructive delaminations, which may render a CCC part unusable.

Currently, there are no commercially available methods to guide resin development or to optimize the pyrolysis of new resins with an aim to improving any of the above metrics. Therefore, we seek the development of novel tools and approaches to optimization of pyrolysis cycles that will allow for more cost effective and efficient densification of CCCs for hypersonics applications. Such tools should be

robust and broadly applicable to different chemistries of interest, rather than tailored exclusively to one particular chemistry, and be transitionable to DoD and industry partners.

PHASE I: The offeror shall develop a method to optimize the pyrolysis cycle for one carbon precursor (e.g., resin or pitch) material of interest to the DoD hypersonics community. This method shall be demonstrated to achieve meaningful improvement of some aspect of the resulting carbon matrix in a CCC that is expected to result in materially improved efficiency of downstream densification cycles.

Measured improvement will be in the context of a composite form relevant to DoD hypersonics needs, i.e., either a continuous fiber 2D or 3D woven carbon form of at least ½" thickness. Metrics of improvement may include 1) increase in char yield, wherein the offeror will show at least 10% improvement in char yield over the baseline case; 2) improved void microstructure for efficient redensification, wherein the improvement may be compared to the baseline case using void characterization techniques including, but not limited to, mercury intrusion porisimetry, pycnometry, computed tomography, or diffusivity measurement; or 3) any other reasonable metric commonly accepted by the CCC community as an indicator of expected improvement in densification efficiency. The baseline in all cases will be defined as a temperature ramp from room temperature to 1000°C at a rate of 5°C/min in an inert atmosphere, or some other reasonable pyrolysis cycle in common use in the industry. The offeror may make use of industry- and DoD-derived databases of pyrolysis processes if these are available, but as these will largely be proprietary, the offeror may need to conduct pyrolysis cycles independently to establish the necessary datasets for development of the tool.

The offeror is encouraged to keep in mind the need to deliver a product that can be readily transitioned and commercialized at the end of the period of performance.

PHASE II: The offeror shall expand the method developed in Phase I to demonstrate the broad applicability of the method to at least two additional carbon matrix precursor chemistries of interest to the DoD hypersonics community. The offeror will demonstrate improvement of pyrolysis cycle for downstream reinfusion/densification with, e.g., demonstration of more complete and uniform infusion of polymer resin into pyrolyzed composite compared to baseline. (Additional pyrolysis and reinfusions beyond this are not required.)
The offeror shall deliver a method and toolset that can be readily transitioned and commercialized. The toolset may be standalone software, software modules that can be integrated into existing commercial software, an analytical model, or any other similar transitionable knowledge product.

PHASE III DUAL USE APPLICATIONS: The offeror is expected to aggressively pursue opportunities to market the method developed herein for use in CCC fabrication for DoD-relevant hypersonics applications.

REFERENCES:
1. "Simulating the Initial Stage of Phenolic Resin Carbonization via the ReaxFF Reactive Force Field", De-en Jiang, Adri C. T. van Duin, William A. Goddard III, and Sheng Dai; J. Phys. Chem. A, 2009
2. "Modification of the pyrolysis/carbonization of PPTA polymer by intermediate isothermal treatments", Alberto Castro-Muñiz, Amelia Martínez-Alonso, Juan M.D. Tascón; Carbon, 2008
3. "Effect of processing parameters on the mechanical properties of carbonized phenolic resin", Chul Rim Choe, Kwang Hee Lee, Byung Il Yoon; Carbon 1992

4. “Stress and damage development in the carbonization process of manufacturing carbon/carbon composites”, Tiantian Yin, Yu Wang, Linghui He, Xinglong Gong; Comp. Mat. Sci., 2017

KEYWORDS: Carbon-carbon; pyrolysis; optimization; polymer design; hypersonics; materials; processing.

VERSION 3

A23B-T012 TITLE: Environmentally Stable Perovskite Solar Cell Module

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

OBJECTIVE: Design and demonstrate a combined materials-, device-, and module-based engineering approach to creating environmentally stable perovskite solar cell modules.

DESCRIPTION: Perovskite solar cells (PSCs) are an increasingly promising photovoltaic (PV) technology, as their power conversion efficiency has increased from less than 4% at the outset of research in 2009 to over 25% today [1 – 4]. Metal halide and hybrid perovskites adopt the general ABX3 chemical formula and crystallize in the perovskite structure, where the A-site is typically occupied by an organic cation like methylammonium or an alkali ion like Cs, the B-site is occupied by a metal cation like Pb, and the X-site is occupied by a halide ion like Cl. This class of perovskites exhibits strong light absorption and emission, has excellent electronic transport characteristics, and is amenable to solution-processing methods. These advantages may translate to significant improvements in PV size, weight, power, and cost (SWaP-C), which could enable the US Army to efficiently generate electrical power from the sun in a variety of environments ranging from large permanent installations to Soldier-level power-on-the-move. Despite these advantages, poor thermodynamic stability, hygroscopic behavior, and poor environmental stability continually plagues PSCs and is limiting their development and ultimate technological impact. This challenge is manifold: lead halide perovskites themselves are thermodynamically unstable with respect to decomposition (i.e., they have a positive enthalpy of formation) [5]; high mobility of X-ions causes significant ion migration during PSC operation and degrades material quality and PV performance; thermal stresses and thermal cycling during operation further degrade performance; and the presence of humidity during PV operation ultimately destroys crystal quality and PV module performance over long periods. These problems are compounded by a lack of mechanistic understanding of degradation modes.

Thus, a holistic research effort is needed to improve stability across the PSC hierarchy, ranging from fundamental science and engineering at the materials level, to device engineering, to module design and integration. This scope-encompassing effort would provide (a) better insight into the physics and chemistry of perovskite degradation; (b) new materials design rules that imbue perovskites with resistance to thermodynamic instability and ion migration; (c) device engineering approaches spanning contacts/electron transport layer/hole transport layer/substrate that address interfacial, thermal, and moisture instability; and (d) module engineering approaches that mitigate or eliminate sources of instability (e.g., moisture, thermal regulation) that cannot otherwise be addressed with materials design or device engineering approaches. Recent isolated, limited-scope research advances suggest this approach is feasible—for example, perovskite A- and B-site ion composition can be tuned to improve stability at the materials and device level [6]. Likewise, composition and tolerance factor engineering in oxide [7] and hybrid perovskites [8] suggests that entropy may be an underutilized tool for thermodynamic stability, i.e., an “entropy-stabilized” hybrid perovskite [9,10]. Interfacial ion-blocking barriers in devices may be useful to modulate chemical potential to suppress ion migration [11]. Ionic passivation of grain boundaries may also suppress ion migration [12]. Encapsulation strategies at the device and module level can provide added protection against humidity and thermal cycling, though more work is needed [13].

PHASE I: Design a concept for an environmentally stable perovskite solar cell module that incorporates stability science and engineering at the materials and thermodynamic stability level, device level, and the module/packaging level. Describe the proposed thermodynamics and materials design science, device engineering, and module packaging schemes that will be employed. Perform ab initio atomistic modeling,

molecular dynamics simulations, thermodynamic calculations, electromagnetic simulations, finite element analysis, and/or technology computer-aided design (TCAD) as needed to demonstrate the feasibility of the proposed approach. The module design must have a minimum of 400-square-cm PV-active area and consist of four (4) individual 100-square-cm perovskite solar cells wired in series, parallel, or combination thereof.

The module must be designed to have an absolute power conversion efficiency of 15% or greater. The module must be designed to retain 90% or more of its initial power conversion efficiency over an 8000-hour period while being subjected to 1 Sun, 40˚C, and 85% relative humidity (RH) for at least 4000 hours. Outline the techniques and procedures that will be used to fabricate the proposed design and characterize its PV power conversion performance. Outline the necessary techniques and procedures specifically needed to evaluate PSC environmental stability based on, or appropriately adapted from, the International Summit on Organic PV Stability (ISOS) [14]. Proposed stability tests must include, but are not limited to, shelf-life and dark-storage testing, outdoor testing, light-soaking testing, thermal cycling testing, and combined light-humidity-thermal cycling testing. The proposed model solution must elucidate the stability parameters requirements, stability constraints, and demonstrably meet the elements critical to success of the proposed design.

A critical Phase I deliverable is to create at least one physical module prototype that successfully demonstrates one or more of the stabilized solutions that are critical to success of the proposed model design. This prototype must demonstrate one or more of the proposed stabilization approaches: improved perovskite materials thermodynamic stability, device engineering, and/or the module integration scheme. This physical module prototype must have at least 100-square-cm PV-active area and a power conversion efficiency of 7.5% or greater. The prototype must retain 75% or more of its initial power conversion efficiency over a 720-hour period while being subjected to 1 Sun, 40˚C, and 85% relative humidity (RH) for at least 360 hours.

PHASE II: Based on the designs, modeling, and prototypes from Phase I, fabricate, test, and demonstrate at least one operational PSC-based solar cell module. The module must have a minimum of 400-square-cm PV-active area and consist of four (4) individual 100-square-cm perovskite solar cells wired in series, parallel, or combination thereof. The module must have a power conversion efficiency of 15% or greater. Perform the proposed ISOS testing protocols and any additional tests, as appropriate, to characterize the solar module stability. Using accelerated and/or surrogate testing methods, environmental chambers, and/or field testing, demonstrate that the prototype module will retain 90% or greater of its initial power conversion efficiency over 8000 hours when subjected to 1 Sun illumination and the entire range of climactic operating conditions (i.e., 11 different daily cycles in air temperature and relative humidity) defined in Table 3-1 of AR 70-38 [15]. Data and metrics to report must include initial solar cell characterization (current-voltage curve, maximum power point, internal and external quantum efficiency), encapsulation strategy and performance (wiring, layering, edge sealing, geometry, evolution of stresses/strains within these components), aging conditions (electrical bias, cycling, light, temperature, atmosphere), number of samples, outdoor stability, and, importantly, the evolution of power conversion efficiency over time (i.e., how long until the module efficiency degrades to 90% of its maximum power output or peak efficiency?).

PHASE III DUAL USE APPLICATIONS: Phase III will transition the newly developed stabilized PSC module technology to commercial availability through prime contractors that build integrated solar power systems, the original equipment manufacturers that manufacture PV modules, other relevant suppliers,

and/or other partnering agreement(s), as appropriate. Commercialization of this technology may occur via the incorporation of one or more stabilization approaches anywhere in the PV module (e.g., materials design, device engineering, module integration, etc.).

Ideally, a successful effort will deliver a capability upgrade for a relevant Army Program of Record at the end of Phase III, in the form of a solar power generating system capable of providing power against SWaP-C metrics of $3/W or less, 150 W/kg or more, and a functional lifetime of 5 years or greater. Expected dual-use applications include commercial PV power plants, self-charging electric vehicles, microgrids for self-powering infrastructure components, residential solar power, and portable solar power generators and battery chargers.

REFERENCES:

1. Wang, R., et al., (2018), A Review of Perovskites Solar Cell Stability, Advanced Functional Materials, 29, 1808843.
2. Zhang, H., et al., (2022), Review on Efficiency Improvement Effort of Perovskite Solar Cell, Solar Energy, 233, 421 – 434.
3. Mahmud, M., et al., (2022), Origin of Efficiency and Stability Enhancement in High-Performing Mixed Dimensional 2D-3D Perovskite Solar Cells: A Review, Advanced Functional Materials, 32, 2009164.
4. Huang, Y., et al., (2022), Recent Progress on Formamidinium-Dominated Perovskite Photovoltaics, Advanced Energy Materials, 12, 2100690.
5. Nagabhushana, G.P., et al., (2016), Direct Calorimetric Verification of Thermodynamic Instability of Lead Halide Hybrid Perovskites, Proceedings of the National Academy of Science, 113, 7717 – 7721.
6. Turren-Cruz, S.-H., Hagfeldt, A., Saliba, M., (2018), Methylammonium-Free, High-Performance, and Stable Perovskite Solar Cells on a Planar Architecture, Science, 362, 449 – 453.
7. Chol, S., et al., (2018), Exceptional Power Density and Stability at Intermediate Temperatures in Protonic Ceramic Fuel Cells, Nature Energy, 3, 202 – 210.
8. Tan, W., et al., (2018), Thermal Stability of Mixed Cation Metal Halide Perovskites in Air, ACS Applied Materials & Interfaces, 10, 5485 – 5491.
9. Rost, C.M., et al., (2015), Entropy-Stabilized Oxides, Nature Communications, 6, 8485.
10. Saliba, M., et al., (2016), Cesium-Containing Triple Cation Perovskite Solar Cells: Improved Stability, Reproducibility, and High Efficiency, Energy & Environmental Science, 6, 1989 – 1997.
11. Qiu, P., et al., (2018), Suppression of Atom Motion and Metal Deposition in Mixed Ionic Electronic Conductors, Nature Communications, 9, 2910.
12. Cai, F., et al., (2018), Ionic Additive Engineering Toward High-Efficiency Perovskite Solar Cells With Reduced Grain Boundaries and Trap Density, Advanced Functional Materials, 28, 1801985.
13. Cheacharoen, R., et al., (2018), Design and Understanding of Encapsulated Perovskite Solar Cells to Withstand Temperature Cycling, Energy & Environmental Science, 11, 144.
14. Khenkin, M.V., et al., (2020), Consensus Statement for Stability Assessment and Reporting for Perovskite Photovoltaics Based on ISOS Procedures, Nature Energy, 5, 35-49.
15. Army Regulation 70 - 38, Research, Development, Test and Evaluation of Materiel for Worldwide Use. https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN30017-AR_70-38-000-WEB-1.pdf

KEYWORDS: Photovoltaics, solar cells, environmental stability, perovskite solar cells, materials, module engineering

VERSION 3

A23B-T013 TITLE: Method of Developing Helicopter Source Noise Models using Parameter Identification Techniques

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

OBJECTIVE: Develop a semiempirical tool for generating time-domain based, nondimensionally scaled, acoustic spheres from limited flight test data.

DESCRIPTION: Accurate helicopter source noise models are required by the US Army in order to estimate the acoustic impact of proposed helicopter operations. Conventional helicopter source noise models used by current mission planning tools are empirical in nature, relying on measurements of helicopter noise captured by ground based microphone arrays during steady flyovers [1-2]. These models are entirely empirical, which limit their capability to estimate the noise produced by the helicopter at operating conditions inside the limited measurement database. Therefore, inaccurate estimates are provided when vehicle operations occur at different altitudes, gross weights, and external store configurations than those measured. These models are further incapable of accurately predicting effects of maneuvering flight conditions that are difficult to measure with a ground-based array.

First-principles helicopter noise prediction models exist, but do not have the validated accuracy sufficient to produce reliable estimates of helicopter noise spheres required by mission planners. This topic proposes the development of a time-domain based hybrid method, where a mid-fidelity helicopter aeroacoustic prediction method is calibrated to measured data using a parameter identification approach. Accuracy comparable to empirical models is assured by calibrating the model to the available data; however, the model can be applied to predict noise at conditions that were not measured because it contains a physical model of the helicopter noise sources.

Prior research has proven the viability of this concept through the development of the Fundamental Rotorcraft Acoustic Modeling from Experiments (FRAME) method of developing source noise models for helicopters and other rotorcraft [3]. The FRAME technique has been used to make accurate helicopter noise predictions from limited sets of vehicle data; for example, validated predictions have been made at different airspeeds, descent rates [4], and density-altitudes [5]. Validated predictions have also been made for a variety of horizontal and vertical maneuvers with load factors ranging from 0.5 g to 2 g [6]. However, the FRAME software is at a low TRL and is primarily oriented towards community noise prediction. The goal of this proposed topic is to prompt the development of a commercial source noise modeling method that can support acoustic predictions for civilian and military helicopter operations.

PHASE I: The objective of phase I is to create a proof-of-concept semiempirical tool for generating, time-domain based, nondimensional scaled acoustic data for an isolated main rotor using wind tunnel acoustic measurements, or flight test measurements, as the source of model calibration data. Validate the tool by demonstrating that when the tool is calibrated to a subset of the measured data, the tool can accurately predict the time-domain main rotor harmonic noise radiation for rotor operating conditions both inside of (interpolation) and outside of (extrapolation) the range of data used to calibrate the tool. Develop technology transition plan and initial business case analysis

PHASE II: The objective of phase II is to further develop the tool to accurately model the acoustics of helicopters in free flight. Extend the tool to produce rotor harmonic time-domain noise data for both the main and tail rotors. Develop a method to calibrate the tool using ground-based microphone acoustic data

collected during the flight testing of helicopters. Validate the tool by demonstrating that when the tool is calibrated to a subset of measured data, accurate rotor harmonic noise predictions can be made for flight conditions both inside of and outside of the range of calibration data. Extend the tool to generate acoustic data spheres suitable for use as input to existing acoustic propagation software used to assess the acoustic impact of helicopter operations. Refine transition plan and business case analysis.

PHASE III DUAL USE APPLICATIONS: The objective of phase III is to further validate and finalize the tool for routine use in Government and commercial applications. Incorporate noise predictions for non-rotor-harmonic noise sources, such as broadband and engine noise. Validate the tool by demonstrating that accurate noise predictions can be made under atmospheric conditions different from those under which the calibration data were collected. Validate the tool by demonstrating that accurate noise predictions can be made under maneuvering flight using only steady flight noise data for calibration. Integrate the tool with a user interface and develop end-user documentation. The resulting tool is applicable to both military and commercial rotorcraft. Key military applications include predicting vehicle acoustic footprints during flight operations. The validated tool will be useful for accurate land use models for both military and civilian community operations.

REFERENCES:

1. Lucas, M. J. and Marcolini, M. A., “Rotorcraft Noise Model,” AHS Technical Specialists’ Meeting, Williamsburg, VA, October 1997.
2. Conner, D. A. and Page, J. A., “A Tool for Low Noise Procedures Design and Community Noise Impact Assessment: The Rotorcraft Noise Model (RNM),” Heli Japan, Tochigi, Japan, 2002.
3. Greenwood, E., Fundamental Rotorcraft Acoustic Modeling from Experiments (FRAME). Ph.D. University of Maryland, 2011.
4. Greenwood, E., and Schmitz, F.H., "A Parameter Identification Method for Helicopter Noise Source Identification and Physics-Based Semi-Empirical Modeling," presented at the American Helicopter Society 66th Annual Forum, Phoenix, AZ. May 2010.
5. Greenwood, E., Sim, B.W., and Boyd, D.D., "The Effects of Ambient Conditions on Helicopter Harmonic Noise Radiation: Theory and Experiment," presented at the American Helicopter Society 72nd Annual Forum, West Palm Beach, FL. May 2016.
6. Greenwood, E., Rau, R., May, B., and Hobbs, C., "A Maneuvering Flight Noise Model for Helicopter Mission Planning," presented at the American Helicopter Society 71st Annual Forum, Virginia Beach, VA. May 2015.

KEYWORDS: Rotorcraft, Helicopter, Acoustics, Noise, Modeling

VERSION 3

A23B-T014 TITLE: Improving the Thermal Conductivity (TC) of Enhanced Performance Coolants (EPC) with inorganic additive nanotechnology

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

OBJECTIVE: A compatible Organic Acid Technology (OAT) coolant with a 50% increase the thermal efficiency over traditional coolants that allows for improved performance of Future Vertical Lift, Unmanned, and ground vehicles.

DESCRIPTION: Develop an advanced Nitrate Free Organic Acid Technology (OAT) based coolant with improved thermal efficiency of at least 50% to reduce coolant needed or improve heat rejection/reliability of affected systems. In May of 2022 DEVCOM Ground Vehicle Systems Center released a technical report in support of the Army converting to modern OAT based coolants. Heavy Duty OAT based coolants are very attractive with up to a five (5) year lifespan versus traditional Supplemental Coolant Additives (SCA) based coolant which have annual service requirements. However, this OAT chemistry only improves the thermal efficiency on average of 2% under laboratory conditions. The reference report by DEVCOM and conducted by SWRL showed OAT coolants at a 60/40 mixture with a thermal conductivity average of 0.4046 (W/mk) versus traditional SCA coolants with a thermal conductivity average of 0.3892 (W/mk). If inorganic additive nanotechnology were added to OAT coolants, a thermal conductivity of approximately 0.60 (W/mk) could be realized while maintaining all legacy performance requirements of the fluids. The new coolant (OAT plus inorganic nano additives) must perform across a wide temperature range between -60°C and 60°C ambient and be compatible to all liquid cooled Army platforms. Thermal efficiency increases of 50% would allow armored vehicles with little airflow to operate more efficiently, UAVs with liquid coolant to reduce operating weights and allow the ARMY to have a single, universal coolant for all vehicles for the next generation of warfighter.

PHASE I: Identify and baseline current OAT coolants. Building upon the previous research conducted by DEVCOM, investigate various inorganic additive materials technology to optimize the thermal efficiency by 25-50% on the two final candidates for OAT/EPC coolants. Demonstrate thermal efficiency while having minimal impact on viscosity, foaming, cavitation, corrosion and without precipitation over an extended service life; begin laboratory benchtop testing on materials candidates. Testing to include by not be limited to:
1. Glycol Content (%) via Refractometer
2. ASTM D1287-11 – Standard Test Method for pH of Engine Coolants and Antirusts
3. ASTM D5931-20 – Standard Test Method for Density and Relative Density of Engine Coolant Concentrates and Aqueous Engine Coolants by Digital Density Meter [10]
4. Thermal Conductivity and Specific Heat using C-Therm TCi Thermal Conductivity Analyzer

PHASE II: Refine and optimize the materials selected in Phase I and develop and deliver prototype OAT plus nano additive coolant for additional benchtop ASTM laboratory testing as needed. Begin long term field trials on selected ground and air warfare systems. Request OEM participation where available.

PHASE III DUAL USE APPLICATIONS: Transition technology to the U.S. Army for adoption and use by specific platforms. Continue long term field trials with monitoring teams. Finalize packaging

requirements Integrate this technology where current SCA technology is being utilized. Investigate where cooling systems can be made more efficient due to new EPC cooling technologies.

REFERENCES:

1. https://apps.dtic.mil/sti/citations/AD1170629
2. https://www.sciencedirect.com/science/article/pii/S0142727X99000673
3. https://www.ijert.org/a-review-on-nanofluids-the-next-super-coolant-for-radiator

KEYWORDS: Enhanced Performance Coolants (EPC), Organic Acid Technology (OAT), GVSC's Ground Systems Fluids and Fuels (GSFF), UAS, Future Vertical Lift (FVL), Nanotechnology, Nanofluids, Nanocoolant

VERSION 3

A23B-T015 TITLE: Solid-State Large Aluminum Additive Manufacturing Replacements

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

OBJECTIVE: Additively manufacture (AM) aluminum alloy 7XXX (Al-Zn-Mg-Cu) or equivalent material via solid-state for replacement of forged legacy components with long lead times and logistics tail.

DESCRIPTION: As the need for sustainment of aging US armed forces aircraft continue to rise and will continue to rise with the introduction of Future Vertical Lift (FVL) [1], there is a growing necessity for supplementing the supply chain for long logistic components to maintain fleet readiness. As a disruptor of traditional manufacturing, AM has come into focus as a leading technology to fabricate components, supplementing hard to procure aerospace components [2]. This is possible due to AM systems offering all-in-one turnkey manufacturing solutions, providing benefits in reducing production costs associated with build time and waste material of traditional manufacturing methods [3]. However, for fusion-based AM processes (e.g. selective laser melting and electron-beam melting), certain alloys suffer from poor weldability impeding fabrication via AM [4], and are typically limited to smaller parts that must fit within 1 sqft. sealed environments for processing. One such alloy system is Al-Zn-Mg-Cu (AA7XXX) aluminum alloys, which comprise the majority of the structural materials used in aerospace across the DoD and industry including FVL offers.

It is well established that the AA7XXX family is traditionally considered unweldable, and when subjected to high thermal gradients, hot cracking occurs in the microstructure. Therefore, fusion-based AM, in which high thermal gradients are introduced into the microstructure similar to welding, typically results in hot cracking and material anisotropy when fabricating or repairing AA7XXX. These deleterious defects within the microstructure reduce the mechanical performance of the material, beyond allowable limits for aviation applications. To alleviate the detrimental-effects to the microstructure, AA7XXX powders for fusion AM have been enhanced with additional alloying elements (e.g. Scandium). However, the introduction of these new additives raises concerns on material response when compared to traditional AA7XXX, and how it will respond during typical aerospace service conditions. Thus, there is need for a 1-to-1 replacement of traditionally high strength, low weight forged aerospace materials to preclude the inherent uncertainties with AM aluminum materials.

Nascent solid-state AM techniques have been proven to be capable of depositing traditional materials, like AA7XXX, due to the low thermal requirements to deposit the material. As a result, the microstructure is not thermally stressed to the same degree as fusion-based AM and is not subject to the same negative effects observed when processing with conventional alloys as the input feedstock. Additionally, solid-state techniques are more modular and are not limited to the geometric constraints governed by inert build chambers or laser interactions, permitting significantly larger build areas. However, the low resolution and characterization of the alloys for aerospace components has left technological gaps to permit adoption for aviation applications.

The goal of this topic is to identify a solid-state AM processes that can 3D print traditionally unweldable aerospace materials without adding additional alloying elements to the bulk material for a true 1-to-1 replacement of components. The solid-state AM process will demonstrate the feasibility of printing a large aviation component free from contamination and additional inoculants. Then after successful printing, an optimized process will produce a final aerospace component as a demonstration.

VERSION 3

PHASE I: Demonstrate the feasibility of printing a large, full-sized aviation component (build area/volume larger than 1sqft/1ft3) via a friction-based solid-state additive manufacturing method utilizing a high-strength alloy (e.g. 7XXX). This component will serve as both a technology demonstrator and a first article cut up. Initial microstructural and mechanical characterization will be performed by extracting material samples from the first article component to demonstrate a lack of process related defects, porosity, and contaminants, with an initial evaluation of mechanical performance.

Phase I deliverables include a report detailing first article production and evaluation of the sectioned component for process defects and optimization plan for the material and process.

PHASE II: Following the initial successful demonstration using solid-state AM to produce a print with a 7XXX aluminum alloy, process optimization will be conducted to further refine parameters. The optimized parameters will then be used to establish repeatability through analysis of process structure property (PSP) relationships and mechanical testing. Material samples shall be evaluated in the final post-processed condition. Extensive microstructural evaluation utilizing a combination of optical and electron microscopy and X-ray spectroscopy and tomography provides an in-depth analysis of the microstructural evolution to elucidate production and post-processing effects on the final prototypes. This includes inspections on density, phase identification and dispersion, and granular characterization. Additionally, mechanical performance of the optimized component shall be evaluated with tensile and fatigue, with detailed observations on damage mechanisms and failure modes using microscopy. Test and evaluation techniques shall follow ASTM standard procedures to be documented and contrasted against legacy aviation material requirements.

Complete data and manufacturing instructions from process preparation to post-processing shall be delivered in a phase II report along with a second finished component fabricated with the optimized and substantiated material developed under this effort.

PHASE III DUAL USE APPLICATIONS: The civilian and defense sectors would benefit from this developed technology as an alternative means to rapidly produce large scale, long lead wrought aluminum forgings with that match original requirements of the legacy component that would be otherwise difficult to match through current additive manufacturing methods. DoD may pursue this technology for transition into the larger organic industrial base, as a close out report with all data and documentation necessary to fully replicate large parts within the defense industrial base. Successful delivery of manufacturing instructions will be transferable to the Jointless Hull activities in relation to the Next Generation Combat Vehicle (NGCV) in direct collaboration with DEVCOM Ground Vehicle Systems Center. Thus, successful demonstration of solid-state AM producing an aluminum alloy component with 1-to-1 equivalent material will increase Army readiness and reduce logistical timeframe for component procurement across ground and aviation systems.

REFERENCES:

1. Dixon, M., 2006, The Maintenance Costs of Aging Aircraft: Insights From Commercial Aviation, RAND Corporation, Santa Monica, CA.
2. Liu, R., Wang, Z., Sparks, T., Liou, F., and Newkirk, J., 2017, Aerospace Applications of Laser Additive Manufacturing, Woodhead Publishing, Sawston, UK.
3. Berman, B., 2012, “3-D Printing: The New Industrial Revolution,” Bus. Horiz., 55(2), pp. 155–162.

4. Cevik, B., 2018, “Gas Tungsten Arc Welding of 7075 Aluminum Alloy: Microstructure Properties, Impact Strength, and Weld Defects,” Mater. Res. Express, 5(6), p. 066540.
5. Reschetnik, W., Brüggemann, J. P., Aydinöz, M. E., Grydin, O., Hoyer, K. P., Kullmer, G., and Richard, H. A., 2016, “Fatigue Crack Growth Behavior and Mechanical Properties of Additively Processed En AW-7075 Aluminium Alloy,” Procedia Struct. Integr., 2, pp. 3040–3048.

KEYWORDS: Additive Manufacturing, Solid-State, Forging, Aluminum, Replacements, Process-Structure-Property

VERSION 3

A23B-T016 TITLE: Lower Temperature Methanol Steam Reforming Catalyst for Fuel Cells

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

OBJECTIVE: Reduce the hottest components temperature through the development of a lower temperature methanol steam reforming catalyst which can be integrated into existing fuel cell systems.

DESCRIPTION: C5ISR Center, in conjunction with industry, have developed wearable Soldier fuel cell systems that can provide on the move light-weight power for systems operations and battery recharge and extend mission duration and reduce Soldier load (carried weight). Current fuel cell systems have been developed based on the Reformed Methanol Fuel Cell Technology. Soldiers have commented that while using fuel cell systems, this capability increases their autonomy in the field. However, heat signature could be a potential issue, and reduction of thermal signature would be beneficial.

Part of this thermal signature reduction will be achieved through a material solution focused on reducing the reformer temperature, which is the hottest part within a reformed methanol fuel cell system [1-2]. Historically, Reformed Methanol Fuel Cells have commonly used copper zinc oxide, which requires reactor temperatures in the range of 300°C [2-4]. However, recently new catalysts have emerged showing that reactor temperatures as low as 150-200°C are possible [4-7]. In these works, the catalyst is in a powdered form. C5ISR Center desires the catalyst to be pelletized.

Reducing the temperature of the hottest component in the fuel cell system (reformer) has significant impacts to the War Fighter, such as potentially reducing the thermal signature and increasing soldier comfort. In addition, by reducing the temperature of the reformer, the system will have quicker startup times. This topic is appropriate for STTR investment due to an applied research solution that can significantly positively impact system development and addresses Soldier feedback. The new catalyst itself can potentially be a near drop in solution. The catalyst itself shall be a pellet or monolith configuration. The catalyst synthesis approach must be scalable to an industrial setting.

The catalyst will be evaluated and characterized at C5ISR Center. If successful, the catalyst will be incorporated into existing fuel cell systems for further evaluation.

PHASE I: Conduct an initial study and provide potential solutions. Provide initial samples of catalyst for evaluation.

PHASE II: Develop and deliver a new low temperature catalyst with small diameter pellets that are less than 4mm in diameter or supported on a monolith surface. The catalyst should be capable of processing about ml per min of methanol water. Four sets of catalyst will be delivered. Catalyst should operate at near atmospheric conditions while maintaining full conversion 99%+. The new catalyst should be able to operate for >1000hrs, with low level of degradation. As previously demonstrated in literature [4-7] the new catalyst should have an activity of greater than135 µmolH2/gcat-sec at low temperatures, definitive numbers to be provided to firm upon selection. The catalyst should be able to support a minimum GHSV of 6000 -hr determined at reactor conditions. Catalyst will be evaluated multiple metrics.

PHASE III DUAL USE APPLICATIONS: The catalyst developed in Phase 2 will be integrated into the existing fuel cell systems. Update as needed the balance of plant software/firmware for optimal fuel cell system performance. Deliver 5 functioning Fuel cell systems with the new catalyst. A Safety

Assessment Report (SAR) shall be provided with the fuel cells. These systems will be initially evaluated at C5ISR Center for performance characterization, and then evaluated at Soldier touch points for Soldier operational use.

REFERENCES:

1. EG&G Technical Services, I., 2004, “Fuel Cell Handbook,” Fuel Cell, 7 Edition (November), pp. 1–352.
2. Reformed methanol fuel cell, Reformed methanol fuel cell - Wikipedia, accessed 10/18/2022
3. Zaizhe Cheng, Wenqiang Zhou, Guojun Lan, Xiucheng Sun, Xiaolong Wang, Chuan Jiang, Ying Li,”High-performance Cu/ZnO/Al2O3 catalysts for methanol steam reforming with enhanced Cu-ZnO synergy effect via magnesium assisted strategy”, Journal of Energy Chemistry, Volume 63, 2021, Pages 550-557, ISSN 2095-4956
4. Sandra Sá, Hugo Silva, Lúcia Brandão, José M. Sousa, Adélio Mendes, "Catalysts for methanol steam reforming—A review", Applied Catalysis B: Environmental, Volume 99, Issues 1–2, 2010, Pages 43-57
5. Gao, Lizhen & Sun, Gebiao & Kawi, S.. (2008). A study on methanol steam reforming to CO2 and H2 over the La2CuO4 nanofiber catalyst. Journal of Solid State Chemistry. 181.
6. Fufeng Cai, Jessica Juweriah Ibrahim, Yu Fu, Wenbo Kong, Jun Zhang, Yuhan Sun,”Low-temperature hydrogen production from methanol steam reforming on Zn-modified Pt/MoC catalysts”, Applied Catalysis B: Environmental, Volume 264, 2020
7. Yufei Ma, Guoqing Guan, Chuan Shi, Aimin Zhu, Xiaogang Hao, Zhongde Wang, Katsuki Kusakabe, Abuliti Abudula,”Low-temperature steam reforming of methanol to produce hydrogen over various metal-doped molybdenum carbide catalysts”, International Journal of Hydrogen Energy, Volume 39, Issue 1, 2014, Pages 258-266.

KEYWORDS: Fuel Cell, Soldier, Reformer, Methanol, Catalysis, Steam Reforming

VERSION 3

A23B-T017 TITLE: Polymer, Solid Electrolyte, and Lithium Anode Battery to Enhance Kinetics

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

OBJECTIVE: Creation of a high energy dense, future safe, lithium-ion battery that facilitates charge transfer of solid-electrolyte interfaces, high voltage cathodes, and lithium-metal anodes.

DESCRIPTION: Higher energy densities can be achieved primarily through pairing high voltage, high-capacity cathodes with Li-metal anodes. To enable the use of next generation elevated voltage cathode materials with lithium-metal anode, stabilizing cathode coatings can be affixed to improve interfacial structural stability, mitigate electrochemical impedance increases, and diminish thermally induced degradation. Additionally, employing electrolytes that can withstand penetration testing without flame and fumes is important for the development of on-platform energy storage such as arial and ground vehicles. Lithium-anodes are vital for improving the energy density of the cell due to the capacity / weight of graphite anodes, although uniform plating and electronic connectivity to the electrolyte needs improvement.

Cathodes with elevated discharge voltages will increase the energy output / electron moved, better understood through this application of the Ohm's Law: Energy Density = (Current Density * Voltage) * Time. Spinel, olivine, and other high voltage cathodes can store high quantities of lithium-ion and discharge at elevated voltages making them prime candidates. Solid-electrolyte batteries are a vital technology that needs to be developed to meet the energy safety requirements for the future Army. They can sustain high cell voltages, which promote greater power and energy capabilities, they are mechanically stronger than liquid electrolyte batteries, fighting dendrite formation with lithium anode increasing safety, and they have high conductivity capabilities leading to high electrochemical performance. The issue with these solid-electrolyte batteries is the elevated charge transfer resistance at both solid-solid interfaces between the electrolyte and the electrodes. If the charge transfer at these interfaces can be improved and the low temperature performance of the solid electrolyte can be augmented. Battery needs to be able to operate in a wide temperature range.

This STTR looks to create artificial solid-electrolyte interface (SEI) layers with conducting polymers to overcome the inherit challenges to ionic transfer across the cathodic and anodic interfaces. These resistances to charge transfer are largely attributed to the poor connection between a solid electrolyte and a solid electrode. Ameliorating these will promote longer cycle lives, improved power, and more stable charge transfer with the lithium-anode, leading to better safety characteristics. Utilizing known supercapacitor work with electrically conducting polymers (ECPs), specifically poly(3,4-ethylenedioxythiophene) (PEDOT), polypyrrole (PPy), polyaniline (PANI), quinone, polyacetylene, and biological derivatives such as lignin / sulfonated lignin, artificial SEI / cathode-electrolyte interface (CEI) layers can exploit the conductive nature of the polymer to assist ionic transport. With these adaptations this battery will fully be able to exploit the inherit safety and energy storage performance of solid electrolyte batteries, while finally amending the internal resistance issues to promote a wide application of energy dense batteries.

This work should be at the STTR level because the maturity of these chemistries is currently in fundamental research.

VERSION 3

PHASE I: Design a concept cell for nonflammable solid-state electrolyte that optimize gravimetric energy density at elevated discharge voltages and prolonged cycle life above 80% capacity retention. Phase I deliverables include monthly progress reports describing all technical challenges, technical risk, and progress against the schedule, a final technical report, and 10 laboratory cells (coin or pouch cells) to the U.S. Army for testing.

PHASE II: Refine and optimize cell level materials selected in phase I and develop and deliver pouch cells to meet target performance requirements of elevated discharge voltage cells, high energy density, decent cycle life capability > 80% capacity retentions at room temperature, and 75% capacity retention at 0 °C with respect to room temperature capacity. Additional optimization with the target of expanding the rate capability of these cells will also be included in phase II. Required phase II deliverables will include 20 cells (pouch), as well as monthly progress reports and a final technical data package.

PHASE III DUAL USE APPLICATIONS: Transition this technology to prototype cells that will be intended for assembly into batteries for soldier carried applications. The deliverable for phase III is multilayered pouch cells with capacities in the order of Ahs to be included in future batteries.

REFERENCES:

1. Baroncini, E. A., Rousseau, D. M., Strekis IV, C. A., & Stanzione III, J. F. (2020). Optimizing conductivity and cationic transport in crosslinked solid polymer electrolytes. Solid State Ionics, 345, 115161.
2. Baroncini, E. A., & Stanzione III, J. F. (2018). Incorporating allylated lignin-derivatives in thiol-ene gel-polymer electrolytes. International journal of biological macromolecules, 113, 1041-1051.
3. Atwater, T. B., & Tavares, P. (2013). Halogenated Lithium Manganese Oxide AB_2O4-dXd Spinel Cathode Material. SAE International Journal of Materials and Manufacturing, 6(1), 85-89.
4. Huang, Y., Dong, Y., Li, S., Lee, J., Wang, C., Zhu, Z., ... & Li, J. (2021). Lithium manganese spinel cathodes for lithium-ion batteries. Advanced Energy Materials, 11(2), 2000997.
5. Zeng, J., Liu, Q., Jia, D., Liu, R., Liu, S., Zheng, B., ... & Wu, D. (2021). A polymer brush-based robust and flexible single-ion conducting artificial SEI film for fast charging lithium metal batteries. Energy Storage Materials, 41, 697-702.
6. Liu, Y., Hu, R., Zhang, D., Liu, J., Liu, F., Cui, J., ... & Zhu, M. (2021). Constructing Li-Rich Artificial SEI Layer in Alloy–Polymer Composite Electrolyte to Achieve High Ionic Conductivity for All-Solid-State Lithium Metal Batteries. Advanced Materials, 33(11), 2004711

KEYWORDS: Energy Storage, Polymeric Electrolytes, Spinel Cathodes, High Energy Density, Improved Safety, Soldier Lethality, Future Vertical Lift.

VERSION 3

A23B-T018 TITLE: Highly conductive brominated graphitic fibers for infrared and centimeter-wave electromagnetic attenuation

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 section 3.5 of 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 a high performing infrared and centimeter-wave attenuating graphitic fiber with improved conductivity through heat treatment and bromination.

DESCRIPTION: To maintain operational overmatch of our near-peers, signature management needs to be exploited to the greatest limits of science. Obscuration leverages our resources by protecting multi-million dollar assets with cost-effect aerosol materials. Recent discoveries have illustrated the ability to vastly increase the performance of these obscurants in the infrared and centimeter-wave regions of the electromagnetic spectrum– both areas in which our enemies use imagers to identify our warfighter's locations. This topic focuses on these developments of carbonaceous-based obscurant materials in the form of fibers, either fractal-quasilinear or linear. Due to the recent improved understanding of the significant impact heat treatment and bromination make on conductivity, and thereby efficiency, STTR is the preferred pathway to ensure success among small business and university partnerships (references 5-7). Graphitic particles have long been recognized as obscurants. Such particles can be produced by graphitization of polymers, for example, or from fibrous forms, already nominally graphitic. One cost-effect, scalable approach may be through electrospinning and subsequent heat-treating of these particles. Further bromination of these particles has been illustrated to improve the conductivity above 10^5 mho/cm—a factor that vastly improves obscuration performance. Produced in this way, a low-cost, high performing, high strength material that will not fuse or agglomerate upon compression can be realized.

PHASE I: Demonstrate with 50 milligram or greater quantities, an ability to produce graphitized fibers using high heat treatments in the range of 2800-3000oC on nominal graphite or polymeric material. For IR fibers optical measurements and/or electrical conductivity will be used to determine the success of the heat treatments while for CMW fibers, both optical and electrical measurements (equivalents) will be used. Following successful heat treatments, the graphite fibers should be brominated and additional enhancement of conductivity remeasured for both wavelengths.

PHASE II: Demonstrate that the process is scalable by providing 1 kilogram of samples with no loss in performance from that achieved with the small samples. During Phase II, idealized particle lengths and widths should be achieved for infrared (3-5 µm in lengths, 50-100 nm diameters) and centimeter-wave (one cm or greater in length, 4-10 µm diameters) attenuation. In Phase II, a design of a manufacturing process to commercialize the concept should be developed.

VERSION 3

PHASE III DUAL USE APPLICATIONS: The techniques developed in this program can be integrated into current and future military obscurant applications. Improved grenades and other munitions are needed to reduce the current logistics burden of countermeasures to protect the soldier and associated equipment. This technology could have application in other Department of Defense interest areas including high explosives, fuel/air explosives and decontamination. Improved separation techniques can be beneficial for all powdered materials in the metallurgy, ceramic, pharmaceutical and fuel industries. Industrial applications could include electronics, fuel cells/batteries, furnaces and others.

REFERENCES:

1. Jelinek Al V., Charles W. Bruce and Sharhabeel Alyones, "Absorption Coefficient of Moderately Conductive Fibrous Aerosols at 35 GHz," Applied Physics, 2021.
2. S. Alyones, C. W. Bruce and A. Buin, "Numerical Methods for Solving the Problem of Electromagnetic Scattering by a Thin Finite Conducting Wire," IEEE Trans. Antennas and Propagation," 55, (June 2007).
3. C. W. Bruce, Al V. Jelinek, Sheng Wu, Sharhabeel Alyones and Qingsong Wang, "Millimeter Wavelength Investigation of Fibrous Aerosol Absorption and Scattering Properties," Appl. Opt., 43, (20 Dec. 2004).
4. Chen, Y., Zhang, X., Liu, E., He, C., Shi, C., Li, J., Nash, P., Zhao, N., "Fabrication of in-situ grown graphene reinforced Cu matrix composites", Scientific Reports 6, 19363, 2016.
5. Ping Wang; Dandan Liu; Jingyun Zou; Yuanhang Ye; Ligan Hou; Jingna Zhao; Chuanling Men; Xiaohu Zhang; Qingwen Li, "Gas infiltration of bromine to enhance the electrical conductivity of carbon nanotube fibers," Materials & Design, Volume 159, p138-144; 2018.
6. Wonsik Eom, Sang Hoon Lee, Hwansoo Shin, Woojae Jeong, Ki Hwan Koh, and Tae Hee Han*, "Microstructure-Controlled Polyacrylonitrile/Graphene Fibers over 1 Gigapascal Strength." ACS Nano 2021, 15, 8, 13055–13064, 2021.
7. Fogg,J.L., Putman, K.J.,Zhang, T., Lei, Y.,Terrones, M., Harris, P.J.Marks, N.A., Suarez-Martinez, I. Catalysis-free transformation of non-graphitising carbons into highly crystalline graphite." Communications Materials, 1,47, 2020.

KEYWORDS: High conductivity, graphene, infrared obscuration, bromination

VERSION 3

A23B-T019 TITLE: Aerosol Particle Collectors for Microsensor Platforms

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

TECHNOLOGY AREA(S): Sensors, Chem Bio Defense

OBJECTIVE: Develop, demonstrate, validate, and produce aerosol particle collectors which are Size, Weight, and Power + Cost compatible with microsensor platforms and capable of being produced using advanced manufacturing techniques.

DESCRIPTION: Small, low-power, low-cost, networked, and potentially attritable sensors ("microsensors") can be rapidly dispersed over an area to enhance situational awareness and continuously monitor for threats such as toxic chemicals or pathogens. The ability to use networks of smaller and cheaper sensors instead of large and expensive systems will allow Warfighters to maintain increasingly expeditionary postures. Current systems for capturing aerosol particles in defense-relevant size ranges and delivering these particles to downstream devices for analysis are not suitable for use microsensors, due to size, power consumption, robustness, or the ability to operate without manual intervention. Recent innovations in miniaturized components such as pumps, well- or channel-based impactors, electrostatic precipitators, and impingers offer potential means by which to capture aerosols then deliver them in a solvent to a downstream process while remaining small and consuming minimal power. To realize these capabilities, additional development is required to identify specific collection components, match them with air and liquid pumps, and demonstrate the ability to efficiently collect and deliver particles in relevant size ranges. To enable successful integration with multiple types of microsensor detection and identification modules, flexible designs are favored. Desired features include but are not limited to 1) The ability to quickly modify a 'base design' to collect different particle sizes, 2) delivering particles in varying volumes of different solvents, 3) utilization of components designed to be produced close to the point of need using advanced manufacturing techniques, and 4) operating under the control of non-proprietary code to enable agile experimentation and integration with experimental detector and identifier modules.

PHASE I: Identify components suitable to achieve aerosol collection and subsequent delivery in a liquid solvent within a minimal SWaP+C envelope. Demonstrate the function of these components in a breadboard system (it is not necessary to minimize SWaP+C at the breadboard stage, but the ability to make those components work in the tightest envelope possible is a vital criteria for later phases). Evaluate their performance working together in the breadboard system. Deliver a report on the breadboard system to include performance data, cost, size, and power consumption of the breadboard system, and an estimate of the cost, size, and power consumption of the system were it to be integrated, packaged, and optimized. Investigate potential civilian markets for the technology.

PHASE II: Develop an integrated collector module based on the breadboard design: Integrate components into a small physical package (threshold: 350mL, objective: 175mL) with efficient power usage (threshold: can idle for 6 hours and perform 4 collect-dispense cycles on a battery internal to the device, objective: can idle for 24 hours and perform 24 collect-dispense cycles on a battery internal to the device), and reasonable weight (threshold: 500 grams, objective: 200 grams). Demonstrate the performance of this collector module on relevant aerosol challenges. Demonstrate integration with Army-specified detector modules. Participate in a user-engagement event with a field demonstration component. Deliver reports on these activities, prototypes, and technical data packages to include

component and system models and software/firmware used on the device. Develop version(s) of the module suitable for identified civilian applications and explore commercialization.

PHASE III DUAL USE APPLICATIONS: Mature concepts and prototypes into a manufacturable or transitionable system: Refine the integrated collector module to improve performance or the ability to flexibly integrate with multiple detectors and multiple missions. Establish the use of advanced manufacturing to adapt the base design to different detectors or missions in collaboration with potential user groups. Develop documentation on the use of the technology for multiple mission types and transition the technology to DoD partners. Commercialize products based on the enabling technologies for civilian applications.

REFERENCES:

1. Pan, M.; Lednicky, J. A.; Wu, C. Y., Collection, particle sizing and detection of airborne viruses. J Appl Microbiol 2019, 127 (6), 1596-1611.
2. Li, H. Y.; Liu, J. K.; Li, K.; Liu, Y. X., A review of recent studies on piezoelectric pumps and their applications. Mech Syst Signal Pr 2021, 151.
3. Lee, U. N.; van Neel, T. L.; Lim, F. Y.; Khor, J. W.; He, J. Y.; Vaddi, R. S.; Ong, A. Q. W.; Tang, A.; Berthier, J.; Meschke, J. S.; Novosselov, I. V.; Theberge, A. B.; Berthier, E., Miniaturizing Wet Scrubbers for Aerosolized Droplet Capture. Anal Chem 2021, 93 (33), 11433-11441.
4. He, J. Y.; Beck, N. K.; Kossik, A. L.; Zhang, J. W.; Seto, E.; Meschke, J. S.; Novosselov, I., Evaluation of micro-well collector for capture and analysis of aerosolized Bacillus subtilis spores. Plos One 2018, 13 (5).

KEYWORDS: aerosol, particle, collector, sampler, chemical, biological, micro, miniature

VERSION 3

A23B-T020 TITLE: Use of Satellite Observations for Analog Ensemble Predictions to Contribute to Decision Advantage

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network System of Systems, Trusted AI and Autonomy

OBJECTIVE: Develop an innovative methodology to utilize satellite observations of weather-related atmospheric variables within the analog ensemble (AnEn) technique for environmental predictions, when no in-situ observations (i.e. field data) are available.

DESCRIPTION: Uncertainty in weather prediction affects Army mission preparation and planning degrading decision advantage. Numerical Weather Prediction (NWP) models generate atmospheric forecasts to provide a deterministic weather forecast, but present inherent uncertainty. A number of factors cause uncertainty associated with Numerical Weather Prediction (NWP) models; including but not limited to, errors in initial conditions, quality of the model initialization field, model physics, and various parameterization schemes [1, 2, 3, 4, 5]. Understanding the uncertainty in forecast predictions will address problems in weather support that cause impediments to the Army's mission preparation and planning.

PHASE I: Determine the scientific, technical merit, and feasibility for developing an AnEn framework using satellite observations (potentially also using hybrid in-situ and satellite observations, required in Phase II) for continuous and discontinuous atmospheric variables. Develop a conceptual methodology providing multiple weather and environmental conditions with their associated uncertainty. Deliver a report documenting the research and development efforts along with a detailed description of the proposed final methodology, implementation, and impacts upon uncertainty quantification results.

PHASE II: The methodology will be fully implemented, using the programming language python, enabling straightforward integration with the Army's geospatial software baseline used by geospatial engineers. The code will allow users, whether civilian or Army, to make weather and environmental predictions based on either satellite data or a combination of satellite and in situ observations. A methodology and implementation for hybrid use of satellite and other observational datasets within the AnEn techniques shall be set forth. A report will be delivered that provides an understanding of the AnEn techniques strengths and weakness when utilizing satellite and/or hybrid observational datasets, along with implementation recommendations.

PHASE III DUAL USE APPLICATIONS: The AnEn prediction geospatial tool can be integrated into baseline software on the Geospatial Workstation (GWS) used by Army geospatial engineers, leading to a DoD commercialization potential. The geospatial engineers will benefit from this tool by having the new capability to predict several potential weather and environmental related impacts to mission planning quickly and capture weather-related mission risks caused by prediction uncertainty. Non-DoD commercialization potential exists within the civilian sector. The technology has many potential applications outside of the military to address weather-related forecasting challenges, and topics. For non-DoD sectors, the python based development fosters access and integration opportunities due to the popular adoption of python in many development practices. Furthermore, the ease of integration with geospatial (i.e. ArcGIS) software will facilitate the potential use within the non-DoD sector for those with existing ArcGIS licensure.

REFERENCES:

1. E. N. Lorenz, "Atmospheric predictability as revealed by naturally occurring analogs," Journal of Atmospheric Science, vol. 26, pp. 639-646, 1969.
2. J. Berner, M. L. Shutts and T. Palmer, "A spectral stochastic kinetic enery backscatter scheme and its impact on flow-dependent predictability in the ECMWF ensemble prediction system," Journal of Atmospheric Science, vol. 66, pp. 603-626, 2009.
3. S. Haupt, P. Jimenez, J. Lee and B. Kosovic, "Principles of meteorology and numerical weather prediction," Renewable Energy Forecasting, no. Elsevier, pp. 3-28, 2017.
4. J. Berner, S.-Y. Ha, A. Hacker, A. Fournier and C. Snyder, "Model uncertainty in a mesoscale ensemble prediction system: Stochastic versus multiphysics representations," Monthly lWeather REview, vol. 139, pp. 1972-1995, 2011.
5. J. Slingo and T. Palmer, "Uncertainty in weather and climate prediction," Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, vol. 369, pp. 4751-4767, 2011.
6. L. Delle Monache, T. Nipen, Y. Liu, G. Roux and R. Stull, "Kalman filter and analog schemes to post-process numerical weather predictions," Monthly Weather Review, vol. 139, p. 35543570, 2011.
7. L. Delle Monache, T. Eckel, D. Rife, B. Nagarajan and K. Searight, "Probabilistic weather predictions with an analog ensemble," Monthly Weather Review, vol. 131, pp. 3498-3516, 2013.
8. S. Alessasndrini, L. Delle Monache, L. Sperati and G. Cervone, "An analog ensemble for short-term probabilistic solar power forecast," Applied Energy, vol. 157, pp. 95-110, 2015.
9. J. Zhang, C. Draxl, T. Hopson, L. Delle Monache, E. Vanvyve and B. M. Hodge, "Comparison of numerical weather prediction based deterministic and probabilistic wind resource assessment methods," Applied Energy, vol. 156, pp. 528-541, 2015.
10. G. Cervone, L. Clemente-Harding, S. Alessandrini and L. Delle Monache, "Photovoltaic Power Forecasts Using Artificial Neural Networks and an Analog Ensemble," Renewable & Sustainable Energy Reviews, 2017.
11. E. Vanvyve, L. Delle Monache, A. J. Monaghan and J. O. Pinto, "Wind resource estimates with an analog ensemble approach," Renewable Energy, vol. 74, pp. 761-773, 2015.
12. H. M. van den Dool, "A new look at weather forecasting through analogs," Monthly Weather Review, vol. 117, pp. 2230-2247, 1989.
13. S. Alessandrini, L. Delle Monache, C. Rozoff and W. Lewis, "Probabilistic prediction of tropical cyclone intensity with an analog ensemble," Monthly Weather Review, vol. 146, no. 6, pp. 1723-1744, 2018.
14. A. Badreddine, D. Bari, T. Bergot and Y. Ghabbar, "Analog Ensemble Forecasting System for Low-Visibility Conditions over the Main Airports of Morocco," Atmosphere, vol. 13, p. 1704, 2022.
15. M. Shahriari, G. Cervone, L. Clemente-Harding and L. Delle Monache, "Using the analog ensemble method as a proxy measurement for wind power predictability," Renewable Energy, vol. 146, pp. 789-801, 2020.
16. L. Clemente-Harding, "Extension of the Analog Ensemble Technique to the Spatial Domain," The Pennsylvania State University, University Park , 2019.
17. E. Kalnay, Atmospheric modeling, data assimilation and predictability, Cambridge University Press, 2003.

KEYWORDS: uncertainty quantification, data analytics, geoinformatics, analog ensemble, prediction, atmospheric science, machine learning

VERSION 3

A23B-T021 TITLE: Ultrawide Transmission Range for Variable Transmission Eyewear (VTE)

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

OBJECTIVE: An active, variable transmission eyewear on a ballistic substrate with ultrawide transmission range that can switch reversibly and automatically between high (≥70%) and low-transmission states.

DESCRIPTION: Soldiers are subjected to quickly changing light conditions, such as inside a dark building versus outside in the sun, within a single mission. The pupil can take a few 10s of seconds to fully acclimate to changing light levels [1]. Additionally, low-energy laser threats such as dazzlers are encountered in the field [2]. Soldiers already have issued (approved) variable transmission eyewear (VTE) on the Authorized Protective Eyewear List (APEL), but the current systems do not provide the required transmission range in a single lens. These are the e-Tint CTRL MS1 Spectacle and the e-Tint CTRL MG1 Goggle. Due to insufficient transmission range, these two designs are currently being fielded with both a variable transmission lens (for use in variable lighting conditions encountered during daytime operations, such as going in and out of buildings) and a standard, high transmittance clear lens for nighttime operations. Based on Soldier feedback during testing, the decision to field a standard clear lens in conjunction with the transition lens was made by eye protection subject matter experts at Product Manager Soldier Protective Equipment. Soldiers commented that the transition lens was too dark for nighttime use [3]. In addition, this creates undue cognitive burden on the Soldier decreasing their situational awareness. In addition, Soldiers may choose to forgo the protection altogether, which puts their eyes at even higher risk. A solution to this problem is active variable transmission eyewear with ultrawide transmission range, i.e., from 10% to 70%, or more, transmission. Previous efforts at active VTE have struggled to achieve much higher than 60% clear state transmission as certain layers have contributed to high parasitic optical losses. VTE with very low transmission in the dark state can also function as laser eye protection for low-energy threats.

The proposed VTE solution should address the following requirements. Variable transmission prototypes must be manufacturable on a ballistic substrate and continue to provide other eyewear functions including anti-fragmentation, anti-scratch, anti-fog, and anti-ballistic. Variable transmission proposals should retain high optical quality. Approaches should be color neutral. While an eyewear is not required in the early Phases, proposals should keep an eye on technologies and approaches amenable to the eyewear platform. Proposals should either have a roadmap to meet or exceed the standard fielded U.S. military combat eye protection requirements, per MIL-PRF-32432. The VTE must reversibly switch repeatedly. It should go to clear state (high transmission) when powered off or fails. Active VTE prototypes should be aware of power needs of proposed solution and work to minimize power requirements. For instance, if a battery is part of a submitted design, then a single charge should last at least 72 hours and be fully borne on the eyewear frame. Ideally switching times should be less than a second, with 250 ms being the objective. Comfort of the VTE should be considered which includes weight, distribution of mass, retention on face, and compatibility with other headgear.

PHASE I: During Phase I, the contractor shall research and develop innovative approaches to ultrawide variable transmission. Proposed solutions should exceed current variable transmission range of 12—65%. Proposed solutions must show how they can achieve higher than 70% clear-state transmission in a single lens. Proposed solutions must be amenable to military relevant eyewear substrates. For the purposes of Phase I, demonstrations may include switchable devices and/or eyewear prototypes that

exhibit active variable transmission. Through Phase I, the contractor should provide monthly progress reports detailing technical and programmatic results.
End products shall include an end-of-phase report with conceptual drawings and a proof-of-concept prototype. End-of-phase report shall include, but not limited to, the following: variable transmission range achieved, power consumption, switching speed, color appearance (i.e., chromaticity), construction of lens and variable transmission layers, electronic schematics, material composition. Ability to enhance situational awareness and increase lethality while preserving existing vision protection capabilities (i.e., be equal to or better than standard fielded U.S. military combat eye protection, per MIL-PRF-32432) should be supported with sound reasoning and substantial evidence.

PHASE II: During Phase II contractor shall address in detail the technical approach and design of the technology chosen in Phase I. Engineering challenges associated with the technological approach should be noted. Minimum required deliverable for the Phase II shall be a switchable active variable transmission eyewear prototype. Dark state transmission should be equal to or less than 15%.

Target clear state transmission is greater than 85%. Prototype shall be on a military relevant substrate. Power shall be on-board prototype. Technical report shall detail optical characteristics (including transmission range and ANSI Z87.1 optical performance), electrical and power characteristics (including power consumed, battery life), and testing associated with MIL-PRF-32432 (i.e., ballistic fragmentation, anti-scratch).

PHASE III DUAL USE APPLICATIONS: The end-state of this technology is for a single combat eye protection for all levels of illumination and provide some protection against laser dazzler threats. Further potential military applications include other headgear platforms that have a need for VTE. Civilian markets for this technology include law enforcement operations, environmental and agricultural markets, and outdoor recreational uses

REFERENCES:
1. ANSI/ISEA Z87.1-2015 American National Standard Occupational and Educational Personal Eye and Face Protection Devices
2. MIL-PRF-32432A, Performance Specification: Military Combat Eye Protection System
3. Authorized Protective Eyewear List (APEL) http://www.peosoldier.army.mil/equipment/eyewear/
4. ATC-11772, "Developmental Test (DT) of the Soldier Protection System (SPS) Human Factors Assessment II (HFA 2) Transition Combat Eye Protection (TCEP) System", Richardson, Elizabeth N., Gearin, Steven G., (2015)

KEYWORDS: Eyewear; variable transmission; laser protection; PPE

VERSION 3

A23B-T022 TITLE: Soldier Personnel Protective Equipment from High Energy Lasers

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

OBJECTIVE: A lightweight and wearable Soldier PPE able to neutralize high energy laser threats upon impact and, incidentally, able to alert the wearer of the presence of such threats

DESCRIPTION: High energy laser (HEL) threats are expected to be deployed in the future battlefield. They exhibit many compelling features including speed-of-light engagement, a deep magazine, and limited protection against the highest powers. The threat mechanism is via optical damage and intense thermal damage. These qualities behoove the development of PPE for Soldiers. A solution to this problem does not have to provide complete protection against HELs, even partially protection can buy Soldiers enough time to evade or engage the threats. In addition, the wavelength could be in the near infrared (NIR), such as with a Nd:YAG laser, making it undetectable visually via scattered light. A PPE system was developed for industrial users of high energy lasers [1]. The PPE proposal here could involve a wearable for the Soldier or a shield-like product. HELs can have irradiances greater than 10 W/cm2 or powers greater than 500 W. Even materials with extremely small amounts of absorption in the visible or NIR, such as noble metals, will lead to optical power absorption, heating and thermal runaway as the material gets damaged. Damage leads to further absorption as the material's absorption coefficient increases. Energy can be reflected away and/or spread around to a larger volume to prevent damage.

The HEL PPE must demonstrably reduce the burn injury/damage to both the wearer and the article itself. The wearable must address the following when exposed to a visible or NIR laser of irradiance 100 W/cm2: not allow the laser to penetrate to the skin before 1 minute, result in an inner surface temperature less than 44 °C, i.e., the burn injury threshold, for at least a minute, not catch on fire before either the inner surface temperature is greater than 44 °C or before 1 minute. Proposers should note that HEL PPE that simply reflects all the energy as may cause injury to nearby bystanders. The HEL PPE must be wearable, flexible, able to be carried by an individual Soldier, and greater than 1 m2 in area. ASTM standards for thermal protection should be followed including ASTM 1959, 1930, 1358, and C1055-20 [2—4].

PHASE I: During Phase I the contractor shall research and develop innovative approaches to HEL personal protection. Throughout the Phase I, monthly reports detailing technical and programmatic results shall be delivered. End of products shall include a technical report detailing proposed materiel solution with expected protection levels in terms of inner surface temperature reached after 1 minute of exposure to vis or NIR laser of 100 W/cm2 and expected length of survival against exposure to an HEL. Proposed solution should address wearability, flexibility, weight, and size. Ability to preserve situational awareness and increase lethality of the Soldier should be supported with sound reasoning and substantial evidence.

PHASE II: : During Phase II, the contractor shall address in detail the technical approach and design of the technology chosen in Phase I. Engineering challenges associated with the technological approach should be noted. Minimum required deliverable for the Phase II shall be a wearable HEL PPE prototype of weight per unit volume no greater than 0.465 lbs/ft2, area greater than 10 ft2, and protection level consistent with that described in Phase I. Prototype should also address considerations for coloring (i.e., camouflage), flame suppression, and no drip/no melt. A technical report detailing the construction of the HEL PPE, design choices, relevant physical parameters, including thermal and optical properties,

performance against a vis or NIR laser of 100 W/cm2, and engineering challenges of achieving said level of performance.

PHASE III DUAL USE APPLICATIONS: The vision for this R&D is a baseline for HEL PPE for Soldiers and shielding material for equipment such as UASs. The end-state is the ability for Soldiers to have extra time while irradiated to evade or engage. The technology developed here would be transitioned to a Program of Record through the Product Manager (PM-SCIE). Additionally, a commercial need for such PPE exists (industrial users of lasers or other intense sources of heat and radiant energy) and would help in driving down fabrication costs as the market grows.

REFERENCES:

1. C. Hennigs, M. Hustedt, S. Kaierle, D. Wenzel, S. Markstein, A.Hutter, “Passive and Active Protective Clothing against High-Power Laser Radiation”, Physics Procedia, Vol 41, pp 291-301 (2013)
2. ASTM C1055-20 “Temperature for Bioeffects”
3. ASTM F1959 “Standard Test Method for Determining the Arc Rating of Materials for Clothing”

KEYWORDS: High energy laser; personal protective equipment; thermal

VERSION 3

A23B-T023 TITLE: Laser Power Beaming to Sustain Small UAVs

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy, Microelectronics, 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 section 3.5 of 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 develop an innovative power beaming and receiver system to a small Unmanned Aircraft System (sUAS). Deliver a prototype demonstrating power beaming (PB) in a relevant outdoors environment.

DESCRIPTION: Unmanned vehicles are playing increasingly central and sophisticated roles on the battlefield and fulfill many different missions during both peace and wartime. Small autonomous vehicles like Group 1 sUAS represent a top DoD and Army priority, and are common in military formations, with wide distribution to units across the Services and in civilian agencies. These sUAS play a critical role in communication, situational awareness, etc. for squads and individual Warfighters, yet their battery lifetimes are limited to the 30-minute range [1,2], which curtails their mission effectiveness; it is unrealistic and cognitively burdensome to swap out batteries by hand every half-hour in a contested battlespace.

New laser and microwave directed energy technologies, including new receiver materials technology, enable “remote power”, where energy is transmitted to a vehicle’s receiver, using an intense, directed-energy beam [3-6]. The vehicle will be more mobile and lethal, not burdened by a heavy load of batteries and frequent battery swaps, and the unsustainable and vulnerable logistics load of extra batteries will be reduced or eliminated. Calculations, based on representative sUAS and onboard batteries, indicate that if 100 W could be continuously supplied to the sUAS batteries in-flight (implying > 100 W incident power on the sUAS receiver and even higher powers in the transmitted beam at the source), the mission lifetime of the sUAS could double to one hour, before the battery would need to be changed. If 200 W could be delivered onboard the sUAS to the battery, the sUAS could operate indefinitely, and the need for extra batteries greatly curtailed. Early demonstrations focused on a UAS relatively stationary in a wind tunnel [7]; a more applicable demonstration is needed.

Beaming power to a sUAS is technically challenging: a powerful beam must be continuously aimed at and confined within the sUAS-borne receiver for a long time, despite atmospheric turbulence and sUAS motion. Eye safety and the effect of the receiver on sUAS motion must also be considered. Photovoltaic receivers have been proven to be lightweight and efficient, especially for space and portable power applications. Photovoltaic cells for PB must also maximize power output and handle some amount of movement (due to atmospheric turbulence, sUAS motion, etc.) of the incident beam, and they must be thermally stable, not heating and losing efficiency excessively under continuous illumination by a powerful beam whose centroid wanders. Rectennas or bolometers are also possible receivers, especially

for wavelengths in the short-wave infrared regime or longer. In all cases, new materials, robust to temperature swings and capable of delivering power, must be designed or reconfigured.

The goal of this Topic is to research and develop a novel PB system to extend the range of Group 1 sUAS (< 20 lb.) far beyond the current limitation of approximately one-half hour flying time for Group 1 sUAS, at least doubling it, while not negatively impacting mission (due to attached receiver) or generating significant safety issues (demonstrated outdoors in Phase II). Laser PB may be best for small Group 1 sUAS.

PHASE I: NOTE THAT IN-HOUSE CONTRACTORS (ORISE POSTDOCTORAL ASSOCIATES) WILL ASSIST WITH PROPOSAL REVIEW
Identifying, through early-stage experiments and modeling (not just modeling), a PB system that will provide at least 100 W continuous onboard a sUAS which is carrying out a simple mission (e.g., reconnaissance, or observing a fixed area), at a range of 500 m or more from the source. The PB system must have source, receiver, and sUAS technology with technical merit specified. The wavelength of the PB source and the receiver can be selected by the responding firm, as can the outdoors environment and mission scenario, but the sUAS must be “blue”; e.g., on the US government’s permitted acquisition list. Model, and conduct initial experiments informing understanding of, power beaming to a sUAS. In reports, comment on eye safety, range, aiming stability, sUAS type, mission and scaling to faster re-charge times. Predict and justify a technical and programmatic path, based on modeling and initial experiments (not just modeling), of extending mission lifetime, ideally by 30 minutes with less than 60 minutes of charging and range of at least 500 meters. Employ preliminary experimental data, for example using a relevant laser in a laboratory.

PHASE II: NOTE THAT IN-HOUSE CONTRACTORS (ORISE POSTDOCTORAL ASSOCIATES) WILL ASSIST WITH PROPOSAL REVIEW Building on Phase I work, in Year 1 of Phase II: demonstrate a prototype, consisting of a full PB system and Group 1 sUAS with receiver, and demonstrate in a lab environment the power delivery to the sUAS batteries in an eyesafe manner. Also in Year 1, demonstrate receiver robustness under high power densities and interaction with a moving beam. In Year 2, demonstrate the full PB system outdoors in the relevant environment with the sUAS’ executing a simple mission, like reconnaissance (moving in a straight line) or hovering or circling a protected area. Power levels should be at least 100 W onboard (not incident on) a sUAS, and the power must be demonstrated over a distance of at least 500 meters continuously. At the end of Phase II, demonstrate onboard delivery of 100 W to the sUAS battery over a range of at least 500 meters outdoors.

PHASE III DUAL USE APPLICATIONS: "Scale the technology demonstrated in Phase II up to a level that produces a full system that could be used for a sUAS mission, such as reconnaissance/situational awareness, in an operationally relevant environment for the Army, including probably larger range to 1 km and beyond. The technology must be of interest for the Warfighter and civilian (e.g., first responders) in challenging environments; for example, for reporting back to Warfighters and/or civilian emergency personnel situations in dangerous environments (battlefield, contaminated area, mines, etc.). Scale up the technology from Group 1 sUAS to much larger UAS that can travel across continents, especially where solar power cannot be relied on.

Dual use potential comes from (1) the great commercial potential of sUAS and UAS in general to deliver commercial products in an efficient and targeted way (2) the application of sUAS and autonomous assets in general to penetrate dangerous environments unfit for humans for reconnaissance and retrieval

purposes, especially where remote power is advantageous because it would be dangerous and inefficient to change sUAS batteries by hand (e.g., environments contaminated by toxic chemicals or pollutants) and (3) the similarity of power beaming to other directed energy applications where the sUAS is flying in an unauthorized area (e.g., near an airport), and where law enforcement or military needs additional tools to defend the area. It is envisioned that this technology will benefit from large emerging civilian markets where remote power is increasingly sought as UAS travel further and are required to carry larger payloads."

REFERENCES:

1. Article/info sheet titeld "Skydio X2D uses unmatched AI to turn every operator into an expert pilot" https://pages.skydio.com/rs/784-TUF-591/images/skydio-x2d-datasheet-x2-pg.pdf
2. National Academies of Sciences, Engineering, and Medicine. 2018. CounterUnmanned Aircraft System [CUAS) Capability for Battalion-and-Below Operations: Abbreviated Version of a Restricted Report. Washington, DC: The National Academies Press. https://doi.org/10.17226/24747
3. Naval Research Laboratory Press Release (2019): “Researchers transmit energy with laser in historic power-beaming demonstration”
4. IEEE Spectrum News Article (2021): “New Optical Antennas Harvest 100 Times More Electricity from Heat”
5. Science v. 367 p. 1341 (2020; abstract only): “Electrical power generation from moderate-temperature radiative thermal sources”
6. Naval Research Laboratory Press Release (2022): “NRL Conducts Successful Terrestrial Microwave Power Beaming Demonstration”
7. Lockheed Martin News release; PR Newswire; Palmdale Calif.; July 11, 2012; https://news.lockheedmartin.com/2012-07-11-Laser-Powers-Lockheed-Martins-Stalker-UAS-For-48-Hours

KEYWORDS: Power beaming, Remote power, Unmanned Aerial Vehicles, Autonomy, Photovoltaic, Receiver, Near-Infrared, Short-wave infrared

VERSION 3

A23B-T024 TITLE: Food and Water Sensor for Sustainment of the Joint Expeditionary Force

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

OBJECTIVE: Develop a multiplex detection system that can be used by an expeditionary force for the detection of pathogens in food and water using shelf-stable nanotechnology enabled assay

DESCRIPTION: U.S. troops are deployed worldwide to places where commercial food sanitation standards may be inferior with poor enforcement. Survey data of military personnel deployed in Iraq or Afghanistan reported high rates of diarrhea, 70 and 54% respectively, for respondents. Higher rates in deployed personnel in Iraq was attributed to more access to local foods (26.6% in Iraq reported eating local food weekly compared to only 5.3% in Afghanistan). There is significant risk to Warfighters consuming local food or water that contains pathogens. Pathogens can be naturally occurring or intentionally introduced. Current methods to detect pathogenic contamination in food/water such as culture counting, molecular diagnostics, and ELISA like assays require reagents with limited shelf-life, cold storage requirement, trained users, multiple manual steps, and long wait times. This topic seeks to utilize detection technologies to protect Warfighters from incidental or intentional contamination by verifying the safety of food/water. Reducing the logistical burden associated with acquiring safe food and water will maintain expeditionary posture on extended missions up to 7 days without resupply as part of multi-domain operations.

Current detection systems for food/water pathogens require multiple pieces of equipment for a pre-enrichment/concentration of target in the food sample followed by multiple steps to isolate the pathogen from the sample matrix. These procedures increase the testing time and ultimately extends the overall time to response. In addition, cold chain logistics is a key resource limiting factor that directly affects reagent stability and is not feasible for the expeditionary force. Recent advances in biotechnology, synthetic biology, nanotechnology, and artificial intelligence/machine learning provide opportunity to overcome many of these limitations and hurdles. The proposed concept would utilize a single hand-held test device that can provide a yes/no determination of food and water safety without the use of other supporting equipment elements in a resource limited environment. This system would be capable of targeting enteric viruses, parasites, and bacteria. Viral targets would include Hepatitis A, Norovirus, Poliovirus, Rotavirus and Coxsackievirus. Parasite targets would include Giardia, Cryptosporidium, Schistosoma, Entamoeba histolytica and Cyclospora. Bacterial targets would include Shiga Toxigenic Escherichia coli (STEC), Listeria monocytogenes, Salmonella, coliforms and Campylobacter.

The overall size and weight of the system should be man portable with the objective of each individual component to be hand-held (threshold total system weight of less than 5lbs with the objective weight of less than 3lbs). Stability of the system and reagents will need to be compatible with non-controlled environmental conditions to include extremes in temperature (low -40°F, high 160° F), freeze-thaw cycles, wide range of moisture condensing and non-condensing (RH% 10 to 90%). Shelf stability of reagents in the test kit is necessary and must not expire for at least one calendar year. System will provide a rapid (threshold time to response < 8 hrs, objective time to response < 2 hrs) yes/no determination of safety without the need for user interpretations. An internal positive control and negative control for system readiness and test reagent verification will also be key requirements of the final system.

PHASE I: Design and develop a proof-of-concept unit capable of demonstrating the performance requirements and metrics outlined above. Establish the feasibility, usability and practicality of the

proposed design and materially demonstrate and validate the concept through preliminary testing. For Phase I the detection system would have to show the ability to detect one target from each group (virus, bacteria, and parasite) in water on a single test kit without using supporting laboratory equipment. Detection of the targets would occur at levels that are high enough that enrichment would not be needed for bacterial targets. Detection system in this phase will be a breadboard unit. A preliminary cost analysis must be completed based on projected scale-up and manufacturability considerations. A final report shall be delivered that specifies how requirements will be met (including mitigation of risks associated with factors limiting system performance). The report will detail the conceptual design, performance modeling and associated drawings (CAD or Solidworks® format), scalability of the proposed technology with predicted performance, safety and human interface (MANPRINT) factors, and estimated production costs. The projected technical readiness level (TRL) shall achieve a TRL of 3 and provide a clear path to Phase II/III and follow-on commercialization.

PHASE II: Refine the technology developed during Phase I in accordance with the goals of the project. Fabricate and demonstrate a high fidelity, full scale, advanced prototype for the target warfighter application, verifying that the desired performance is met. Expand detection to the other four organisms in each group that were not addressed during Phase I. Phase II will also include sampling of food matrices for all of the pathogens in each group. Food samples will include spinach, strawberries, and ground beef. Phase II will also maximize sensitivity improving on the detection limit established in phase I in water by lowing the detection limit by factor of 10 (Threshold) to 1000 (Objective). Minimize detection time for the assay (time to result; Threshold 8hrs, Objective less than 2hrs). Shelf stability of included reagents without refrigeration or other controlled environment will be addressed (shelf-life threshold 1 year, objective 5 years). Complete construction of full-scale prototype system meeting metrics for size (handheld), weight (Threshold 5 lbs., Objective 3 lbs.) and run time before recharge (i.e. battery life; Threshold 10 hr, Objective 24 hr) requirements. Provide a report, associated drawings and control software/source code, if applicable, documenting the theory, design, component specifications, performance characterization, projected reliability/maintainability/cost and recommendations for technique/system implementation. Deliver a high-fidelity full-scale prototype, consumables, and user guide to support joint Warfighter technical, operational, environmental and safety testing in the target application by the end of Phase II. An updated production cost analysis shall be completed and design for manufacture considerations shall also be projected to support advancement of TRL and associated Manufacturing Readiness Level (MRL). An implementation plan shall be provided for the scalable warfighter sustainment (food and water) sensor system and reagents for use by the joint expeditionary force. The Phase II prototype shall support operational testing that validates the feasibility of the approach and can ultimately support transition to military and commercial applications (Phase III). The projected technical readiness level shall be a TRL 6.

PHASE III DUAL USE APPLICATIONS: The proposed technology innovation and associated manufacturing capability will overcome the present technology gap and be rapidly transitioned to both military and commercial applications. The anticipated product is a self-contained, rapid, easy to use, shelf stable assay as part of an ideal detection platform for field use by expeditionary forces, as appropriate. The detection system in this phase will be a fully operational single process unit. The Phase III is expected to advance the proposed innovation to a TRL of 7 or higher, supporting a system demonstration in a relevant environment in the hands of the Soldier. Ultimately, the technology will be transitioned to the Squad or individual Warfighter, where high efficiency, long life, and low-cost technology is needed. This will maximize the performance, lethality and security of the Warfighter by ensuring safe and optimum hydration and nutrition in all operating environments. The Phase III represents concurrent

(unfunded) commercialization of the technology that is expected to provide economy of scale, logistic, and other benefits that can be attributed to the proposed development. This technology will transition to Joint Project Manager Medical Countermeasure Systems – Diagnostics (JPM-MCS-dX) or Product Manager Soldier Clothing and Individual Equipment (PdM-SCIE). Commercially, this system can be used for rapid, simple identification of pathogens in food and water that may be contaminated with multiple pathogens. The system may also have potential use in point of care diagnostics for these targets in a medical environment.

REFERENCES:

1. Expeditionary Advanced Base Operations (EABO) Handbook, Ver. 1.1,1 June 2018
2. Commandants Planning Guidance, 38th Commandant of the Marine Corps, 2019
3. Bülbül, G., Hayat, A., & Andreescu, S. (2015). Portable Nanoparticle-Based Sensors for Food Safety Assessment. Sensors (Basel, Switzerland), 15(12), 30736–30758. https://doi.org/10.3390/s151229826
4. Yanli Lu, Zhenghan Shi, Qingjun Liu, Smartphone-based biosensors for portable food evaluation, Current Opinion in Food Science, Volume 28, 2019, Pages 74-81, ISSN 2214-7993, https://doi.org/10.1016/j.cofs.2019.09.003
5. Putnam SD, Sanders JW, Frenck RW, et al. Self-reported description of diarrhea among military populations in operations Iraqi Freedom and Enduring Freedom. J Travel Med. 2006;13(2):92-99. doi:10.1111/j.1708-8305.2006.00020.x

KEYWORDS: Nanotechnology, Biosensor, Food and water, Diagnostics, Pathogen detection, Multiplex, Shelf-stable reagents, Synthetic biology, Machine Learning, Artificial Intelligence

VERSION 2

DEPARTMENT OF THE NAVY (DON)
23.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to STTR topics only:**
  - **N23B-T030 through N23B-T034**
- **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.**
- Phase I Technical Volume (Volume 2) and Supporting Documents (Volume 5) templates, specific to DON topics, are available at https://www.navysbir.com/links_forms.htm.
- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- 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. Additional information on DON's mission can be found on the DON website at www.navy.mil.

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

The Program Manager of the DON STTR Program is Mr. Steve Sullivan. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information
Program and administrative	Always	Program Managers list in Table 2 (below)

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

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

Topic Numbers	Point of Contact	SYSCOM	Email
N23B-T030 to N23B-T034	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil

PHASE I SUBMISSION INSTRUCTIONS

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

(NOTE: 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 10 pages, regardless of page content
- Single column format, single-spaced typed lines
- Standard 8 ½" x 11" paper
- Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
- No font size smaller than 10-point
- Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified. Phase I Options are exercised upon selection for Phase II.
- Work proposed for the Phase I Base must be exactly six (6) months.
- Work proposed for the Phase I Option must be exactly six (6) months.

- Additional information:
  - It is highly recommended that proposing small business concerns use the Phase I proposal template, specific to DON topics, at https://navysbir.com/links_forms.htm to meet Phase I Technical Volume (Volume 2) requirements.
  - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, 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 40% of the work is performed by the proposing small business concern, and a minimum of 30% of the work is performed by the single research institution. 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 effort 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 single research institution percentage is calculated by taking the sum of all costs attributable to the single research institution (identified as Total Subcontractor Costs (TSC) 1 in DSIP Cost Volume) 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.

- Research Institution (numerator for Research Institution calculation):
  - Total Subcontractor Costs (TSC) 1
- Total Cost (i.e., Total Cost before Profit Rate is applied, denominator for either calculation)

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

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

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

  All 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

- 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 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.

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. 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 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; 40% of the work is performed by the proposing small business concern, and a minimum of 30% of the work is performed by the single research institution. 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 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 STTR proposing small business concern
- Propose a TABA provider that is the STTR proposing small business concern
- Propose a TABA provider that is an affiliate of the STTR proposing small business concern
- Propose a TABA provider that is an investor of the STTR 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 DON STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the 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 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.

Partnering Research Institutions. The Naval Academy, the Naval Postgraduate School, and other military academies are Government organizations but qualify as partnering research institutions. However, DON laboratories DO NOT qualify as research partners. DON laboratories may be proposed only IN ADDITION TO the partnering research institution.

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.

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 concerns 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.

VERSION 2

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

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

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

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

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

PHASE II GUIDELINES

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

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

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

PHASE III GUIDELINES

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

VERSION 2

Navy STTR 23.B Topic Index

VERSION 2

N23B-T030 TITLE: Secure Mid-wave Free-space Mid-wave Infrared Optical Communication Using Chaotic Laser Mode

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

OBJECTIVE: Develop mission capability of secure free-space mid-wave infrared communications that optimize data transfer rates and bit error rate (BER) while achieving physical-layer security such that eavesdroppers cannot decipher intercepted messages.

DESCRIPTION: Free-space optical (FSO) communication in the mid-wave infrared (MWIR) allows the transmission of signal in non-optimal atmospheric conditions with the presence of optical obscurants such as fog, rain or snow, taking advantage of the low-absorption windows in the 3–5 μm and 8–12 μm spectral ranges. Quantum Cascade Lasers (QCLs) have attained performance levels, which make them attractive as transmitter sources for FSO communication. The extremely fast carrier dynamics and pico-second scale upper-level photon lifetimes present the potential for high bandwidth with relatively low-temperature dependence and a small-package footprint. Semiconductor lasers with distributed feedback have shown strong longitudinal-mode selection, and are ideal candidates for communication applications. Although the narrow-beam, direct link between the FSO transmitter and receiver makes it more difficult to intercept an FSO signal than RF-wireless communication, the FSO is still not impervious to interception. Advances in high-speed computing threaten the ability of data encryption to prevent deciphering of intercepted messages. Additional measures to ensure data security are needed when absolute security is a requirement. Various methods of securing data at the physical level have been studied extensively for telecom lasers and wavelengths, but while these methods may conceivably be extended to mid-IR QCLs, the device dynamics for QCLs are much more complex. One method for secure communication is using lasers operating within the chaotic regime. Researchers using chaos in the fiber-optic telecom wavelength range have been able to theoretically show data transfer rates on the order of 4–10 Gbit/s while using chaos [Refs 1, 2].

Recent work [Refs 3-6] has shown that, similar to their interband (diode) semiconductor laser counterpart, QCLs exhibit chaotic behavior in both the temporal and frequency domains. However, this work has shown a relatively high BER for larger data transfer rates owing to a reduced correlation between the leader and follower lasers. In interband devices, the linewidth enhancement factor, which can influence chaotic behavior, is dependent on the feedback ratio, as well as the drive current and output power [Ref 7]. Further work is needed to control the onset of chaos in QCLs and demonstrate the feasibility of a QCL-based communication link using chaos to ensure security of high-data rate communications. For FSO communication over longer distances and in adverse weather conditions such as rain or haze, high-power MWIR sources are required. Furthermore, the degree of chaos is expected to increase with output power since for QCLs it has been found [Ref 8] that the linewidth enhancement factor increases as the drive current above threshold increases. Characterization of chaos at high-output powers will be necessary for the development and use of secure mid-IR FSO communications. To ensure security, an eavesdropper BER can be used as guidance with values above 25% [Ref 9].

PHASE I: Establish the feasibility of the proposed method to improve chaos bandwidth beyond 100 MHz and link distance beyond 100 m from an MWIR source operating within the ~ 10 μm low-absorption window. Support the analysis with QCL experimental data at any wavelength. Design a leader and follower laser to meet Phase II goals. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Demonstrate a transmitter and receiver using chaos in the 10 μm wavelength region to mask a signal with a BER of less than 4% and a data transfer rate greater than 100 Mbit/s at a link distance > 1 km. An eavesdropper should have an error rate of > 25%.

VERSION 2

PHASE III DUAL USE APPLICATIONS: Develop a prototype based on the design from Phase II for transition to an operational test asset, which will be determined in Phase III. Issues related to test platform integration will be addressed in cooperation with the Government. Focus on risk management and mitigation (versus the test plan and schedule). Other Government applications within the Drug Enforcement Agency and the Intelligence Community for use with non-RF, covert communication under adverse weather conditions are also considerations.

Private sector use in telecommunication and local, urban communication (communication nodes—line of sight) would benefit from this technology due to its high-security and high-bandwidth capabilities even in adverse weather conditions.

REFERENCES:

1. Sanchez-Diaz, A., Mirasso, C. R., Colet, P., & Garcia-Fernandez, P. (1999). Encoded Gbit/s digital communications with synchronized chaotic semiconductor lasers. IEEE journal of quantum electronics, 35(3), 292-297. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=748833&casa_token=JYXvDVKW-oIAAAAA:PXYM-6EjBFoZuDzCMpol3WrKfK6cta1WEdnjDocHPCoYynHnasavbzUKcFMYQPsMQ55oEzUs&tag=1
2. Yang, Z., Yi, L., Ke, J., Zhuge, Q., Yang, Y., & Hu, W. (2020). Chaotic optical communication over 1000 km transmission by coherent detection. Journal of Lightwave Technology, 38(17), 4648-4655. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9091335&casa_token=Fzy7w4DPJ9YAAAA:0Tx7Htbet_1WTr7cxty7OYhYJ8TopKj8kzUIm0ht6Qyl9Zq3yzxMIsT9NSdfaet1ukkW513l
3. Jumpertz, L., Carras, M., Schires, K., & Grillot, F. (2014). Regimes of external optical feedback in 5.6 μ m distributed feedback mid-infrared quantum cascade lasers. Applied Physics Letters, 105(13), 131112. https://perso.telecom-paristech.fr/grillot/60.pdf
4. Jumpertz, L., Schires, K., Carras, M., Sciamanna, M., & Grillot, F. (2016). Chaotic light at mid-infrared wavelength. Light: Science & Applications, 5(6), e16088-e16088. https://www.nature.com/articles/lsa201688.pdf?origin=ppub
5. Spitz, O., Wu, J., Herdt, A., Carras, M., Elsässer, W., Wong, C. W., & Grillot, F. (2019). Investigation of chaotic and spiking dynamics in mid-infrared quantum cascade lasers operating continuous-waves and under current modulation. IEEE Journal of Selected Topics in Quantum Electronics, 25(6), 1-11. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8815933&casa_token=bmv4S9nQZJ4AAAAA:0TnT1oFXIQZFWYqh4_umcAbtsJ1rQYBTA-vigD5GNwIPK0_6M_z7t1uYHBPyBXEmEnTgbC7j
6. Spitz, O., Herdt, A., Wu, J., Maisons, G., Carras, M., Wong, C. W., Elsäßer, W., & Grillot, F. (2021). Private communication with quantum cascade laser photonic chaos. Nature communications, 12(1), 1-8. https://www.nature.com/articles/s41467-021-23527-9.pdf?origin=ppub
7. Takiguchi, Y., Ohyagi, K., & Ohtsubo, J. (2003). Bandwidth-enhanced chaos synchronization in strongly injection-locked semiconductor lasers with optical feedback. Optics letters, 28(5), 319-321. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1084.7122&rep=rep1&type=pdf
8. Jumpertz, L., Michel, F., Pawlus, R., Elsässer, W., Schires, K., Carras, M., & Grillot, F. (2016). Measurements of the linewidth enhancement factor of mid-infrared quantum cascade lasers by different optical feedback techniques. AIP Advances, 6(1), 015212. https://aip.scitation.org/doi/full/10.1063/1.4940767

9. Bogris, A., Argyris, A., & Syvridis, D. (2010). Encryption efficiency analysis of chaotic communication systems based on photonic integrated chaotic circuits. IEEE journal of quantum electronics, 46(10), 1421-1429. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5565358&casa_token=OOOMv4lQJm8AAAAA:3cLWbaq1nTCPEdFTeDacRI-t14rfpDUdzyis78GeZlPpYYpPn8cTmUywl0N8GTKTbSG0suLQ

KEYWORDS: Secure; mid-wave; infrared; free-space; optical communication; chaotic laser Mode

VERSION 2

N23B-T031 TITLE: Collaborative Multi-Robot Systems by RF-Optical-Quantum Ultra-Low Latency Wireless Networking

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

OBJECTIVE: Design and develop a fully autonomous robotic solution where a multi-robot team in a communication-degraded and GPS-denied environment can complete a mission with minimal human supervision under extreme environmental conditions.

DESCRIPTION: It is well known that the future battlefield will experience complex artificial intelligence (AI) competition. An automated group of drones, or unmanned ships/submarines, is expected to be a primary form of future weapon systems and surveillance/reconnaissance systems. Technology-wise, based on the collected sensor information, each robot collaboratively acts to accomplish the common mission goal of this multi-robot system (MRS) and multi-agent system (MAS). In the meantime, the adversary will develop similar collaborative MRS to form the "competition". A major focus on AI of a single agent or collective data analytics of battlefield, is desirable to elaborate the collaborative MRS to achieve superiority in the battlefield using intelligent machines and systems, provided there is:

(a) effective artificial intelligence/machine learning (AI/ML) among multi-robot, not just AI for a single robot, so that complex strategy and maneuver for these robots can be facilitated, and
(b) ultra-low latency wireless networking to enable fastest possible response to complicated situations in the battlefield, while maintaining low probability of interception and jamming.

The proposed technology is to dominate the winning edge in such "competitions" through the cyber warfare technology in communication and computation, with feature technologies:

1. Cyber topology control: A fully connected cyber topology (sensor observation and communication among robots) would assist achieving the mission. Smart topology control enhances the performance of collaborative MRS.
2. Predictive machine learning for adversary's movement: achievable through integrating multiple online machine learning techniques, while deep learning as offline reference may further assist.
3. Strategic maneuver to neutralize adversary's actions: In addition to AI, with the aid of communication, proper selection of action algorithms for each collaborative robot works.
4. Attack the cyber links of the adversary (both communication and AI), to destroy adversary's cyber topology control and ensures the success of the mission.

There is interest in innovating the two technological frontiers listed above (cyber topology and AI) and developing an integrated solution, to accomplish superior AI capability in the future battlefield, with the following long-term technologies:

1. An MRS that can accomplish the collective goal or mission in a sophisticated and dynamic policy subject to the dynamics in the battlefield, with the shortest possible response time. For example, (a) to intercept one or multiple hypersonic missile(s) toward an extremely high-value asset by collaborative lower-speed anti-missiles, and (b) a group of collaborative drones to attack an adversary's high-value asset. This research aims at innovative networked AI for MRS.
2. Current secure data links typically suffer delays in the range up to seconds or even tens of seconds, which is not possible to support any real-time collaboration of robots. The fundamental reason behind this is that the communication links and networks have been designed based on human-to-human (H2H) communication, rather than machine-to-machine (M2M) communication. This research aims at wireless M2M networking of minimal end-to-end latency (i.e., < 1 msec).

3. Given the adversary's capability of electronic warfare, the wireless network must be resilient against jamming and interception. In addition to post-quantum cryptography, a multimode wireless network shall be innovated, which consists of multi-frequency radio frequency (RF), optical wireless, and quantum optical wireless technologies to form the multimode multipath (M3P) transmissions as a secure and resilient ultra-low latency wireless networking for 2. Possible blockchain management of launching codes, and so forth, allows distributed battlefield management to better fit the efficiency of MRS.

There is interest in utilizing emerging classes of miniature (Group 1) Unmanned Vehicles (UVs) for a variety of surveillance and reconnaissance applications in support of the Department of the Navy's Strategic Blueprint for the Arctic. This SBIR topic seeks to develop and demonstrate a new class of miniature UVs (air, ground, surface, subsurface or a combination thereof). These systems will be air deployed and have the capability to traverse across difficult terrain such as swamps, desert, tundra, and snow or water bodies to satisfy the most demanding mobility requirements of airborne and expeditionary forces. The end goal is a fully autonomous robotic solution where a multi-robot team in a communication-degraded and GPS-denied environment can complete a mission with minimal human supervision under extreme environmental conditions, such as artic and desert temperatures, high altitudes, sand, rain, sleet, and ice.

System Attributes are:

(a) air, surface and subsurface capable,
(b) each robot/agent in the MRS/MAS has its own AI capability to act, and collaboratively accomplish a goal (or mission),
(c) end-to-end latency: less than 1 m/sec,
(d) operate in a communication-degraded and GPS-denied environment,
(e) real-time data output: longitude, latitude, altitude/height, velocity, roll, pitch, yaw/heading, angular rates, acceleration, health status, and calibrated raw data INS/GNSS (for post-processing)
(f) interfaces: RS422 (UART and HDLC/SDLC) interfaces, CANaero/ARINC825/CAN, ARINC429, Ethernet (TCP/IP and UDP), and SYNC-I/Os, and
(g) output and diagnostic measurement system included (full mission duration storage).

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 NAVY level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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: Describe offense and defense tactics via collaboration in order to compete against the adversary. Define the architecture and topology for ultra-low latency communications and networked AI/ML methodology and operational features. Identify specific sensors or sensor suites to be included and develop the strategy and design of integration and scale of the autonomous platform and onboard processing/architecture. Describe logistics and maintenance strategy. Define the autonomous behaviors, requirements of software and communications to allow cooperative sensor array technology collaboration. The Phase I effort will include prototype plans to be developed under Phase II.

VERSION 2

PHASE II: Develop a multimode wireless network architecture of ultra-low latency prototype platform and validate the component integration in terms of physical implementation: architectures, electronics, and communications to facilitate networked AI MRS. Conceptual demonstration of technology (i.e., networked AI to form the collaborative strategy), with one scenario of field demonstration and another scenario of computer simulations. Develop the autonomous behaviors, swarming software and communications defined in Phase I. Perform potential land/sea trial tests of cooperative swarming activities of multiple vessels. Evaluate performance using both single and swarming deployment. Demonstrate ability to operate in various EM environments.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Complete final testing and perform necessary integration and transition for use in multi-platform operations with appropriate current platforms and agencies, and future combat systems (FCS) under development.

Commercially this architecture and product could be used to enable remote airborne environmental monitoring and surveying.

REFERENCES:

1. Marks III, R. J. (2020, October 15). The first war using modern AI-based weapons is here. Mind Matters News. https://mindmatters.ai/2020/10/the-first-war-using-modern-ai-based-weapons-is-here/
2. Hambling, D. (2020, November 10). The “magic bullet” drones behind Azerbaijan’s victory over Armenia. Forbes. https://www.forbes.com/sites/davidhambling/2020/11/10/the-magic-bullet-drones-behind--azerbaijans-victory-over-armenia/?sh=71f1e0eb5e57
3. Frantzman, S. J. (2021). The drone wars: pioneers, killing machines, artificial intelligence, and the battle for the future. Bombardier Books. https://www.amazon.com/s?k=9781642936766&i=stripbooks&linkCode=qs
4. U.S. National Ice Center. (2021). Department of the Navy: A strategic blueprint for the Arctic. Department of the Navy. https://media.defense.gov/2021/Jan/05/2002560338/-1/-1/0/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF/ARCTIC%20BLUEPRINT%202021%20FINAL.PDF

KEYWORDS: Artificial Intelligence/Machine Learning; AI/ML; Quantum; Communication Architecture; Ultra Low-Latency; Communication; GPS denied

VERSION 2

N23B-T032 TITLE: Development of an Additive Manufacturing (AM) Candidate Assessment Tool

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

OBJECTIVE: Design and develop a data access tool that can determine if a part could be and should be produced via additive manufacturing (AM). These disciplines can include, but are not limited to the following: engineering design, manufacturability, producibility, testing, and machine learning to develop expert-guided algorithms to identify which readiness degraders, sustainment issues, and next generation components can be produced via AM.

DESCRIPTION: AM has the potential to increase readiness and improve maintenance and sustainment operations by reducing long lead times and eliminating obsolescence related issues. Furthermore, the technology enables improvements to current systems (e.g., light-weighting, part count reduction, increased system performance) through designs that are not possible by conventional manufacturing techniques. However, for the technology to continue to transition from indirect uses to efficiently producing qualified end use parts several technology barriers need to be overcome. One of the primary needs is the development and integration of data access tools with analytical capability to optimize the selection of viable families of AM candidate parts without requiring the burden of manual item-by-item review. The solution also should include analytical capabilities to effectively manage product technical and logistics information and provide users with substantive assessments on an item's suitability to AM production.

Knowledge of computer aided design (CAD), technical data packages (TDPs), and product lifecycle management (PLM) tools is required, as well as the ability to quantify the limitations of existing AM systems and processes. Innovative design concepts are being sought for the development of an AM candidate assessment tool with the ability to:

(1) coarsely filter and screen for irrelevant parts,
(2) identify candidate parts using criteria such as material, performance requirements and parts family types,
(3) predict production estimates and delivery schedules by building/expanding upon a cost and time estimation tool, and
(4) automatically search Navy databases for parts most suitable for AM and subsequently validate them using a machine learning model or algorithm.

PHASE I: Develop, design, and demonstrate feasibility of a concept for an AM candidate assessment tool utilizing representative data. Develop a "coarse" filter or screening mechanism for candidate parts. The filter will use binary (yes/no) expert judgments, combined with active machine learning (ML) (e.g., adding expert judgements iteratively to understand the value of additional information), to filter parts unsuitable for AM. The tool will screen by critical dimensions (i.e., work envelope or bounding box) and known limitations of existing additive manufacturing systems of interest. Design should consider other criteria such as material, performance requirements, and parts family when determining the suitability of a part for AM. Refine existing cost and time estimation tools to predict production cost estimates and delivery schedules for representative AM part candidates. Production cost estimates should consider all post-processing operations (e.g., heat treatment, surface treatment, final machining, and inspection) required to meet the part's acceptance criteria. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Extend the decision model(s) developed under Phase I to address Navy part characteristics and mission priorities to develop a mutually agreed upon prioritization schema. Produce a ML algorithm, seeded with the aforementioned models, to integrate and search Navy databases for parts most suitable for

AM, and the value of potentially (costly) additional information. Demonstrate and validate the prototype by utilizing actual Navy data.

PHASE III DUAL USE APPLICATIONS: Transition the tool under the guidance of PEO-CS Digital Thread team and/or NAWCAD LKE's Digital Enterprise Tools Branch. Commercialize the tool resulting from the Phase I/II R/R&D activities. This would likely involve further integration with existing, commercially-available CAD and PLM platforms.

Military and Commercial sectors that could benefit from this AM part identification tool include: aerospace, shipping, space, transportation, rail, automobile, and medical. Applications include almost all technology areas such as engine parts, structural parts, mechanical or electrical parts, medical prosthetics, and dental implants. Support the Navy/DoD to help transitioning the system to a DoD SYSCOM in support of various programs.

REFERENCES:

1. Parks, T. K., Kaplan, B. J., Pokorny, L. R., Simpson, T. W., & Williams, C. B. (2016). Additive manufacturing: Which DLA-managed legacy parts are potential AM candidates? LMI. https://apps.dtic.mil/sti/pdfs/AD1014552.pdf
2. Page, T. D., Yang, S., & Zhao, Y. F. (2019, July). Automated candidate detection for additive manufacturing: a framework proposal. In Proceedings of the design society: international conference on engineering design (Vol. 1, No. 1, pp. 679-688). Cambridge University Press. https://www.cambridge.org/core/services/aop-cambridge-core/content/view/08AD686E70255907AA0DBC9D6F9B6E09/S2220434219000726a.pdf/automated-candidate-detection-for-additive-manufacturing-a-framework-proposal.pdf
3. Yang, S., Page, T., Zhang, Y., & Zhao, Y. F. (2020). Towards an automated decision support system for the identification of additive manufacturing part candidates. Journal of Intelligent Manufacturing, 31(8), 1917-1933. https://link.springer.com/article/10.1007/s10845-020-01545-6
4. Lindemann, C., Reiher, T., Jahnke, U., & Koch, R. (2015). Towards a sustainable and economic selection of part candidates for additive manufacturing. Rapid prototyping journal. https://www.emerald.com/insight/content/doi/10.1108/RPJ-12-2014-0179/full/html

KEYWORDS: Additive Manufacturing; AM; Artificial Intelligence; AI; Machine Learning; ML; ; Neural Networks; Laser-Based Powder Bed Fusion; Candidate Identification; Decision Making

VERSION 2

N23B-T033 TITLE: Electron Beam Additive Manufacturing (EBAM) Capability for Large, Complex, Metallic Components

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

OBJECTIVE: Develop the capability to additively manufacture large, high-complexity, high-criticality metallic parts using wire-fed directed energy deposition (DED) electron beam additive manufacturing (EBAM) and establish a qualification approach for these parts.

DESCRIPTION: Traditional manufacturing techniques used to produce large, high-complexity, high-criticality metallic parts involve significant cost and schedule investments related to machine time and material waste. Alternatively, these parts can be manufactured using wire-fed DED EBAM to create near-net fabrications to reduce final machine time, raw material lead time, and material waste. In addition to these part-specific benefits, developing this capability will impact readiness by reducing manufacturing lead times, as well as sustainment by producing difficult to acquire parts or part repairs. Naval Air Warfare Center Aircraft Division (NAWCAD) Lakehurst is seeking innovative solutions to develop this capability through the material and process qualification and production of a large (~12 in. x 16 in. x 56 in. [30.48 cm x 40.64 cm x 142.24 cm]; ~400 lb [181.44 kg]) critical safety item (CSI) part belonging to the Aircraft Launch and Recovery (ALRE) Department made from a custom high-strength steel. Access to commercially available EBAM technology that can deposit steel wire feedstock and the ability to characterize the material properties of AM produced parts in order to develop an optimized parameter set resulting in repeatable mechanical properties for the selected part are required for this SBIR effort. The goal is to produce and test AM material in two stages. The initial stage of this initiative aims to produce an optimized parameter set for depositing custom high-strength steel with a wire-fed DED EBAM system. This will consist of initial bead on plate deposition trials, preliminary material analysis, larger volume depositions to optimize hatch spacing and layer height, coupon fabrication, and material property characterization. The intent of the second stage of this initiative is to apply the optimized parameter set to manufacture the near-net fabrication of the custom high-strength steel part. This will include the development of a process control document, toolpath generation, part deposition, final machining, establishment of qualification considerations, and Non-destructive Inspection/Non-destructive Testing (NDI/NDT) requirements, final part inspection and testing, coupon testing, and the documentation of all processes referenced here. The final deliverable will be a prototype part that meets the engineering requirements of the high-strength steel CSI ALRE part as well as the procedures and documentation required to establish a repeatable wire-fed DED EBAM process for manufacturing the part.

PHASE I: Develop optimized wire-fed DED EBAM process parameters for the targeted ALRE component using initial bead on plate trials and preliminary material analysis for the deposition of custom high-strength steel wire feedstock deposited onto a compatible substrate material (most likely made from the same alloy as the wire feedstock). The resulting plates will be sectioned and analyzed with respect to density, hardness, porosity, bead geometry, microstructure, adhesion, and visual defects. Once a suitable baseline parameter set is achieved, larger volume depositions will be required to optimize hatch spacing and layer height. These depositions will be designed to section, polish, and etch in order to determine porosity and grain structure. Further large volume depositions will be used to machine coupons that will be tested to determine the following mechanical properties: tensile strength, density, porosity, hardness, and thermal distortion. At the end of Phase I, an optimized and repeatable parameter set will be developed and demonstrated to meet the qualification test plan (QTP) requirements for the deposition of this custom high-strength steel. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design and develop a near-net fabrication process based on the results of Phase I, for a large CSI ALRE part made from high-strength steel on a wire-fed DED EBAM system. This process will cover system setup, material selection, parameter set selection, toolpath generation, feed rates, preheating, and

post-build processing. Produce a near-net fabricated part along with ride-along coupons necessary to determine the final mechanical properties of the build using the process outlined. After deposition, the near-net fabrication will be final machined, inspected, tested, and qualified. Alongside the NDI/NDT of the part, the ride-along coupons will be machined and prepared for destructive testing. The final deliverable will be a prototype part produced by wire-fed DED EBAM utilizing the custom high-strength steel, an approved process control document, and material test data that meets the performance requirements set forth in the agreed upon part certification plan.

PHASE III DUAL USE APPLICATIONS: Work with Navy programs of record to certify and implement components manufactured using wire-fed DED EBAM. Developing this capability using pathfinder parts like this CSI ALRE component will help to identify other parts throughout the Navy that would be good candidates for wire-fed DED EBAM technology. Wire-fed EBAM technology can be utilized on any metallic parts that have high-material waste, machine time, procurement lead time, procurements costs, or other issues that could be solved with EBAM technology. Once the material has been qualified and the part has been certified, the procedures can easily be replicated for a family of parts in the same material and part classification level.

Military and Commercial sectors that could benefit from this AM system include: aerospace, shipping, space, transportation, rail, and automobile. Applications include almost all technology areas such as: engine parts, structural parts, mechanical parts, and support equipment.

REFERENCES:

1. Gusarova, A. V., & Khoroshko, E. S. (2019, November). Influence of electron beam parameters on the structure and properties of 321 steel obtained by additive manufacturing. In AIP Conference Proceedings (Vol. 2167, No. 1, p. 020133). AIP Publishing LLC. https://doi.org/10.1063/1.5132000
2. AMS AM Additive Manufacturing Metals Committee. (2020, November 18). Electron Beam Directed Energy Deposition-Wire Additive Manufacturing Process (EB-DED-Wire). SAE International. https://www.sae.org/standards/content/ams7027/
3. Gibson, I., Rosen, D., & Stucker, B. (2015). Directed energy deposition processes. In Additive manufacturing technologies (pp. 245-268). Springer, New York, NY. https://doi.org/10.1007/978-1-4939-2113-3_10
4. Fortuna, S. V., Filippov, A. V., Kolubaev, E. A., Fortuna, A. S., & Gurianov, D. A. (2018, December). Wire feed electron beam additive manufacturing of metallic components. In AIP Conference Proceedings (Vol. 2051, No. 1, p. 020092). AIP Publishing LLC. https://doi.org/10.1063/1.5083335

KEYWORDS: Additive Manufacturing; AM; Electron Beam; Directed Energy Deposition; Wire-fed DED; Metal AM; Large Format AM

VERSION 2

N23B-T034 TITLE: Silicon Photonics Integration

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

OBJECTIVE: Develop new methodologies (or improve existing methodologies) to determine the reliability of silicon Photonic Integrated Circuit (PIC) devices and identify failure mechanisms with an emphasis on determining the influence of neighboring intra-chip devices, input/output components, and packaging.

DESCRIPTION: PICs provide a tremendous opportunity to significantly improve the performance of future generation microelectronic systems. PICs of continuously increasing complexity are finding applications in analog signal processing, optical communication, light detection and ranging (lidar), chemical and biological sensing, artificial intelligence (AI), quantum applications, and custom Department of Defense (DoD) applications. For example, PICs are a key part of high-capacity transceivers and switches for internet data centers, and are under investigation for transmitters and receivers for free space optical communications, hyperspectral imaging devices, light sources for medical diagnostic equipment, and light sources for atomic clocks and gyroscopes. The reliability of PIC devices applicable to DoD avionics, sensors, and electronic warfare (EW) continues to be under study by the DoD Science & Technology community. Verification and validation of integrated photonic device reliability is paramount to opening the door for technology transition opportunity discussions with programs. Laboratory testing of state-of-the-art silicon photonic devices under development in the DoD or in commercial-sector production requires integration with electrical and optical input/output devices at the package level.

Military uses of PICs require environmental ruggedness and reliable operation on the order of 100,000 hr mean time or longer between failures. Device operation has to be sustained under extreme conditions, such as high temperature (> 100 ºC), low temperature (< -40 ºC), high radiation, vibration, shock, and humidity. This SBIR topic seeks to evaluation of the underlying reliability physics of silicon based PIC chips and their corresponding packages, to improve the understanding of their failure mechanisms. Representative silicon-based PICs should be selected, and the main degradation modes should be experimentally and theoretically evaluated. Possible degradation modes include semiconductor crystal point defects and dislocations, dielectric and semiconductor optical absorption changes, material transition interface damage and passivation, dopant diffusion, material mechanical stress, metal diffusion, outgassing, solder creep, and intermetallic compound instability. At the package level possible degradation modes include optical coupling efficiency degradation at optical waveguide and/or fiber optic interfaces, electrical bond (bump or wire) failure, and loss of hermetic seal. These representative PICs should be subjected to Highly Accelerated Life Test (HALT) experiments to uncover failures, which will then improve the understanding of device failure physics and packaging failures after appropriate analysis. Individual chips, chip-on-carrier (CoC), and fully packaged devices should be considered for HALT plan creation and evaluation. Acceleration factors such as temperature, electrical bias, optical power, radiation and mechanical stress should be considered according to MIL-HDBK 217 and MIL-STD-810. Particular emphasis should be placed on understanding the influence of individual PIC devices on the reliability of the optical coupling and packaging. PIC integration with planar lightwave circuits (PLCs) and other optical waveguide devices should also be investigated.

Possible failure mechanism evaluation tools to be used include X-Ray radiography, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Optical beam induced current (OBIC), Focused Ion Beam Etching (FIB), Deep-level Transient Spectroscopy (DLTS), and Atomic Force Microscope (AFM) among many others.

VERSION 2

The models verified through experimental testing and the improved understanding of PIC/PLC device and package reliability physics will be used to create reliability prediction models and software for PICs/PLCs planned for use in military environments. Due to the large variety of PIC/PLC architectures and base materials, both in fabrication and under development, it is possible that several methods will be identified to extrapolate the PIC lifetime depending on the device specifics.

PHASE I: Define innovative methods to model, and predict silicon PIC and packaged silicon PIC reliability, including experimental test plans based on state-of-the-art reliability physics of failure and modeling, and simulation analyses to ascertain existing software prediction shortcomings. Develop models and experimental test plans for application to silicon-photonic integrated circuit devices, including circuit layouts and packages designed to accommodate these test plans. The focus should be on PIC circuits and components relevant to microwave and analog signal processing. Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Acquire representative silicon PIC and packaged silicon PIC devices for experimental testing and perform testing. Develop, demonstrate, and validate the reliability prediction models. Subject silicon PIC and packaged silicon PIC devices to environmental and mechanical test stresses based on modeling and simulation results, reliability engineering principles, and experimental test plans. Perform root cause analyses of device failures to understand silicon PIC, optical input/output, electrical input/output device, and package interactions and reliability prediction interdependencies. Develop, demonstrate, and deliver a packaged silicon PIC reliability software package for subsequent independent verification and validation.

PHASE III DUAL USE APPLICATIONS: Transition the software package to enable DoD and silicon photonic device producers to predict reliability. Commercial data centers or internet facilities are commercial sector applications of silicon photonics.

REFERENCES:

1. Margalit, N., Xiang, C., Bowers, S. M., Bjorlin, A., Blum, R., & Bowers, J. E. (2021). Perspective on the future of silicon photonics and electronics. Applied Physics Letters, 118(22), 220501. https://aip.scitation.org/doi/full/10.1063/5.0050117
2. Mekis, A., Armijo, G., Balardeta, J., Chase, B., Chi, Y., Dahl, A., De Dobbelaere, P., De Koninck, Y., Denton, S., Eker, M., Fathpour, S., Foltz, D., Gloeckner, S., Hon, K. Y., Hovey, S., Jackson, S., Li, W., Liang, Y., Mack, M., … & Zhou, R. (2017, July). Silicon Integrated Photonics Reliability. In Integrated Photonics Research, Silicon and Nanophotonics (pp. IW3A-3). Optical Society of America. https://opg.optica.org/viewmedia.cfm?uri=IPRSN-2017-IW3A.3&seq=0
3. Norman, J. C., Jung, D., Liu, A. Y., Selvidge, J., Mukherjee, K., Bowers, J. E., & Herrick, R. W. (2021). Reliability of lasers on silicon substrates for silicon photonics. In Reliability of Semiconductor Lasers and Optoelectronic Devices (pp. 239-271). Woodhead Publishing. https://doi.org/10.1016/B978-0-12-819254-2.00002-3
4. Rome Laboratory/ERSR. (1995, February). MIL-HDBK 217F (Notice 2): Military handbook: Reliability prediction of electronic equipment. Department of Defense. http://everyspec.com/MIL-HDBK/MIL-HDBK-0200-0299/MIL-HDBK-217F_NOTICE-2_14590/
5. The MIL-STD-810 Working Group. (2019, January). MIL-STD-810H: Department of Defense test method standard: Environmental engineering considerations and laboratory tests. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810H_55998/

KEYWORDS: Silicon photonics; reliability; failure analysis; modeling; simulation tools; packaging

Defense Health Agency
2023.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

INTRODUCTION

The Defense Health Agency (DHA) STTR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

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

The DHA Program participates in up to three DoD STTR BAAs each year. Proposals not conforming to the terms of this BAA will not be considered. Only Government personnel will evaluate proposal submissions.

Specific questions pertaining to the administration of the DHA STTR Program and these proposal preparation instructions shall be directed to:
DHA Program Management Office (PMO)
Email: 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

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD 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 STTR 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 STTR Program BAA. Do not duplicate the electronically-generated Cover Sheet or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically-generated Cover Sheet and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be reviewed only to the last word on the 20th page. Information beyond the 20th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-compliant and score it accordingly.

Content of the Technical Volume
The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Refer to the instructions provided in the DoD STTR Program BAA for full details on content of the technical volume.

Cost Volume (Volume 3)
The Phase I amount must not exceed **$250,000**. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DHA during proposal evaluations.

Supporting Documents (Volume 5)
DHA STTR will accept a Volume Five (Supporting Documents) as required under the DoD STTR Program BAA.

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

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. All DHA STTR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA STTR PMO. Submission instructions are typically sent in month five of the Phase I contract. The awardees will receive a Phase II window notification via email with details on when, how and where to submit their Phase II proposal.

Small businesses submitting a Phase II Proposal must use the DoD SBIR/STTR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/login). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, the Technical Volume, Supporting Documents, and Fraud, Waste, and Abuse certificate.

The DHA STTR Program will evaluate and select Phase II proposals using the evaluation criteria in the DoD STTR Program BAA. Due to limited funding, the DHA STTR 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 STTR Phase II Proposals have six Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse. The Technical Volume has a **40-page** limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically- generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40th page. Information beyond the 40th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-compliant and score it accordingly.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
The DHA STTR 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 STTR 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 STTR 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 STTR Office at usarmy.detrick.medcom-usamrmc.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 STTR 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

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 rational 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 STTR 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
In rare situations, the DHA STTR 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 STTR Program has the right of refusal. If approved, the DHA STTR 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 APAN 15-01 requirements that will be included in the Phase II submission instructions.

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 STTR 23.B Topic Index

DHA23B-001 TITLE: To Develop a Technological Solution for Automated Detection of Circulating and Exosomal miRNAs

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: To develop a reliable, rapid, sensitive, multiplex method to quantify the levels of small RNA molecules such as exosome and circulating microRNAs (miRNA) in biological samples to explore their potential as diagnostic and prognostic tools.

DESCRIPTION: The volume of in vitro diagnostics continues to grow steadily due to increased availability of easy-to-use devices, thus making it possible to deliver less costly care closer to the patient site in a shorter time relative to the central laboratory services. A novel class of small non-coding RNA molecule microRNAs have recently gained attention in healthcare management for its potential as biomarkers for human diseases. MicroRNAs (miRNAs) are evolutionary conserved, ~18–24 nucleotides long non-coding RNA, playing a significant role in controlling human gene expression by post-transcriptional gene regulation or silencing.

Each miRNA can regulate up to 200 predicted target genes, and one mRNA may be influenced by multiple miRNAs. miRNAs are abundant in many cell types, exosomes, and even occur as extracellular circulating molecules in blood and other biological fluid. A growing number of reports have shown that subsets of miRNAs may have clinical relevance as biomarkers. These biomarkers can be used to indicate presence of a pathology and even the stage, progression, or genetic link of pathogenesis (1). In certain situations, one miRNA biomarker may be sufficient to identify a health outcome such as acute injuries to Warfighters in the operational environment; however, in other cases, a well-defined panel of miRNAs is necessary for increased diagnostic sensitivity and/or specificity such as traumatic brain injury (TBI), post-traumatic stress disorder (PTSD) etc. These investigations have been undertaken in preclinical animal models and in human cohorts. For example, multi-omics investigation of PTSD patients' blood samples identified a diversified panel including miRNAs (miR-133a-3p, miR-192-5p, mir-424-3p and miR-9-5p) (2). Data from our lab have also shown exosome derived miRNA are involved in chronic neuropathic pain (3) as well as early impacts of irradiation was underscored by the large number of miRNAs in total body radiation pre-clinical model (4). However, the most widely used methods for analyzing miRNAs, including Northern blot-based platforms, in situ hybridization, reverse transcription qPCR, microarray, and next-generation sequencing involves cascade of operations including sample processing, miRNA quantification can be cumbersome and crippled by serious flaws at all stages of the process. In addition, these methods require that the low abundance miRNA be several folds greater than background to give a significant result. Therefore, the current topic is about the possibility and feasibility to develop a reliable, rapid, sensitive, multiplex method to quantify the levels of exosome and circulating miRNA in biological samples. The ultimate goal is to translate technological developments into diagnostic and prognostic tools.

1) The development of a robust and portable device.
2) To conduct an integrated sample collection-to-assay-to-detection architecture including exosomal and cell-free miRNA.
3) The amount and character of sample requirements. Consider minimally invasive clinical samples, such as blood, urine, saliva.
4) Device should have multiplexing capability and should be flexible to adapt new miRNA panels.
5) The sensitivity and specificity of the assay should be addressed.
6) The robustness and simplicity of the method.
7) The simplicity of software for analysis and interpretation of the data.
8) Minimal use of specialized equipment and reagents.
9) Low turn-around time to result
10) Assay cost

11) Capable to differentiate between exosome-derived vs cell-free miRNA

PHASE I: To establish feasibility for a quantitative molecular diagnostics technology based on the detection of exosomal and cell free circulating miRNA using readily available clinical or pre-clinical samples. Current in vitro approaches require extensive preparation involving extraction, reverse transcription of miRNA into cDNA, amplification followed by data analytics. To devise specific technological bricks to release these low molecular weight RNA molecules before proceeding to detection and analysis. Here, we are seeking experimental evidence of the proof-of-concept explaining methodologies to detect multiplexed miRNA panel (exosomal and/or circulating) from a single input of biomatrix of choice with minimal human handling. The proposed device should be able to conduct the entire process starting from the biomatrix collection to analysis in a rapid fashion. Molecular diagnostics assay will have a potential for more sensitive, more accurate, and more objective clinical judgments. Use of human or animal subjects is not intended, nor expected, in order to establish/achieve the necessary proof-of-concept in Phase I. Further noting, animal or human use research shall not occur during Phase I as the period of performance does not allow enough time for required approvals to be received. In addition, descriptions of data analysis and interpretations concept and concerns should be outlined. Phase I should also include the detailed development of Phase II testing plan.

PHASE II: The Phase I proposed protype shall be validated in Phase II. During this Phase, technology should undergo testing using a panel of miRNA (exosomal and circulating) for evaluation of the operation and effectiveness of utilizing an integrated system. A complete demonstration from biomatrix to detection of miRNA quantification is expected. Accuracy, reliability, and usability should be assessed. The device should be easy to use and interpret. The testing should be controlled and rigorous. Statistical power should be adequate to document initial efficacy and feasibility of the assay. This phase should also demonstrate evidence of commercial viability of the tool. Any information about risk and its mitigation should be discussed. We encourage to have a data driven analysis of the proposed capability tested using biomatrix that can inform us about the feasibility of next steps. Lastly, shall develop a clear regulatory strategy on how FDA clearance will be obtained.

PHASE III DUAL USE APPLICATIONS: The product developed is intended to be suitable for use and potential procurement by all Military Services and for civilian. The dual-use technology would be applicable via securing funds from other sources. The successful transition path of the technology is expected to include close engagement with military medical acquisition program managers during product commercialization to ensure appropriate product applicability for military field deployment. This assay format should also be seamlessly integrated into the device for its potential be used as monitoring tool for short- or long-term health assessment. Once developed and demonstrated, the technology can be used for identification of risk, diagnostic, prognostic, monitoring and/ or
predictive biomarkers for diseased state. The broader/commercial impact of this project will be to enhance current diagnostic and prognostic tools for early detection of disease.

REFERENCES:

1. Hanna Johora, Hossain Gazi S., Kocerha Jannet. The Potential for microRNA Therapeutics and Clinical Research. Frontiers in Genetics 2019 https://www.frontiersin.org/articles/10.3389/fgene.2019.00478
2. Dean, K.R., Hammamieh, R., Mellon, S.H., Abu-Amara, D., Flory, J.D., Guffanti, G., Wang, K., Daigle, B.J., Gautam, A., Lee, I. and Yang, R., 2020. Multi-omic biomarker identification and validation for diagnosing warzone-related post-traumatic stress disorder. Molecular psychiatry, 25(12), pp.3337-3349.
3. Sosanya NM, Kumar R, Clifford JL, Chavez R, Dimitrov G, Srinivasan S, Gautam A, Trevino AV, Williams M, Hammamieh R, Cheppudira BP, Christy RJ, Crimmins SL. Identifying Plasma Derived Extracellular Vesicle (EV) Contained Biomarkers in the Development of Chronic

Neuropathic Pain. J Pain. 2020 Jan-Feb;21(1-2):82-96. doi: 10.1016/j.jpain.2019.05.015. Epub 2019 Jun 19. PMID: 31228575.
4. Chakraborty N, Gautam A, Holmes-Hampton GP, Kumar VP, Biswas S, Kumar R, Hamad D, Dimitrov G, Olabisi AO, Hammamieh R, Ghosh SP. microRNA and Metabolite Signatures Linked to Early Consequences of Lethal Radiation. Sci Rep. 2020 Mar 25;10(1):5424. doi:

KEYWORDS: miRNA, Biosensors, exosomes, Biomarkers, non-coding RNA, small RNA, microfluidics,

DHA23B-002 TITLE: To develop an In Vitro Diagnostic (IVD) Platform for Rapid Detection of Multiplexed Multi-omics Biomarker Panel From Minimally Invasive Biomatrix

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: To meet an innovation gap in rapidly detecting multiplexed multi-omics library of gene-epigene-protein-metabolite from single input of minimally invasive biomatrix in austere condition.

DESCRIPTION: High throughput multi-omics readout and Systems integration galvanize our understanding about the molecular interplay and their roles in manifesting phenotypes. This interactive molecular landscape encompasses different layers of omics, namely epigenomics, transcriptomics, proteomics and metabolomics1, which operate in synchronized fashions to carry out biological functions. For instance, an epigenetic information flows through transcriptomics and proteomics layers to modulate metabolite landscape. Evidently, disease pathophysiology leaves footprints in any or all these layers of omics; hence a robust panel of disease biomarkers should include candidates from every layer of omics. Indeed, the current trend in biomarker discovery is progressively shifting from finding a single biomarker to a group of multi-omics biomarkers that can collectively define a clinical event2. A growing number of studies have identified multi-omics markers for psychological diseases like PTSD3,4 and somatic illnesses like rectal and prostate cancer1. Rapid probing of multi-omics molecular landscape is expected to enhance the diagnostic performance2, however such capability is yet to be fully materialized. This is the core innovation gap that we are poised to address here.

To develop this capability, the pilot prototype of IVD platform will detect multiplexed multi-omics PTSD biomarkers3,4 as a proof of its capability. We will ensure maximum flexibility in this prototype development process, so that the prototype could be easily repurposed in future to diagnose additional diseases including, but not limited to sepsis, TBI, infection, exposure to CBRN and cancer.
Diseases like PTSD is a good target for developing the pilot prototype due to two primary reasons. First, PTSD adversely impacts entire system; hence holistic screening of multi-omics landscape is imperative for PTSD subtyping, biomarker discovery and predicting comorbidities. For instance, DNA methylation markers were reported to biotype PTSD patients3. Moreover, multi-omics PTSD blood diagnostic markers included differentially methylated contigs (cg01208318, cg20578780, and cg15687973), miRNAs (miR-133a-1-3p, miR-192-5p, and miR-9-1-5p) and metabolites (gammaglutamyltyrosine)4. Although, we are yet to identify most robust panel of biomarkers for PTSD diagnosis and bio typing, a trend is rather apparent- the final product is likely to have representations from different omics layers, and this trend essentially justifies the proposed STTR program. The second reason to select PTSD is because many of its biomarkers are available in public domain3,4, ensuring an easy access to the Phase I awardees.

A web search of SBIR.gov (dated January 25, 2023) found existing solicitations to develop multiplexed multi-omics tools to primarily reconstruct the cellular motifs with high resolution; all these prototypes are expected to be used in sophisticated laboratory settings and preclude any pursuit to make these assays rapid, automated and operatable in austere condition. There are several ongoing STTR efforts to rapidly screen individual omics layer in a field-rugged platforms. Clearly, there is a vast innovation and capability gap in developing a platform enabled to support rapid detection of pan-omics panel in austere condition. Present proposal is poised to meet this innovation gap.

PHASE I: Provide experimental evidence of the proof-of-concept explaining methodologies to detect multiplexed multi-omics panel from a single input of biomatrix of choice. The expectation is that the biomatrix should be minimally invasive, such as blood, saliva, urine etc. We further expect that the proposed IVD platform should be able to conduct the entire process starting from the biomatrix collection to analysis in a rapid fashion.

It is also important to note that different biomatrix is enriched by different omics components. For instance, whole blood is the preferred biomatrix for extracting maximum amount of mRNA and DNA, while the cell free serum or plasma is the preferred biomatrix for extracting maximum amounts of proteins and metabolites. Therefore, if an IVD prototype targets blood for molecular extraction, it should be able to handle whole blood and serum/plasma concurrently from single input volume.
Target PTSD biomarkers could be curated from the public domain3,4. Use of human or animal subjects is not intended, or expected, in order to establish/achieve the necessary proof-of-concept in Phase I. At the end of this phase, a working prototype of the device should be demonstrated with reasonable sensitivity and feasibility. In addition, descriptions of data analysis and interpretations concept should be outlined. Phase I should also include the detailed development of Phase II testing plan.
In summary, our expectations from Phase I is the following
1. A plan to develop an IVD device that can detect multiplexed multi-omics biomarker panel to map phenome of interest. For the pilot prototype, we plan to detect multi-omics PTSD biomarkers that are available in public domain. However, the final product should be flexible to diagnose other diseases, such as sepsis, traumatic brain injury, pathogenic infection, exposure to CBRN and cancer.
2. The expected device should be an automated and portable IVD platform enable to be used in far forward lab or at bedside in an energy inexpensive manner.
3. The device is expected to support an end-to-end methodology e.g., an integrated sample collection-to-assay-to-detection protocol.
4. Multiplexing capability of multi-omics panel from single input volume is essential. Should the device select blood as the input biomatrix, the platform should be able to simultaneously handle whole blood and serum/plasma from single input volume.

PHASE II: The knowledge/ prototype generated in Phase I should be ready to be improved during Phase II. Phase II should start with a plan to assay the biomatrix of choice to detect a panel of multi-omics biomarkers. A comprehensive testing is expected to determine the feasibility of the platform to be operated with minimum hands-on time and least supervision. Suitable biomatrix should be finalized. The mode of endpoint reading should be finalized, and this process should be easily interpretable. Finally, we expect to have clear indications of the prototype's operational capability in real-world situations; some knowledge about the risks, source of confounders and concerns should be outlined, and pertinent mitigation plan should be furnished. We encourage to have a data driven analysis of the proposed capability tested using biomatrix that can inform us about the feasibility of next steps. This phase should also deliver a plan for commercialization.

In summary, our expectation from Phase II is the following:
1. The input and output modus operandi should be finalized.
2. Assay sensitivity and specificity should be characterized. Screening of limit of detection (LOD) profile in presence of potential confounders and contaminates is expected.
3. A turn-around time should be finalized. Herein the assay time includes the sample collection, assay and detection.
4. Potential risk factors and mitigation plan should be discussed.
5. Probable assay cost should be estimated.
6. Plan for commercial production and a plan on how FDA clearance will be obtained.

PHASE III DUAL USE APPLICATIONS: The product developed is intended to be suitable for use and potential procurement for primary use in the field/prehospital environment, including austere, prolonged care scenarios. At this phase, target diseases and pertinent biomarkers should be determined. As mentioned previously, the target disease might not be relevant to the health issues exclusive to active duty members. Realization of a dual-use technology applicable to both the military and civilian use could be achieved via securing funds from third party. Therefore, the successful transition path of the technology is

encouraged to include close engagement with military medical acquisition program managers during product commercialization to ensure appropriate product applicability for military field deployment. Accuracy, reliability, and usability should be assessed. This testing should be controlled and rigorous. Statistical power should be adequate to document final efficacy and feasibility of the assay. FDA submission and approval is a goal for this phase.

REFERENCES:

5. Subramanian I, Verma S, Kumar S, Jere A, Anamika K. Multi-omics data integration, interpretation, and its application. Bioinformatics and biology insights. 2020 Jan;14:1177932219899051.
6. Vincent, J.-L., Bogossian, E. & Menozzi, M. J. C. c. c. The Future of Biomarkers. 36, 177-187 (2020).
7. Yang, R., Gautam, A., Getnet, D., Daigle, B.J., Miller, S., Misganaw, B., Dean, K.R., Kumar, R., Muhie, S., Wang, K. and Lee, I., 2021. Epigenetic biotypes of post-traumatic stress disorder in war-zone exposed veteran and active duty males. Molecular psychiatry, 26(8), pp.4300-4314.
8. Dean, K.R., Hammamieh, R., Mellon, S.H., Abu-Amara, D., Flory, J.D., Guffanti, G., Wang, K., Daigle, B.J., Gautam, A., Lee, I. and Yang, R., 2020. Multi-omic biomarker identification and validation for diagnosing warzone-related post-traumatic stress disorder. Molecular psychiatry, 25(12), pp.3337-3349.

KEYWORDS: In vitro diagnostic device, multi-omics biomarker detection, multiplexing capability, targeted molecular identification, minimally invasive biomatrix, rapid diagnosis, austere environment-friendly, minimum hands-on time

DHA23B-003 TITLE: Electrodermal Activity for Prediction and Detection of Symptoms Related to the Central Nervous System Oxygen Toxicity Including Seizures

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Military Operational Medicine

OBJECTIVE: Develop a means to detect the onset of seizures due to CNS-OT for real-time monitoring of divers immersed underwater.

DESCRIPTION: Divers breathing hyperbaric oxygen (HBO2) are at risk for developing Central Nervous System Oxygen Toxicity (CNS-OT), which can manifest as symptoms that might impair a diver's performance, such as headache, nausea, tinnitus, lip twitching, tingling of the limbs, or even more serious symptoms such as seizure or altered consciousness(1,2). Oxygen seizures themselves are not harmful, the environmental conditions greatly influence the risks associated with losing consciousness or convulsing; being underwater could result in the dislodgement of the diver's air supply from his or her mouth, possibly leading to drowning(3,4). Furthermore, the risk of CNS-OT dictates strict diving protocols greatly limiting mission capabilities (depth and duration of a dive are impacted by risk of CNS-OT). Developing a means to detect the onset of seizures due to CNS-OT would provide great safety monitoring that has been absent from risk of CNS-OT in diving. If proven, mitigation strategies to prevent CNS-OT and detection of the consequential seizures in some subjects could reduce risk to divers. The risk of CNS-OT occurrence is highly variable between individuals, making it hard to predict the onset of seizures, and to determine the safety of exposure to HBO2. Being able to establish an individual safe level of exposure would maximize the therapeutic and operational uses of HBO2 in hyperbaric, diving, and submarine medicine (e.g. healing problematic wounds or preventing DCS), by enabling the extension of exposure time in individuals with more neurological tolerance to HBO2. Previous studies have suggested that electrodermal activity (EDA) can be used to predict seizures in rodents exposed to HBO2(5).

PHASE I: Demonstrate feasibility through analysis and limited laboratory demonstrations, a device that is capable of measuring electrodermal activity (EDA) to be worn by: pool swimmers/divers, surface supplied divers, free swimming divers, and patients receiving hyperbaric oxygen treatment in dry chambers. The device shall provide full function and data processing while immersed in salt water and exposed to increased hyperbaric pressures of 100 feet of sea water (FSW) (threshold)/300 FSW (objective) at a temperature range of 32-95 Degrees F, Provide cost-effective designs and reliability estimates, including lifetime expectancy and lifetime cost estimate. The required Phase I deliverables will include: 1) a research plan for the engineering design of the physiologic monitor; 2) a preliminary prototype, either physical or virtual, capable of demonstrating effectiveness of the proof-of-concept design; and 3) a test and evaluation plan to validate accuracy of data collection including identification of proper controls. Important considerations should include location, minimization of motion artifacts, enhanced comfort and wearability (minimization of wired elements), and on-board processing. Device should detect EDA while submerged underwater. Phase I will provide key information about the uses and limitations of the system and could include rapid prototyping and/or modeling and simulation.

PHASE II: Develop, demonstrate, and validate the underwater EDA prototype based on the Phase I design concept. The system should be used under the expected extreme environmental conditions (as cited in the description section) to collect and analyze data and test algorithms against the known physiological alterations during diving activity. Device shall collect data continuously for up to 24 hours at minimum with on-board processing capability to enable feedback to individual. Initial prototype may be designed for use on the body of a diver with or without a wetsuit or drysuit using traditional scuba or rebreather life support. Device should include onboard data processing enabling real-time feedback to diver. No data transmission will be included under the initial development. A lithium battery may be used but alternative power sources that have minimal safety hazards and can function submerged in ocean water should be considered. Initial design may be intended for experimental or training use and need not be adapted for operational use. Phase II deliverable of, at minimum, two prototype units that includes detailed design specifications and technical data package drawings (level 2/3) established through this STTR to ONR that ensures IP protection.

Interest by military customer would be defined by validation through testing and confidence in predictive measures. Successful devices would need to be tested either at a Naval dive unit such as Naval Experimental Diving Unit (NEDU) if possible or another acceptable dive facility, which could include commercial dive centers. If NEDU is preferred, it is advisable to plan well in advance to ensure they are able to accommodate testing schedule.

PHASE III DUAL USE APPLICATIONS: If successful, transition prototype to a functional unit to the US Navy's Naval Sea Systems Command Supervisor of Salvage and Diving (NAVSEA SUPSALV), which maintains diving equipment authorized for Naval use. Operationally relevant conditions will necessitate additional testing and may require greater depths, prolonged data collection, and security considerations.

If successful, the small business shall support the Navy in transitioning the resulting technology for use in operational environments. The small business shall develop a plan to transition and commercialize the technology and its associated guidelines and principles. Private Sector Commercial Potential: This SBIR would provide much needed understanding of objective measures for detecting early signs of neurologic distress and generally monitoring brain health across recreational and commercial diving populations during mixed gas dives for use in hyperbaric treatments by medical professionals.

REFERENCES:

9. R. Arieli, T. Shochat, and Y. Adir, "CNS Toxicity in Closed-Circuit Oxygen Diving: Symptoms Reported from 2527 Dives," Aviation, Space, and Environmental Medicine, vol. 77, no. 5, pp. 526-532, 2006/05/01/ 2006.
10. K. Donald, Oxygen and the diver. Images, 1992.
11. J. M. Clark and T. S. Neuman, "Physiology and Medicine of Hyperbaric Oxygen Therapy," 2008 2008.
12. M. J. Natoli and R. D. Vann, "Factors Affecting CNS Oxygen Toxicity in Humans," DUKE UNIV MEDICAL CENTER DURHAM NC FG HALL LAB FOR ENVIRONMENTAL RESEARCH1996 1996, Available: http://www.dtic.mil/docs/citations/ADA307505.
13. Posada-Quintero HF, Landon CS, Stavitzski NM, Dean JB, Chon KH. Seizures Caused by Exposure to Hyperbaric Oxygen in Rats Can Be Predicted by Early Changes in Electrodermal Activity. Front Physiol. 2022 Jan 5;12:767386. doi: 10.3389/fphys.2021.767386. PMID: 35069238; PMCID: PMC8767060.

KEYWORDS: Electrodermal Activity, waterproof, oxygen toxicity, diving medicine, hyperbaric medicine

Defense Threat Reduction Agency (DTRA)
Small Business Technology Transfer (STTR) 23.B
Proposal Submission Instructions

INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA STTR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY23.B topics solicited for the Defense Threat Reduction Agency (DTRA) Small Business Technology Transfer (STTR) Program are included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

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.

The DTRA Small Business Technology Transfer (STTR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA STTR Program and these proposal preparation instructions should be submitted to:

Mr. Mark D. Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at dodsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

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

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 STTR 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 STTR Program BAA. Any pages in the technical volume over 20 pages will not be considered in proposal evaluations.

Content of the Technical Volume

The Technical Volume should cover the following items in the order given below:

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

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

(c) Phase I Statement of Work (including Subcontractors' Efforts)

(1) Provide an explicit, detailed description of the Phase I approach. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

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

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

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

(1) Short description,
(2) Client for which work was performed (including individual to be contacted and phone number), and
(3) Date of completion.

(e) Relationship with Future Research or Research and Development

(1) State the anticipated results of the proposed approach if the project is successful.

(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

(3) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

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

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

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

(i) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(j) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two-thirds (66%) of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing firm. The percentage of work is measured by both direct and indirect costs. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposer must certify their use of such facilities on the Cover Sheet of the proposal.

For both Phase I and II, the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Primary employment with a small business concern precludes full-time employment at another organization.

(k) Prior, Current, or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information. Refer to the instructions provided in the DoD STTR BAA for this requirement.
Note: If this does not apply, state in the proposal "No prior, current, or pending support for Proposed work"

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $167,500. For the Cost Volume, DTRA requires the use of a Microsoft excel spread sheet which is available on the DSIP portal.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded. Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotiations if selected. Refer to the instruction provided in the DoD STTR program BAA for additional details on the content of the Cost Volume.

Note: Cost for travel funds must be justified and related to the needs of the project. DTRA does not include any fee on travel costs, so proposal should exclude fee on any travel costs proposed.

For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit- Process-Overview/.

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA 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). Please refer to the DoD Program BAA for details on required Supporting Documents.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees.

The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All STTR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume for Phase II proposals. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

Phase II Proposal Instructions
Each Phase II proposal must be submitted through the Defense SBIR/STTR Innovation Portal (DSIP) by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. **The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages.** Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see the appropriate section of the DoD Program BAA) and Volume 5. The Commercialization Strategy section of the technical proposals should be more specific than was required for Phase I. Refer to the DoD Program BAA for additional details.

Phase II Evaluation Criteria
Phase II proposals will be reviewed for overall merit based upon the criteria specified in this Broad Agency Announcement and will be similar to the Phase I process.

Public Release of Award Information
If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil/submissions/login.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II STTR award to purchase Discretionary Technical & Business Assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting in areas such as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.

Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.

For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD STTR Program BAA. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Notifications. Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The

E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "STTR 23.B / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

DTRA Support Contractors

Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc (contract specialist support), Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Kapili Services, LLC and TekSynap (DTRIAC) and Savantage Solutions (Accounting and Financial Systems Support). This list is not all inclusive (e.g., subcontractors) and is subject to change.

Protests.

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

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:

"Service of Protest (Sept 2006)
(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer), as follows by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)"

AWARD AND CONTRACT INFORMATION

DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $167,500.00, notwithstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24 month period of performance. The award size of a Phase II contract is no more than $1,100,000.00, notwithstanding a maximum of $50,000.00 for TABA for the entire project.

ADDITIONAL INFORMATION

Export Control Restrictions

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

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**

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

Cyber Security

Any Small Business Concern receiving an STTR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

Feedback

In an effort to encourage participation in, and improve the overall STTR award process, offerors may submit feedback on the STTR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future STTR BAAs.

DTRA STTR 23.B Topic Index

DTRA23B-001 Ultra-Compact DT Neutron Generator for Enhanced Radiation Detection

DTRA23B-001 TITLE: Ultra-Compact DT Neutron Generator for Enhanced Radiation Detection

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

OBJECTIVE: DTRA seeks to significantly reduce the size, weight, and power (SWaP) of battery-powered Deuterium-Tritium (DT) neutron generators to less than 10 pounds (stretch goal: less than 5 pounds) with as small a volumetric footprint as possible, while operating on CR123 or standard power tool lithium-ion batteries.

DESCRIPTION: Current commercial DT neutron generators are too large for Department of Defense (DoD) expeditionary missions. The Defense Advanced Research Projects Agency (DARPA) previously invested in the Intense and Compact Neutron Sources (ICONS) program1, which made significant strides towards the development and commercialization of highly compact neutron generators. However, DoD forces require an even more lightweight (<10 pound), compact (<100 cubic inches), 1E8 neutrons/second (both pulsed and continuous are acceptable if they reach average 1E8 neutrons/second over 1 second) DT neutron generator for multiple applications. Advancements in high-voltage power supplies, capacitors, and spark gap technologies due to DoD investments in directed energy weapons (DEW) for the past decade as well as recent advances in medical isotope production may provide new opportunities for extremely compact and modern neutron generator concepts. The proposed effort does not require associated particle imaging (API) electronics to be incorporated.

PHASE I: Conceptualize and design a breadboard electronic DT neutron source. Although not required, more than one concept may be developed and/or evaluated during the Phase I effort. For the completion of Phase I, the prototype design(s) should be capable of the following performance characteristics: (1) 1E8 neutron/second, (2) design weight of all primary and supporting equipment required to operate the system (i.e. produce neutrons) less than 10 pounds, (3) total volume of all primary and supporting equipment required to operate the system less than 100 cubic inches, and (4) the system operates on a CR123 or standard lithium-ion battery for power tools. Modeling and simulation of the design should be conducted and results leading to the final design(s) should be documented and provided in the final report along with a data package on all proposed critical components in the breadboard system design. A design plan should also be submitted outlining the plans for scaling the system to meeting Phase II requirements.

PHASE II: Design, construct and test a brassboard electronic DT neutron source building on the Phase I design concept. The use of actual hardware and empirical data collection is expected for the performance analysis of the electronic radiation source and the results should be provided in the final report along with a data package on all critical components in the breadboard system. At the completion of Phase II, the prototype system should be capable of demonstrating the following performance characteristics: (1) 1E8 neutron/second, (2) design weight of all primary and supporting equipment required to operate the system (i.e. produce neutrons) less than 10 pounds with a stretch goal of less than 5 pounds, (3) total volume of all primary and supporting equipment required to operate the system less than 100 cubic inches, and (4) the system operates on a CR123 or standard lithium-ion battery for power tools, (5) the system should be capable of producing 1E8 neutrons/second in less than 1 minute of set up time and (6) the system should be able to be safe to transport within 5 minutes after turn off (i.e. minimal activation of components, automated stored energy dissipation).

PHASE III DUAL USE APPLICATIONS: Phase III will consist of a demonstration of a fully capable and packaged electronic neutron source meeting the specified requirements outlined in this paragraph. The final system will represent a complete solution and should be ruggedized. As a minimum threshold, the system should be ruggedized for testing in a dry, outdoor environment. The objective for the system should be to meet MIL-STD-810H standards for shock, vibration, temperature, and altitude. At the completion of Phase III, the prototype system should be capable of demonstrating the following

performance characteristics: (1) 1E8 neutron/second DT option, (2) design weight of all primary and supporting equipment required to operate the system (i.e. produce neutrons) less than 10 pounds with a stretch goal of less than 5 pounds, (3) total volume of all primary and supporting equipment required to operate the system less than 100 cubic inches, (4) the system operates on CR123 or standard lithium-ion battery for power tools, (5) the system should be capable of producing 1E8 neutrons/second in less than 1 minute of set up time, and (6) the system should be able to be safe to transport within 5 minutes after turn off (i.e. minimal activation of components, automated stored energy dissipation). All data collected during the demonstrating and analysis of the final system will be included in the final report along with a user's manual and a data package on all critical system components.

REFERENCES:

1. https://www.darpa.mil/program/intense-and-compact-neutron-sources;

KEYWORDS: Radiography; radiation; imaging; neutron; accelerator; particle; non-destructive testing; NDT; inspection

Missile Defense Agency (MDA)
23.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

INTRODUCTION

The Missile Defense Agency's (MDA) mission is to develop and deploy a layered Missile Defense System (MDS) to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight.

The MDA Small Business Technology Transfer (STTR) Program is implemented, administered, and managed by the MDA Small Business Innovation Research (SBIR)/STTR Program Management Office (PMO), located within the Innovation, Science, & Technology (DV) directorate.

Offerors responding to a topic in this Broad Agency Announcement (BAA) must follow all general instructions provided in the Department of Defense (DoD) STTR Program BAA. MDA 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 MDA STTR Program and these proposal preparation instructions should be directed to:

Missile Defense Agency
SBIR/STTR Program Management Office
MDA/DVR
Bldg. 5224, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil

Your proposal must conform to the terms of this announcement. MDA reserves the right not to consider any or all non-conforming proposals. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by MDA will be funded. MDA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues). Only United States small businesses and certain individuals are eligible to participate in the SBIR/STTR programs. A small business must meet the eligibility requirements set forth in 13 CFR 121.702. Please see SBA's SBIR/STTR website: https://www.sbir.gov/about#eligibility

Please read the entire DoD Announcement and MDA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about#policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

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

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

DSIP (available at https://www.dodsbirsttr.mil) will lead you through the preparation and submission of your proposal. Read the front section of the DoD announcement for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this announcement may not be considered.

MDA's objective for Phase I is to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I is six (6) months.

Proposal Cover Sheet (Volume 1)

On DSIP at https://www.dodsbirsttr.mil/submissions, prepare the Proposal Cover Sheet.

Technical Volume (Volume 2)

The technical volume is not to exceed 15 pages and must follow the formatting requirements provided in the DoD STTR Program BAA. Any pages submitted beyond the 15-page limit will not be evaluated.

Content of the Technical Volume

For technical volume format guidance, please refer to the "Format of Technical Volume" section within the DoD STTR 23.B BAA

If including a letter(s) of support and/or Technical and Business Assistance (TABA) request, it must be included as part of Volume 5 and will not count towards the 15-page Technical Volume (Volume 2) limit. Any technical data/information that should be in the Technical Volume (Volume 2) but is contained in other Volumes will not be considered.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed $150,000 or not to exceed $155,000 if TABA is included. MDA does not utilize the Phase I Option.

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by MDA during proposal evaluations.

Supporting Documents (Volume 5)

In addition to the requirements listed in the DoD Program BAA, MDA will only accept the following documents as part of Volume 5:

1. Request for TABA using the MDA Phase I TABA form (optional).
2. Letters of support (optional).

If including a request for TABA, the MDA Phase I TABA Form MUST be completed and uploaded using the "Other" category within Volume 5 of DSIP.

If including letters of support, they MUST be uploaded using the "Letters of Support" category within Volume 5 of DSIP. A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what MDS

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.

Any documentation other than required documents listed in the DoD Program BAA, letter(s) of support, or requests for TABA included as part of Volume 5 WILL NOT be considered.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR Program Management Office during the fourth month of the Phase I period of performance.

MDA will evaluate and select Phase II proposals using the Phase II evaluation criteria listed in the DoD Program announcement. While funding must be based upon the results of work performed under a Phase I award and the scientific and technical merit, feasibility and commercial potential of the Phase II proposal, Phase I final reports will not 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, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system. It is strongly urged that an approved accounting system be in place prior to the MDA Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay/prevent Phase II contract award. Please visit https://www.dcaa.mil/Customers/Small-Business for more information on obtaining a DCAA approved accounting system.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR/STTR Policy Directive allows agencies to enter into agreements with suppliers to provide technical assistance to SBIR and STTR awardees, which may include access to a network of scientists and engineers engaged in a wide range of technologies or access to technical and business literature available through on-line data bases.

All requests for TABA must be completed using the MDA SBIR/STTR Phase I TABA Form and included as a part of Volume 5 of the proposal package. MDA will not accept requests for TABA that do not utilize the MDA SBIR/STTR Phase I TABA Form or are not provided as part of Volume 5 of the Phase I proposal package.

A STTR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its STTR proposal that the individual or entity selected can provide the specific technical services needed. In addition, costs must be included in the cost volume of the offeror's proposal. The TABA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

If the awardee supports the need for this requirement sufficiently as determined by the Government, MDA will permit the awardee to acquire such technical assistance, in an amount up to $5,000 per year. This will be an allowable cost on the STTR award. The per year amount will be in addition to the award and is not subject to any burden, profit or fee by the offeror. The per-year amount is based on the original

contract period of performance and does not apply to period of performance extensions. Requests for TABA funding outside of the base period of performance (6 months) for Phase I proposal submission will not be considered.

The purpose of this technical assistance is to assist STTR awardees in:
1. Making better technical decisions on STTR projects;
2. Solving technical problems that arise during STTR projects;
3. Minimizing technical risks associated with STTR projects; and
4. Developing and commercializing new commercial products and processes resulting from such projects including intellectual property protections.

The MDA Phase I TABA form can be accessed here: (https://www.mda.mil/global/documents/pdf/SBIR_STTR_PHI_TABA_Form.pdf) and must be included as part of Volume 5 using the "Other" category.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD STTR Program BAA. Selections will be based on best value to the Government considering the evaluation criteria listed in the DoD STTR Program BAA which are listed in descending order of importance

MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the offeror before award of any contract. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality as determined by MDA will be funded.

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.

AWARD AND CONTRACT INFORMATION

The MDA SBIR/STTR Program Management Office will distribute selection and non-selection email notices to all firms who submit an MDA STTR proposal. 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 email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet and will originate from the sbirsttr@mda.mil email address. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

MDA will provide written feedback to unsuccessful offerors regarding their proposals upon request. Requests for feedback must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting proposal feedback. Only firms that receive a non-selection notification are eligible for written feedback. Refer to the DoD STTR Program BAA for procedures to protest the announcement.

As further prescribed in Federal Acquisition Regulation (FAR) 33.106(b), FAR 52.233-3, protests after award should be submitted to Tina Barnhill via email: sbirsttr@mda.mil.

The Missile Defense Agency will issue all contract awards. The cognizant Government Contracting Officer is the only Government official authorized to enter into any binding agreement or contract on behalf of the Government.

Offeror Small Business Eligibility Requirements

Each offeror must qualify as a small business at time of award per the Small Business Administration's (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Small businesses that are selected for award will also be required to submit a Funding Agreement Certification document and be registered with Supplier Performance Risk System https://www.sprs.csd.disa.mil/ prior to award.

Ownership Eligibility

Prior to award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR/STTR 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 MDA, the contractor shall provide all necessary documentation for evaluation prior to STTR award. Failure to submit the requested documentation in a timely manner as indicated by MDA may result in the offeror's ineligibility for further consideration for award.

Performance Benchmark Requirements for Phase I Eligibility

MDA does not accept proposals from firms that are currently ineligible for Phase I awards as a result of failing to meet the benchmark rates at the last assessment. Additional information on Benchmark Requirements can be found in the DoD SBIR/STTR Program BAA.

References to Hardware, Computer Software, or Technical Data

In accordance with the SBIR/STTR Policy Directive, the work within the SBIR/STTR contracts are to conduct feasibility-related experimental or theoretical Research/Research and Development (R/R&D) related to described agency requirements. The purpose for Phase I is to determine the scientific and technical merit and feasibility of the proposed effort.

It is not intended for any formal end-item contract delivery and ownership by the Government of your hardware, computer software, or technical data. As a result, your technical proposal should not contain any reference to the term "Deliverables" when referring to your hardware, computer software, or technical data. Instead use the term: "Products for Government Testing, Evaluation, Demonstration, and/or possible destructive testing."

The standard (if applicable) formal deliverables for a Phase I are the:
A001: Report of Invention(s), Contractor, and/or Subcontractor(s) // Patent Application for Invention
A002: Status Report // Phase I Bi-monthly Status Report
A003: Contract Summary Report // Phase I Final Report
A004: Certification of Compliance // STTR Funding Agreement Certification - Life Cycle Certification
A005: Computer Software Product // Product Description
A006: Technical Report - Study Services // Prototype Design and Operation Document

FAR 52.203-5 Covenant Against Contingent Fees

As prescribed in FAR 3.404, the following FAR 52.203-5 clause shall be included in all contracts awarded under this BAA:

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) Bona fide agency, as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

ADDITIONAL INFORMATION

Federally Funded Research and Development Centers (FFRDCs) and Support Contractors

Only Government personnel with active non-disclosure agreements will evaluate proposals. Non-Government technical consultants (consultants) to the Government may review and provide support in proposal evaluations during source selection. Consultants may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. Consultants will not establish final assessments of risk and will not rate or rank offerors' proposals. They are also expressly prohibited from competing for MDA STTR awards in the STTR 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 "Government Only." Pursuant to FAR 9.505-4, the MDA 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, MDA 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 MDA SBIR/STTR 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 aforementioned organizations may require access to proprietary information contained in the offerors' proposals.

SBA Company Registry

Per the SBIR/STTR Policy Directive, all applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control Identification number to be used for submissions at any of the eleven (11) participating agencies in the SBIR or STTR program. For more information, please visit the SBA's Firm Registration Page: http://www.sbir.gov/registration.

Organization Conflicts of Interest (OCI)

The basic OCI rules for Contractors that support development and oversight of STTR topics are covered in FAR 9.5 as follows (the Offeror is responsible for compliance):

(1) The Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract;

(2) The Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) The Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All applicable rules under the FAR Section 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any STTR 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.

In addition, FAR 3.101-1 states that Government business shall be conducted in a manner above reproach and, except as authorized by statute or regulation, with complete impartiality and with preferential treatment for none. The general rule is to avoid strictly any conflict of interest or even the appearance of a conflict of interest in Government-contractor relationships. An appearance of impropriety may arise where an offeror may have gained an unfair competitive advantage through its hiring of, or association with, a former Government official if there are facts indicating the former Government official, through their former Government employment, had access to non-public, competitively useful information. (See *Health Net Fed. Svcs*, B-401652.3; *Obsidian Solutions Group*, LLC, B-417134, 417134.2). The existence of an unfair competitive advantage may result in an offeror being disqualified and this restriction cannot be waived.

It is MDA policy to ensure all appropriate measures are taken to resolve OCI's arising under FAR 9.5 and unfair competitive advantages arising under FAR 3.101-1 to prevent the existence of conflicting roles that might bias a contractor's judgment and deprive MDA of objective advice or assistance, and to prevent contractors from gaining an unfair competitive advantage.

Use of Foreign Nationals (also known as Foreign Persons), Green Card Holders, and Dual Citizens

See the "Foreign Nationals" section of the DoD STTR 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 this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a STTR 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). MDA reserves the right to vet all un-cleared 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.

Export Control Restrictions

The technology within most MDA 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.

All MDA STTR topics are subject to ITAR and/or EAR. Your company will be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

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: MDA clause H-08 (Public Release of Information), DFARS 252.204-7000 (Disclosure of Information), DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements), MDA clause H-09 (Organizational Conflict of Interest), MDA clause H-27 (Foreign Persons), and MDA clause H-28 (Distribution of Control Technical Data). Your proposal submission confirms that any proposed subcontract is in accordance to the clauses cited above and any other clauses identified by MDA in any resulting contract. All proposed universities will need to provide written acceptance of the Flow-Down Clauses in both SBIR and STTR proposals.

MDA Clause H-08 Public Release of Information (Publication Approval)

MDA Clause H-08 pertaining to the public release of information is incorporated into all MDA STTR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under all MDA STTR contracts must be submitted to the Procuring Contracting Officer (PCO) for review and approval prior to its release to the public. This mandatory clause also includes subcontractors, who shall provide their submission through the prime contractor for MDA's approval for release.

a. In addition to the requirements of National Industrial Security Program Operations Manual (DoD 5220.22-M), all foreign and domestic contractor(s) and its subcontractors are required to comply with the following:

1) Any official MDA information/materials that a contractor/subcontractor intends to release to the public that pertains to any work under performance of this contract, the Missile Defense Agency (MDA) will perform a prepublication review prior to authorizing any release of information/materials.

2) At a minimum, these information/materials may be technical papers, presentations, articles for publication, key messages, talking points, speeches, and social media or digital media, such as press releases, photographs, fact sheets, advertising, posters, videos, etc.

b. Subcontractor public information/materials must be submitted for approval through the prime contractor to MDA.

c. Upon request to the MDA PCO, contractors shall be provided the "Request for Industry Media Engagement" form (or any superseding MDA form).

d. At least 45 calendar days prior to the desired release date, the contractor must submit the required form and information/materials to be reviewed for public release to MDAPressOperations@mda.mil, and simultaneously provide courtesy copy to the appropriate PCO.

e. All information/materials submitted for MDA review must be an exact copy of the intended item(s) to be released, must be of high quality and are free of tracked changes and/or comments. Photographs must have captions, and videos must have the intended narration included. All items must be marked with the applicable month, day, and year.

f. No documents or media shall be publically released by the Contractor without MDA Public Release approval.

g. Once information has been cleared for public release, it resides in the public domain and must always be used in its originally cleared context and format. Information previously cleared for public release but containing new, modified or further developed information must be re-submitted

Rights in Noncommercial Technical Data and Computer Software – SBIR/STTR Program (DFARs 252.227-7018)
Use this link for full description of Data Rights:
https://www.acquisition.gov/dfars/part-252-solicitation-provisions-and-contract-clauses#DFARS_252.227-7018

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.

To Report Fraud, Waste, or Abuse, Please Contact:
MDA Fraud, Waste & Abuse
Hotline: (256) 313-9699
MDAHotline@mda.mil

DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: (800) 424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this announcement.

Proposal Submission
All proposals MUST be submitted online using DSIP (https://www.dodsbirsttr.mil). Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk: DoDSBIRSupport@reisystems.com.

It is recommended that potential offerors email topic authors to schedule a time for topic discussion during the pre-release period.

Classified Proposals
Classified proposals **ARE NOT** accepted under the MDA STTR Program. The inclusion of classified data in an unclassified proposal MAY BE grounds for the Agency to determine the proposal as non-responsive and the proposal not to be evaluated. Contractors currently working under a classified MDA STTR contract must use the security classification guidance provided under that contract to verify new STTR proposals are unclassified prior to submission. Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on Phase II contracts will require security clearances. If a Phase II contract will require classified work, the offeror must have a facility clearance and appropriate personnel clearances in order to perform the classified work. 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 MDA SBIR/STTR PMO will originate from the sbirsttr@mda.mil email address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

Proposal titles, abstracts, anticipated benefits, and keywords of proposals that are selected for contract award will undergo an MDA Policy and Security Review. Proposal titles, abstracts, anticipated benefits, and keywords are subject to revision and/or redaction by MDA. Final approved versions of proposal titles, abstracts, anticipated benefits, and keywords may appear on DSIP and/or the SBA's SBIR/STTR award site (https://www.sbir.gov/sbirsearch/award/all).

Approved for Public Release (instructions)
23-MDA-11398 (13 Mar 23)

MDA STTR 23.B Topic Index

MDA23-T001 TITLE: Enhanced SM3 Communications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Network Systems-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: Design and develop tri-band (S, C, and X-band) communications antennas for on-missile body use.

DESCRIPTION: This topic seeks to design and develop an on-missile body tri-band (S, C, and X-band) communications antenna. This program desires to create drop-in, or near drop-in replacements of existing antenna systems to extend the communication capability of a missile across the common RF bands of S, C, and X. No specific antenna types are being recommended for this effort. Proposer is encouraged to propose and explore any of the myriad of antenna concepts (1) (2) (3) that may result in a compliant final design.

The goal of this proposed effort is to design and demonstrate a set of proof of manufacturing prototype antenna elements to serve as drop-in replacements. These elements would match existing antenna systems in terms of size, weight, and power (SWaP) to minimize the impact on the existing qualification. The objective would be a single antenna aperture capable of communicating on all three stated bands. The threshold is an antenna system consisting of no more than two distinct apertures capable of being drop-in replacements of current systems.

PHASE I: Conduct a study to determine the feasibility of the design concepts. The feasibility would be demonstrated, at a minimum, with modeling results demonstrating antenna gain, return loss, and patterns. The final deliverable produced would be a report containing design concept plots indicating antenna performance across the entire S, C, and X-bands. Trades between antenna performance and band coverage should be explained. No performance requirements are stated for this phase, but a detailed explanation of the trade space illustrating feasibility will be required.

PHASE II: Develop, refine, and mature the initial concepts demonstrated in Phase I to meet refined performance requirements provided by the government at a program kick-off meeting. A preliminary design review would be held 12 months after award. Design would be fabricated and demonstrated to a technology readiness level of 5 or greater by the end of the 24 month Phase II effort.

PHASE III DUAL USE APPLICATIONS: Reducing or maintaining a common SWaP performance while integrating additional communication band is a technology applicable across the defense and commercial spaces. In particular, the greater commercialization of Space would lead to an increased need for communication redundancy of these platforms.

REFERENCES:

1. https://ieeexplore.ieee.org/document/9708507;
2. https://ieeexplore.ieee.org/document/8943886;
3. https://ieeexplore.ieee.org/document/8748427;

KEYWORDS: Missile Antenna; Tri Band (S, C, & X) Communications

MDA23-T002 TITLE: AI-Informed Algorithms Combined with Differential Game Theory to Support Swarm-on-Swarm Engagements

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Network Systems-of-Systems; 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: Design and develop innovative solutions, methods, algorithms and concepts that leverage differential game theory and artificial intelligence to support anti-swarm operation in the hypersonic defense context. Demonstrate a working software prototype with example results. The algorithms should be narrow in focus, and verifiable in operation. The solutions should identify appropriate methods and technologies to minimize the time intensive processes, incorporate new technologies unearthed during the effort, and document key areas for further development.

DESCRIPTION: Unmanned vehicles operating in "swarms" are a growing concern for warfighters operating across all domains of the modern battlespace (air, sea, ground, and space). In particular, swarms operating in the exo-atmosphere and in the hypersonic regime may be encountered by missile defense systems. To enable defensive systems to counter these evolving threats, this program desires AI-informed algorithms combined with differential game theory to support swarm-on-swarm engagement where the adversary swarm is AI-directed. In addition, the desire for algorithms that are executable post-launch on hardware with size, weight, and power suitable for carrying on each missile and have adequate on-board (and/or satellite-based) sensing and intra-missile-fleet communications. Ideally, entire system would be free of command and control after launch while utilizing centralized battle management control prior to launch; the entire system would be peer-to-peer, without a central fly-along "mother ship", in order to reduce single-point vulnerability. Hypersonic engagements may include multiple attacking hypersonic missiles (glide vehicles or powered, and either separately launched or multi-warhead launched) and multiple defensive missiles, presumably involving multiple launches with multiple KVs on each launch. For both red and blue missiles fleets, consider the following factors:

* Significant missile-trajectory maneuverability
* Intra-vehicle communication
* Implementation of pursuit/evasion strategies
* Maneuvers informed by real-time observation of adversary action
* Distributed decision-making connecting (perhaps onboard) sensor information and directing maneuver response
* Decision making informed by artificial intelligence (AI), particularly of the machine learning/deep learning type (ML/DL)
* Maneuvering decisions based on differential game theory.
* Possible total autonomy from human control after launch.

Exploitation of AI algorithms being developed for offensive deployment of, or defense against, UAV-borne weapons is encouraged. Development of sensing and communication technology would not be part of research.

PHASE I: Develop preliminary system design(s) with anticipated performance. Perform modeling, simulation and analysis (MS&A) and/or limited bench level testing to demonstrate the concept and an understanding of the technology. The proof of concept demonstration may be subscale and used in conjunction with MS&A results to verify scaling laws and feasibility.

PHASE II: Complete a critical design and demonstrate the use of the technology in a table top/brass board prototype. Evaluate the effectiveness of the technology. Perform MS&A and characterization testing within the financial and schedule constraints of the program to show the level of performance achieved. If brass board achieved, government can provide independent test and characterization. Develop a plan for Phase III product design, test and characterization.

PHASE III DUAL USE APPLICATIONS: Incorporate lessons-learned from the Phase II prototype into a product design and formulate how to Integrate into battle management. Work with government and/or government contractor to demonstrate product's performance improvement as compared to the state of the art. Work with government and/or government contractor to fully qualify the product for the intended application(s). Assist government and/or government contractor in integrating this product into a demonstrator system and assist with test and characterization.

REFERENCES:

1. Campbell, Adam. (2018). Enabling tactical autonomy for unmanned surface vehicles in defensive swarm engagements.;
2. Montalbano, Nicholas G., Humphreys, Todd E., "Intercepting Unmanned Aerial Vehicle Swarms with Neural-Network-Aided Game-Theoretic Target Assignment," 2020 IEEE/ION Position, Location and Navigation Symposium (PLANS), Portland, Oregon, April 2020, pp. 36-43.;
3. H. Duan, P. Li and Y. Yu, "A predator-prey particle swarm optimization approach to multiple UCAV air combat modeled by dynamic game theory," in IEEE/CAA Journal of Automatica Sinica, vol. 2, no. 1, pp. 11-18, 10 January 2015, doi: 10.1109/JAS.2015.7032901.;
4. Laura Strickland, Michael A. Day, Kevin DeMarco, Eric Squires, and Charles Pippin "Responding to unmanned aerial swarm saturation attacks with autonomous counter-swarms", Proc. SPIE 10635, Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR IX, 106350Y (4 May 2018); https://doi.org/10.1117/12.2305086.

KEYWORDS: AI; artificial intelligence; game theory; differential game theory; swarm; hypersonic; hypersonic defense; distributed decision making; peer-to-peer; ML/DL; machine learning; deep learning

MDA23-T003 TITLE: Coatings for Sharp Hypersonic Leading Edges

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: Develop robust oxidation resistant coatings for metals and/or composites to enable shape stable performance in extreme heat flux environments.

DESCRIPTION: Sharp leading edges and nose tips for hypersonic vehicles are beneficial because they enable low drag, but it is difficult to produce sharp leading edges that retain their shape throughout hypersonic flight due to rapid heating, oxidation, and aerodynamic forces. This topic seeks protective coating solutions that enable shape retention and prevent passage of oxygen at high transient heat fluxes, for tens of seconds. Coating solutions are sought for both metallic and composite substrates. Metallic substrates of interest include tungsten alloys (e.g. W-25Re), niobium alloys (e.g. C103), and molybdenum alloys (e.g. TZM - titanium-zirconium-molybdenum). Composite substrates of interest include carbon-carbon, carbon-silicon-carbide, and carbon-carbon-silicon-carbide. Solutions must provide the coating, but solutions may also include modifications to the substrate material and intermediate layers to improve coating interface. Novel coating solutions with functionally graded, structural compatibility and high interfacial characteristics are desired. Vertical integration of coat solution is desired but not required. If proposing glass forming coating solutions, analytical models and simulation tools to predict formed glass retention as a function of temperature and shear is desired. Proposals must provide a path to mature production capability. Mature production capability includes 100 leading edges per year throughput and <10% scrap rate.

PHASE I: Evaluate feasibility of proposed coating solution through analytical modeling and simulation, process modeling and/or proof of concept testing. Material formulation and/or coupon fabrication is recommended to provide evaluation of critical properties. Work with hypersonic system integrators to understand environments.

PHASE II: Continue material and process development through design, analysis, and experimentation. Optimize processing parameters for yield and quality. Scale process to facilitate coating of leading edge components representative of full-scale configurations, as agreed to by the government. Experimental validation techniques should simulate representative heat fluxes and pressures. Diagnostics and/or process modeling techniques should be utilized to ensure experimental evaluation approach is traceable to target environment. Demonstration in a representative environment is desired. Phase II should identify insertion opportunities, include cost/rate estimates and conclude with definition of a mature manufacturing process.

PHASE III DUAL USE APPLICATIONS: Work with a hypersonic system integrator to iteratively design and fabricate prototype components for high-fidelity testing in a relevant environment for current or future missile defense applications. A successful Phase III would provide the necessary technical data to transition the technology into a missile defense application.

REFERENCES:

1. https://doi.org/10.1016/j.compositesb.2021.109278;
2. https://doi.org/10.1016/j.surfcoat.2021.126913

KEYWORDS: Coatings; Leading Edges; Hypersonics; Materials; High Temperatures; Oxidation

MDA23-T004 TITLE: Solutions for Rapid Yaw Maneuvers for High L/D Hypersonic Vehicles

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: Develop solutions for rapid yaw maneuvers for high lift to drag (L/D) hypersonic glide vehicles.

DESCRIPTION: Hypersonic vehicles with non-axisymmetric lifting bodies may achieve L/D ratios around 4, which is significantly higher than finned vehicles with conical bodies, but may have slower yaw maneuver response times since bank to turn yaw maneuvers are slower than skid to turn maneuvers. This topic seeks solutions, such as innovative control surfaces and or hybrid configurations to decrease the time constant for maneuvers while maintaining the high L/D of the vehicle concepts. This topic does not seek a solution for any systems in development, but rather seeks to develop and demonstrate solutions that could be applied to future developments. Proposers should assume a glide vehicle with a non-conical geometry similar to the waveriders in reference 1 or the artistic representation of DARPA Falcon HTV-2 in reference 2. Proposers should provide their own geometry or the government may be able to provide a generic geometry after contract award. Design solutions should seek to minimize mass, volume, and drag impacts from control surfaces and/or other mechanisms. Designs should seek to enable time constant for all maneuvers comparable with time constants for finned conical vehicles. Proposers may assume a range of Mach numbers above Mach 5 and a range of altitudes up to 50km.

PHASE I: Basic studies on aerodynamic controls or other mechanisms. Could include modeling and/or limited wind tunnel assessment. Estimate maneuverability and kinetic energy loss for maneuvers at a range of Mach numbers and altitudes. Down select to 1 or 2 preferred designs.

PHASE II: Work with a missile defense system integrator to mature selected geometry and design. Obtain higher fidelity estimates of performance. Test in representative environment such as wind tunnel.

PHASE III DUAL USE APPLICATIONS: Work with system integrator to refine requirements and integrate into full guidance navigation and control system. Demonstrate technology in a representative environment. Transition Technology into missile defense application.

REFERENCES:

1. http://www.aerospaceweb.org/design/waverider/waverider.shtml;
2. https://www.darpa.mil/about-us/timeline/falcon-htv-2 (topics) Approved for Public Release 23-MDA-11365 (30 Jan 23)

KEYWORDS: Aerodynamic Control; Hypersonic; Maneuvers; Lifting Body

Office of the Undersecretary of Defense, Research and Engineering (OUSD(R&E))
Basic Research Office (BRO)
23.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

INTRODUCTION

The Office of the Undersecretary of Defense, Research and Engineering (OUSD(R&E)) Basic Research Office (BRO) STTR Program aims to facilitate the transition of basic research to applied research by collaborations between academic researchers and small businesses, as well as 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 (R&D) results. The BRO STTR program focuses on exploiting scientific discoveries from the DoD Basic Research Programs and providing a mechanism to further scientific development, maturation, and commercialization. **High-risk with potential for high-reward approaches are sought in addressing the scientific challenges described in the topics below**. These approaches should be stimulated by early research in academia supported by DoD basic research programs.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) 23.B STTR Program BAA.

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.

OSD BRO 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 OSD BRO STTR Program and these proposal preparation instructions should be directed to: Dr. Jennifer Becker, jennifer.j.becker.civ@army.mil

Phase I is to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted under the STTR Program. Proposals should concentrate on research or R&D that will significantly contribute to proving the scientific and technical feasibility and commercialization potential of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. **Phase I proposals should clearly articulate the basic research advances that will be exploited. Phase I proposals should also include a tentative plan for Phase II. Evaluation of the Phase I proposal will include an assessment of not only the feasibility studies planned for Phase I, but the overall approach and product proposed at the end of Phase II.** The BRO anticipates funding up to two (2) STTR Phase I contracts to small businesses with their research institution partner for each topic. The BRO reserves the right to not fund a topic if the proposals received have insufficient merit.

The Phase I Base amount must not exceed $150,000 over a period of exactly 6 months and the Phase I Option amount must not exceed $100,000, with a period of performance of exactly 6 additional months.

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 STTR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 15 pages and must follow the formatting requirements provided in the DoD STTR Program BAA. Technical volumes exceeding 15 pages will be deemed non-compliant and will not be evaluated**.**

Content of the Technical Volume

In addition to the Phase I proposal content specified in DoD STTR Program BAA, this program requires a narrative description on how early research in academic labs will be transitioned to the small business via this opportunity. In addition, the Phase I Technical Proposal must also include a preliminary Phase II Plan specifying the overall vision, approach, and potential product proposed at the end of Phase II. This must all be included within the 15 page limit for the technical volume.

Include, within the 15-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. Option tasks should be those tasks that would enable rapid transition from the Phase I feasibility effort into the Phase II prototype effort.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed $150,000 and the 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.

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by OSD BRO during proposal evaluations.

Supporting Documents (Volume 5)

BRO will only accept Supporting Documents required by the DoD STTR Program BAA.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. All Phase I awardees are eligible to submit a Phase II proposal. Please note that Phase II selections are based, in large part, on the success of the Phase I effort, so it is vital for small business concerns to discuss the Phase I project results with their BRO Technical Point of Contact (TPOC). The 30-day window to submit a Phase II proposal will commence at the end of the Phase I Base Period. The details on the due date, content, and submission requirements of the Phase II proposal will be provided to Phase I awardees by the BRO STTR PMO via subsequent notification. This will be the only opportunity to submit a Phase II proposal for the BRO topics. The BRO STTR Program *cannot* accept proposals outside the Phase II submission dates established. Proposals received by the DoD at any time other than the submission period will not be evaluated.

Phase II proposals are expected to be structured as follows: a 10-12 month base period not to exceed $850,000; a 10-12 month option period not to exceed $850,000. The entire Phase II effort should not exceed $1,700,000.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
Technical and Business Assistance is not offered for the OSD BRO topics.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD STTR Program BAA. The criteria will be in descending order of importance with technical merit, soundness, and innovation of the proposed approach being the most important, followed by qualifications of key personnel, and then followed by the commercialization potential. **Evaluation of the Phase I proposal will include an assessment of not only the feasibility studies planned for Phase I but the overall approach and product proposed at the end of Phase II.** Due to limited funding, the BRO reserves the right to limit awards under any topic. Awards will be made on the basis of technical evaluations using the criteria described in the DoD STTR Program BAA and availability of BRO STTR funds.

Only Government personnel will evaluate proposals with the exception of personnel from Strategic Analysis, Inc who will provide programmatic and administrative assistance for all topics.

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. Email notifications of selection or non-selection will be sent to the point-of-contact listed as the Corporate Official on the proposal Cover Sheet. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Requests for a debrief must be made within 30 calendar days of select/non-select notification as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 30 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.

Refer to the DoD STTR 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: usarmy.rtp.aro.mail.sttr-pmo@mail.mil

AWARD AND CONTRACT INFORMATION
The Phase I Base amount must not exceed $150,000 over a period of exactly 6 months and the Phase I Option amount must not exceed $100,000, with a period of performance of exactly 6 additional months.

ADDITIONAL INFORMATION
Companies should plan carefully for research involving animal or human subjects, biological agents, etc. (Reference details provided in the DoD STTR Program BAA). The short duration of a Phase I effort may preclude plans including these elements unless coordinated before a contract is awarded.

If the offeror proposes to employ a foreign national, refer to the DoD STTR Program BAA for definitions and reporting requirements. Please ensure no Privacy Act information is included in this submittal.

If a small business concern is selected for an STTR award, they must negotiate a written agreement between the small business and their selected research institution that allocates intellectual property rights

and rights to carry out follow-on research, development, or commercialization (See Model Agreement for the Allocation of Rights).

END

OSD-BRO STTR 23.B Topic Index

O23B-001 TITLE: Dispersion engineered electrically small antennas

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

OBJECTIVE: Design, fabricate, and demonstrate electrically small antennas with enhanced bandwidth going beyond the fundamental bounds dictated by Chu's limit. The proposed electrically small antennas should involve dispersion engineered matching loads using tailored dispersive materials or circuits that will allow tailoring the bandwidth independently from the stored energy in the system, resulting in electromagnetic radiation with higher data rates than conventional antennas. Dispersion engineering may be achieved through suitable electromagnetic design, metamaterial loading, and/or circuit loads implementing desirable frequency dispersion features. The final layout should include all relevant components to tune the antenna for operation beyond Chu's limit.

DESCRIPTION: The need for broader bandwidth in electrically small antennas is one of the most challenging tasks in the general area of antenna design for energy and information transfer, and it is of particular relevance to DoD in the low-frequency regime. Significant advances have been recently made in the realization of electrically small antennas operating close to Chu's lower bound on bandwidth, and theoretical proposals to overcome this bound have been put forward, with important opportunities for communication systems and energy harvesting. Chu's lower bound on the quality factor of linear, passive, time-invariant, one-port dipole antennas characterized by a single resonance dictates the maximum achievable bandwidth for given volume and efficiency. Recently it has been recognized that simple matching networks with dispersive materials can overcome these constraints and operate beyond Chu's lower bound. Dispersion engineering in the form of metamaterial loading, multiple coupled self-resonant modes and/or circuit loading relying on tailored loss and dispersion can be used to enhance the bandwidth of electrically small antennas beyond Chu's lower bound, still retaining a passive approach. Antennas can be loaded with passive matching networks, which so far have been used to extend the bandwidth by coupling multiple resonances together in order to operate close to the Bode-Fano bound on matching bandwidth. This approach, however, comes with several drawbacks, including introduced signal distortion within the impedance bandwidth, large and dispersive group delay, and inefficiencies associated with a large stored energy.

The goal of this STTR is to demonstrate passive electrically small antennas targeting the HF or UHF band supporting data rates beyond state-of-the-art antennas that approachChu's lower bound. The antennas should have a return loss of at least -6dB at the input port, with a radiation efficiency larger than 70%, an effective stored energy equal or lower than that based on operation with a single-resonant matching network, and a flat group delay across the enhanced bandwidth of operation. The demonstrated antenna should be low-profile, with or without a closely spaced ground plane.

PHASE I: In the Phase I effort, a complete design of a passive electrically small antenna operated beyond Chu's lower bound shall be demonstrated. Proof-of-principle simulations based on accepted methods and computational techniques shall be provided. Comparison of performance metrics to include the bandwidth anticipated by the proposer, efficiency, group delay, and stored energy with conventional approaches to impedance matching of small antennas, should be carried out.

PHASE II: In the Phase II effort, the experimental procedures outlined and begun in Phase I shall be realized, and the fabrication and full characterization of the radiation properties of the devices shall be reported. The radiation pattern as a function of frequency across the bandwidth proposed in Phase I shall be verified, clearly demonstrating the behavior proposed in Phase I. Demonstration of broadband response well beyond Chu's lower bound should be sought after. Comparison of performance metrics to include bandwidth, efficiency, group delay, and stored energy with conventional approaches to

impedance matching of small antennas, should be carried out in the experiments, and a demonstration of higher data rates in a standard communication setup should be pursued.

PHASE III DUAL USE APPLICATIONS: The Phase III work will demonstrate the reliability and scalability of the proposed antennas, their compact form factor including the matching network and feed, and their integrability in standard communication systems, including applying relevant modulation strategies for signal communications. A partnership with industry to commercialize the technology will be created, aiming for both DoD as well as scientific and civilian applications.

REFERENCES:

1. L. J. Chu, “Physical limitations of omni-directional antennas”, J. Appl. Phys. 19, pp. 1163-1175, 1948;
2. Yaghjian, Arthur D. "Overcoming the Chu lower bound on antenna Q with highly dispersive lossy material." IET Microwaves, Antennas & Propagation 12.4 (2018): 459-466;
3. Yaghjian, Arthur D., and Steven R. Best. "Impedance, bandwidth, and Q of antennas." IEEE Transactions on Antennas and Propagation 53.4 (2005): 1298-1324;
4. A. Mekawy, H. Li, Y. Ra’di, and A. Alù, "Parametric Enhancement of Radiation from Electrically Small Antennas," Physical Review Applied, vol. 15, no. 5, p. 054063, 05/27/ 2021

KEYWORDS: electrically small antennas; Chu’s limit; dispersion engineered

O23B-002 TITLE: Ultra-Compact Wideband Electro-Optic Modulator based on Ferroelectric Materials

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Quantum Science; Space Technology; Advanced Materials

OBJECTIVE: Develop a new ultra-compact, wideband, electro-optic modulator by exploiting ferroelectric materials for the purpose of radio frequency (RF) photonic link applications in DoD platforms.

DESCRIPTION: The replacement of the coaxial cable used in various onboard RF/analog applications with RF/analog fiber optic links requires ruggedized, high dynamic range and wideband electro-optic modulators. Current military communications and electronic warfare systems require ever increasing bandwidths while simultaneously requiring reductions in size, weight and power (SWaP). Replacement of the coaxial cabling would provide increased immunity to electromagnetic interference, reduction in size and weight, and an increase in bandwidth and power, however it requires an innovative modulator to complete the system. The ability to harness and control the electro-optic effect in a sub-micron-thick film of a ferroelectric could revolutionize optical switches used in Si photonics. To fully realize the tremendous potential of this novel concept, ferroelectric materials on silicon, which have the largest electro-optic coefficients known for a low loss material, show promise. Recent advances in film growth methods that allow for fabrication of ferroelectric transition metal oxides directly on Si created ground-breaking opportunities in silicon photonics, a hybrid technology combining semiconductor logic with optical information technologies.

The desired electro-optic modulators used in RF/analog fiber optic links must be compatible with distributed feedback (DFB) lasers with greater than 100 mWatts of single-mode fiber coupled optical power. These modulators in the future might have dual outputs for use with balanced photo detector receivers which would enable a higher link gain, a lower noise figure and a higher spur free dynamic range, as required in DoD systems. A minimum 3 dB optical bandwidth of up to 40 GHz is required, with V-pi less than 5V at 40GHz and below, and it must be compatible with emerging systems out to 100 GHz. A twofold reduction in SWaP requirements as compared to current electro-optic modulators must be achieved without any degradation in device performance. A future major challenge that must be analyzed is to develop a new compact modulator packaging approach that can achieve operation over a minimum temperature range of -40 to +120 degrees Celsius to avoid material specific phase transition, this will likely require active temperature controls to operate. This key criterion must be met without sacrificing modulator bandwidth and drive voltage efficiency, while demonstrating low optical insertion loss at fiber-coupled DFB laser powers up to 200 mWatts, and possibly higher in the future.

PHASE I: Develop a ferroelectric on silicon modulator fabrication process, demonstrate feasibility of the modulator with a supporting proof of principle bench top experiment, and analyze electro-optic modulator performance to meet the target metrics identified above.

PHASE II: Optimize the growth and processing techniques required for the modulator fabrication. Initially the modulators will likely be stand-alone devices but by the end of phase II a roadmap must be developed for transition to heterogeneous fabrication of integrated systems. At the end of phase II demonstration of greater than 2 square centimeters of high-quality single domain ferroelectric material must be attained, along with a demonstration of reliable fabrication processes for either fiber coupled or integrated modulators exceeding 3dB optical bandwidth at frequency 40GHz or higher and identification most pertinent direction and use of optical coefficients, i.e., r_{33} or r_{42}.

PHASE III DUAL USE APPLICATIONS: Perform extensive modulator reliability and durability testing. Develop packaging for both stand alone and integrated systems. Transition the demonstrated technology to Air platforms and interested commercial applications. The technology would find application in commercial systems such as fiber optic networks and telecommunications.

REFERENCES:

1. A. Rahim, A. Hermans, B. Wohlfeil, D. Petousi, B. Kuyken, D. Van Thourhout and R. Baetsa, “Taking silicon photonics modulators to a higher performance level: state-of-the-art and a review of new technologies,” Adv. Photonics 3, 024003 (2021);
2. S. Abel, F. Eltes, J. E. Ortmann, A. Messner, P. Castera, T. Wagner, D. Urbonas, A. Rosa, A. M. Gutierrez, D. Tulli, P. Ma, B. Baeuerle, A. Josten, W. Heni, D. Caimi, A. A. Demkov, J. Leuthold, P. Sanchis and J. Fompeyrine, “Large Pockels effect in micro- and nano-structured barium titanate integrated on silicon,” Nature Materials 18, 42 (2019);
3. C. Xiong, W. H. P. Pernice, J. H. Ngai, J. W. Reiner, D. Kumah, F. J. Walker, C. H. Ahn, and H. X. Tang, "Active Silicon Integrated Nanophotonics: Ferroelectric BaTiO3 Devices," Nano Letters 14, 1419 (2014).

KEYWORDS: Ultra-Wideband; Electro-Optic Modulator; Dual-Output; Extended Temperature Range; Analog Fiber Optic Links

O23B-003 TITLE: Advanced Metrology of High Thermal Conductivity Materials and Interfaces

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

OBJECTIVE: Develop a turnkey system to measure the thermal conductivity and thermal boundary resistance of wide bandgap semiconductor films, interfaces, and substrates.

DESCRIPTION: Future military platforms will require high-power converters for propulsion, sensors, and directed energy systems. The power densities for these converters necessitate high-voltage, high-efficiency power switches based on the application of wide bandgap (WBG) and ultra-wide bandgap (UWBG) semiconductor thin films, because of their wide bandgaps and high breakdown fields. An added benefit of these materials is their intrinsically large thermal conductivities, which can help to mitigate extreme temperature rises during power cycling and high-power operation. For example, isotopically pure diamond can have thermal conductivities of 3000 $W \cdot m^{-1} \cdot K^{-1}$, low defect AlN films were recently shown to have thermal conductivities over 300 $W \cdot m^{-1} \cdot K^{-1}$, and homoepitaxially grown GaN films can have thermal conductivities near 200 $W \cdot m^{-1} \cdot K^{-1}$. However, these large thermal conductivities are often not observed when WBG materials are integrated into power devices. It is well known that defects arising from material growth, interfaces from heterogeneous integration, and dopant species used to tune electrical properties all scatter phonons leading to reductions in thermal conductivity. The resultant reduced thermal conductivity, itself a temperature-dependent quantity, in integrated materials compromise high power devices and can lead to device failure and/or dictate lower max power thresholds. Given the large thermal resistances that occur at heterogeneous interfaces, especially at interfaces of WBG and UWBG materials, measurements of thermal boundary resistances in the 1-100 $m^2 \cdot K/GW$ range are similarly crucial to and predictive of reliable device operation.

The current state-of-the-art for laboratory measurements are thermoreflectance-based techniques that can measure the thermal conductivity of thin films with accuracy significantly higher than that available in commercial systems. Further, control of laser spot sizes these techniques allows for micron-scale spatial resolution of thermal conductivity on sample surfaces, which can reveal spatial inhomogeneities due to dislocations, defects, grain boundaries, and other growth-related phenomena. A major limiting factor in the use of these thermoreflectance techniques for wide scale materials characterization is their complicated, free space design on open optical tables that is not conducive to turnkey operation, even with a highly-skilled technician operating and aligning these systems full time. An additional limitation is the need for user-friendly and versatile instrument control software and analysis codes that can be widely used to acquire and analyze measurement data. The development of a reliable, repeatable, and fully automated tool that harnesses the sensitivities and resolution of free-space thermoreflectance systems is thus a key to establishing consistent and common measurements of materials for DoD applications. This necessitates a system design that does not require optical maintenance or alignment of laser paths to ensure day-to-day repeatability and accuracy when operated by different users. Such a tool would be of significant use for testing a wide array of materials for both military and civilian applications, including hybrid electric vehicles. Recent advances in fiber-optic-based thermoreflectance systems show promise to meet these requirements; however, any approach that has potential to achieve the desired measurement capabilities will be considered.

PHASE I: Establish design of a temperature-dependent (25-225 °C) thermal conductivity measurement system that can produce highly accurate (± 5%) and reproducible (± 1%) measurements of the thermal conductivity in both thin films and bulk substrates of wide bandgap semiconductors, as well as thermal boundary resistance in the 1-100 $m^2 \cdot K/GW$ range across semiconductor interfaces at the wafer scale. The system should have micrometer area resolution and depth resolution capable of measuring atomically thin interfaces/contacts to thin films and buried substrates with device relevant length scales. The system should be designed for ease and repeatability of measurements among multiple users. Demonstrate the

capability of measuring the thermal conductivity of materials ranging from 0.1 $W \cdot m^{-1} \cdot K^{-1}$ to 2000 $W \cdot m^{-1} \cdot K^{-1}$ through experimentation or detailed modeling. Perform an initial estimate of size, weight, and cost of production unit, as well as technical risks to be addressed during potential Phase II.

PHASE II: Refine Phase I design and fabricate a fully-functional prototype system having automated data collection and analysis capabilities. The system should be able to measure thermal conductivity of materials as high as 3000 $W \cdot m^{-1} \cdot K^{-1}$, measure thermal boundary resistance independently from thermal conductivity of materials, and resolve these properties and thermal resistances of thin film stacks with dimensions and temperatures appropriate for power electronic devices, as well as perform these measurements on an electronic device or test structure under nominal voltage and current operating conditions. Data reduction should be available in analysis codes with GUIs that can rapidly analyze large data sets. Deliver a fully operational prototype of the measurement system, including appropriate control and analysis software, to the Navy for evaluation.

PHASE III DUAL USE APPLICATIONS: Develop final design and manufacturing plans using the knowledge gained during Phases I and II in order to support transition of the technology for Navy use and adoption in the WBG/UWBG device community. A thermal conductivity measurement tool of this design will enable cost- and time-effective material evaluation of high-power devices.

REFERENCES:

1. D. G. Cahill, "Analysis of heat flow in layered structures for time-domain thermoreflectance," Review of Scientific Instruments 75, 5119-5122 (2004);
2. A. J.. Schmidt, R. Cheaito and M. Chiesa, "A frequency-domain thermoreflectance method for the characterization of thermal properties," Review of Scientific Instruments 80, 094901 (2009);
3. J. L. Braun, D. H. Olson, J. T. Gaskins and P. E. Hopkins, "A steady-state thermoreflectance method to measure thermal conductivity," Review of Scientific Instruments 90, 024905 (2019);
4. Naval Power and Energy System Technology Development Roadmap. https://www.navsea.navy.mil/Resources/NPES-Tech-Development-Roadmap/;
5. U. S. Drive Electrical and Electronics Technical Team Roadmap. https://www.energy.gov/eere/vehicles/downloads/us-drive-electrical-and-electronics-technical-team-roadmap

KEYWORDS: Thermal Conductivity; Thermal Boundary Resistance; Thermoreflectance; Wide Bandgap Semiconductors

VERSION 2

UNITED STATES SPECIAL OPERATIONS COMMAND
23.B Small Business Innovation Technology Transfer (STTR)
Phase I Proposal Submission Instructions

Join us for a virtual Q&A with our Technical Point of Contact
4 May 2023: SOCOM23B-001 at 3:00 EDT

INTRODUCTION
The United States Special Operations Command (USSOCOM) seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces through the Department of Defense (DoD) STTR 23.B Program Broad Agency Announcement (BAA).

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD STTR Program BAA. USSOCOM 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.

The Offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of these instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

The USSOCOM SBIR/STTR Program Office will be hosting a virtual USSOCOM Industry Day on 4 May 2023 to further specify requirements and stimulate small business/research institute partnership-building. Please visit https://events.sofwerx.org/sbir23-2_sttr23-b/ **register.**

PHASE I PROPOSAL GUIDELINES
The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be discarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD STTR Program BAA.
Proposal Volumes are key in the qualification of the proposal. Offerors shall complete each of the following volumes: (1) Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report, (5) Pitch Day Presentation, and (6) Fraud, Waste and Abuse Training.

Please Note:

1. It is the Offeror's responsibility to make sure all DoD and USSOCOM instructions are followed, and all required documents are submitted. The DSIP (DoD's SBIR/STTR proposal submission website)

does NOT ensure your submission is in accordance with both DoD and USSOCOM instructions. The DSIP notice "100% submitted" means that the upload process is complete; it does NOT mean the proposal submission complies with the stated instructions and that all required documents are successfully uploaded.

2. USSOCOM does not assist Offerors with proposal preparation nor does USSOCOM review proposals for completeness. We recommend you use your local and state resources for assistance. (See DoD Program BAA for resources information.)
3. USSOCOM has encountered issues while downloading proposals due to lengthy file names. The Offeror shall not use more than 20 characters to include spaces in any of the proposal documents titles.
4. **USSOCOM does NOT require a Government Letter of Support (LoS). Any Government LoS provided will deem the proposal to be non-responsive (Disqualified).**

Cover Page (Volume 1)
Volume 1 is created as part of the DoD Proposal Submissions process. Follow all instructions provided in the DoD STTR Program BAA and DSIP.

Technical Volume (Volume 2)
The Technical Volume is not to exceed (5) pages and must follow the formatting requirements provided in the DoD STTR Program BAA titled "DoD STTR 23.B Program BAA". USSOCOM will only evaluate the first (5) pages of the Technical Volume, additional pages will not be considered or evaluated.

Content of the Technical Volume:
Required items are specified in the DoD STTR Program BAA Phase I Format of Technical Volume instructions, reference https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/ then scroll to the bottom of the page and click on the tab titled "Supporting Documents and Attachments". At the bottom of the list, select the document titled "Phase I Technical (Vol 2) Sample Template".

Contract Data Requirement Lists (CDRLs): CDRLs identify which data products must be delivered by the contractor to the Government. Please make sure you read all required CDRLs requirements (each using a DD Form 1423-1) prior to developing your proposal. All five of the required Phase I CDRLs are available on https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.

Cost Volume (Volume 3)
The Phase I amount must not exceed $210,000.00. Costs must be identified on the Proposal Cover Sheet (Volume 1) and in Volume 3. Once the proposal is established in DSIP, the Offeror will have access to the required USSOCOM specific Cost Volume instructions and template.

A minimum of 40% of the research and/or analytical work in Phase I must be conducted by the proposing firm. A minimum of 30% of the research and/or analytical work must be conducted by a not-for-profit (typically an education institution or a laboratory). The percentage of work is measured by both direct and indirect costs as a percentage of the total contract cost.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. USSOCOM will not accept any deviation to the POW requirements on these Phase I topics.

VERSION 2

The cost volume template (volume 3 template) is located on DSIP and https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.

The identification of foreign national involvement in a USSOCOM STTR topic is needed to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 of the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined in section titled "Foreign Nationals" of the DoD STTR Program BAA) to work on a USSOCOM ITAR topic must possess an export license to receive a STTR Phase I contract.

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 STTR Program BAA for full details on this requirement. Information contained in the CCR will be considered by USSOCOM during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the documentation outlined in the DoD STTR Annual BAA, the following USSOCOM required documents must also be included with Volume 5: (1) PowerPoint presentation, (2) Section K, and (3) Resumes.

1. PowerPoint Presentation: Potential Offerors shall submit a slide deck **not to exceed 15 PowerPoint slides** (inclusive of the cover sheet). The presentation shall not have any videos or links to videos. There is no set format for this document. It is recommended (but not required) that more detailed information is included in the technical volume and higher-level information be included in the slide deck, suitable for a possible presentation. Refer to the "Phase I Evaluations" Section of this instruction for more details.
2. Section K - Titled "Representations, Certifications, and other statements of Offerors": If Section K is not submitted with the proposal, the proposal will still be considered responsive, but the completed Section K shall be required at the time of award. Section K is available at https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.
3. Resumes: Include resumes.

Fraud, Waste and Abuse Training (Volume 6)
Fraud, Waste and Abuse (FWA) training is required for Phase I proposals. Please refer to the DoD SBIR/STTR Program BAA instructions for full details.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
USSOCOM does not provide Discretionary Technical and Business Assistance for Phase I awards.

INQUIRIES:
USSOCOM does not allow direct communication with the topic authors (differs from the DoD STTR/STTR Program BAA instructions).

During the Pre-Release and Open Periods of the DoD STTR Program BAA, only and all technical questions that enhance the Offerors understanding of the topic's requirements must be submitted to the online Defense SBIR/STTR Innovation Portal (DSIP) Topic Q&A. All questions and answers submitted to DSIP Topic Q&A will be released to the general public.

VERSION 2

USSOCOM does NOT allow inquirers to communicate directly in any manner to the topic authors (differs from the DoD STTR Program BAA instructions). Only questions pertaining to the proposal preparation instructions should be directed to: sbir@socom.mil. All inquiries must include the topic number in the subject line of the e-mail.
Consistent with DoD STTR instructions, USSOCOM will not answer programmatic questions, such as who the technical point of contact is, the number of contracts to be awarded, the source of funding, transition strategy.

Physical site visits will not be permitted during the Pre-release and Open Periods of the DoD STTR Program BAA.

EVALUATION AND SELECTION
All Offerors will be evaluated in accordance with the evaluation criteria listed in the DoD STTR Program BAA, with the following exceptions:

1. Proposals missing any of the six stated volumes, or those that do not comply with the requirement that 40% of the work is to be executed by the proposing firm and 30% of the work is to be executed by one partnering nonprofit research institution (as stated in Volume 3) of the work conducted by the proposing firm or those proposals that exceed the maximum price allowed as per Table 1 of these instructions will be considered non-responsive. Non-responsive proposals will not be evaluated.
2. The technical evaluation will utilize the Evaluation Criteria provided in DoD STTR Program BAA instructions. The Technical Volume and PowerPoint Presentation slide deck will be reviewed holistically.

   The technical evaluation is performed in two parts:

   Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in the DoD STTR Program BAA. Once the evaluations are complete, all Offerors will be notified in a timely manner.
   Part II: Selected offerors **may** receive an invitation to present their slide deck (30-minute presentation time/30-minute Government question and answer period) to the USSOCOM technical evaluation team, using virtual teleconference. This will be a technical presentation of the proposed solution **ONLY**. The key personnel listed in the proposal should represent the presentation and responding to the questions of the evaluation team. This presentation is NOT intended for business development personnel, it is purely technical. Selected offerors shall restrict their Pitch Day presentations to the 15-page PowerPoint presentation submitted with the respective proposals. There will be no changes or updates to the presentations from what was proposed. This presentation will complete the evaluation of the proposal against the criteria listed in the DoD STTR Program BAA.

3. The Cost Volume (Volume 3) evaluation:
   For this Phase I, the award amount is set at a not to exceed (NTE) amount and a technical evaluation of the proposal cost will be completed to assess price fair and reasonableness. The team will assess the technical approach presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, subcontractors, and consultants (scope of work, expertise, participation, and proposed effort), and other direct cost as proposed.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. When appropriate, non-Government advisors may have access to Offeror's proposals and may be utilized to objectively review a proposal in a particular functional area and provide comments and recommendations to the Government's decision makers. They may not establish final assessments of risk, or rate or rank Offerors' proposals. All advisors shall comply with procurement Integrity Laws and shall sign Non-Disclosure and Rules of Conduct/Conflict of Interest statements. The Government shall take into consideration requirements for avoiding conflicts of interest. Submission of a proposal in response to this request constitutes approval to release the proposal to Government support contractors.

Offerors will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of this BAA topic by the USSOCOM Contracting Office. This notification will come by e-mail to the Corporate Official identified by the Offeror during proposal submission. The Government will also notify the Offerors if their proposal is considered non-responsive (disqualified).

A non-selected Offeror can make a written request to the Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The Contracting Officer will provide informal feedback after receipt of an Offeror's written request rather than a debriefing as specified in the DoD STTR Program BAA instructions.

Refer to the DoD STTR Annual BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: sbir@socom.mil.

PATH TO PHASE II

Phase II proposals may only be submitted by Phase I awardees. In the event that the Phase II of a topic is cancelled, Phase I awardees will be informed by USSOCOM and Phase II proposals will not be accepted. To obtain the Phase II requirements, refer to the Contract Data Requirements List (CDRL) A004. The Final Report will be due on or before 6 months of the start of the Period of Performance (PoP) In Accordance With (IAW) CDRL A003. Your Phase II proposal will be due on or before the 195th day of the start of the PoP IAW CDRL A005.

All CDRLs are available on https://www.socom.mil/SOF-ATL/Pages/sbir.aspx. There are two different attachments for CDRL 5. Please refer to the section titled "Award and Contract Information" for the contracting path pertaining to the topic.

The Government reserves the right to issue any of the following type of awards for Phase II:

I. FAR type contract
II. Non-FAR based fixed price (level of effort type):
    a. Other Transactions Agreements (OTA). Successful completion of the prototype under an OTA may result in a follow-on production OTA or contract. Successful completion of the prototype is defined as meeting one or more threshold requirements.

VERSION 2

AWARD AND CONTRACT INFORMATION

Table 1: Consolidated STTR Topic Information

Topic	Technical Volume (Vol 2)	Additional Info. (Vol 5)	Period of Performance	Award Amount	Contract Type
Phase I SOCOM23B-001	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 7 months	NTE $210,000.00	Firm-Fixed-Price

The Government will conduct evaluations and selections for STTR Phase I topic award(s) listed in this BAA. SOCOM23B-001 awards will be made by USSOCOM STTR Contracting Officer.

ADDITIONAL INFORMATION

Phase I proposals shall NOT include:

1) Any travel for Government meetings. All meetings with the Government will be conducted via electronic media.
2) Government furnished property or equipment.
3) Priced or Unpriced Options.
4) "Basic Research" (or "Fundamental Research") defined as a "Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind."
5) Discretionary Technical and Business Assistance (TABA)
6) Letters of Support

VERSION 2

SOCOM STTR 23.B Topic Index

SOCOM23B-001 TITLE: AI/ML Aided Aviation Sensors for Cognitive and Decision Optimization

VERSION 2

SOCOM23B-001 TITLE: AI/ML Aided Aviation Sensors for Cognitive and Decision Optimization

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation. Additionally, Offerors will describe compliance mechanisms offerors have in place or will put in place to address any ITAR issues that arise during the course of agreement administration.

OBJECTIVE: Over the course of the last forty years aircraft have developed, acquired, and fielded sensor systems that span the electromagnetic spectrum (for example: Ultraviolet, Electro-Optics, Infra-Red, Radio Frequency). Historically, each system addressed a unique problem, and consequently was developed and manufactured by a distinct Original Equipment Manufacturer to address the corresponding requirement. While successfully accomplishing their siloed objectives, the data and information generated from these systems have yet to be leveraged by advances in Artificial Intelligence (AI) and Machine Learning (ML), particularly in Deep Learning sub-fields such as Computer Vision and Recommendation Systems. As a result, aviators today are inundated with unstructured data that prohibits the operator to make the final decision on how and when to use the information presented, and correspondingly inhibits peak performance. The objective of this topic is to develop applied research toward an innovative capability to deploy AI/ML to the edge of aircraft and their corresponding systems to enable a wave of new capabilities that increase lethality, safety, and mission effectiveness, while at the same time leveraging the large capital investments in already fielded suites of sensors.

IMPORTANT: For SOCOM instructions: please visit: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/. Go to the bottom of the page and click the “DoD STTR 23.B” tab. Once there, go to the SOCOM STTR 23.B document.

DESCRIPTION: There are several key innovative tasks required for this approach: The first is the establishment of the compute environment with host operating system necessary to enable the second key task, a Docker like platform where discrete sensor and data streams can be made modular and open source, to finally feed into the third task, tailorable AI/ML algorithms that leverage discrete streams of data into actionable information. As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications on the key system attributes.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”

The objective of this USSOCOM Phase I STTR effort is to conduct and document the results of a thorough feasibility study (“Technology Readiness Level 3”) to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I STTR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM STTR funds during Phase I feasibility studies. Operational prototypes developed with other than STTR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

VERSION 2

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on the application of AI/ML techniques for Aviation Sensors in order to optimize cognitive function and decision aiding.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where legacy sensor systems have been developed, but can be enhanced through the application of AI/ML. Examples include the fusion and analysis of multiple sensor inputs to enhance and analyze safer vehicle traffic on roadways; cognitive aiding through the application of AI/ML for sensor data fusion in commercial aviation, and enhanced aerial surveillance and analysis of terrain for the purposes of managing deforestation, smart farming, or forest fire prevention.

REFERENCES:

1. **Army Pursues Sensor-Related Artificial Intelligence Effort, 18 November 2022, https://www.afcea.org/signal-media/defense-operations/army-pursues-sensor-related-artificial-intelligence-effort**
2. **How can AI/ML improve sensor fusion performance? https://www.sensortips.com/featured/how-can-ai-ml-improve-sensor-fusion-performance-faq/**
3. **AI: how it's delivering sharper route planning, https://aerospaceamerica.aiaa.org/features/ai-how-its-delivering-sharper-route-planning/**

KEYWORDS: Artificial Intelligence; Machine Learning; automation; synthetic data generation; data labeling; computer vision; deep learning; decision aiding, target recognition