

AMENDMENT 2

DEPARTMENT OF DEFENSE SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM STTR 24.A Program Broad Agency Announcement (BAA)

November 29, 2023: DoD BAA issued for pre-release

January 03, 2024: DoD begins accepting proposals

February 21, 2024: Deadline for receipt of proposals no later than **12:00 p.m. ET**

The purpose of Amendment 2 is to:

- 1. Extend the deadline for proposal receipt to February 21 2024 at 12:00 PM ET**

Participating DoD Components:

- Department of Navy (Navy)
- Department of Air Force (Air Force)
- Defense Microelectronics Activity (DMEA)

IMPORTANT

This BAA incorporates **MANDATORY** foreign disclosure requirements and other important programmatic changes as required by the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). These updates can be found in sections 2.2, 2.5, 3.0, 4.2.e., 4.3, 6.0, 8.2, and Attachment 2. **Proposals that do not include the fully completed and signed Attachment 2 of this BAA (labeled Version 2) in Volume 5 of the proposal submission will be deemed noncompliant and will not receive an evaluation. All**

small business concern/proposal identifying information and a response to every question on the form MUST be provided. Small business concerns are highly encouraged to review the full BAA to remain apprised of any additional recent programmatic changes.

Deadline for Receipt: Complete proposals must be certified and submitted in DSIP no later than **12:00 PM ET on February 21, 2024**. Proposals submitted after 12:00 p.m. ET will not be evaluated. The final proposal submission includes successful completion of all firm level forms, all required volumes, and electronic corporate official certification. Please plan to submit proposals as early as possible in order to avoid unexpected delays due to high volume of traffic during the final hours before the BAA close. DoD is not responsible for missed proposal submission due to system latency.

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

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. Proposing Small Business Concerns are required to register for a Login.gov account and link it to their DSIP account. See section 4.16 for more information regarding registration.

The Small Business Administration (SBA), through its SBIR/STTR Policy Directive, purposely departs from normal Government solicitation formats and requirements, thus authorizing agencies to simplify the SBIR/STTR award process and minimize the regulatory burden on small business. Therefore, consistent with the SBA SBIR/STTR Policy Directive, the Department of Defense is soliciting proposals as a Broad Agency Announcement (BAA). The DoD SBIR/STTR Programs follow the policies and practices of the SBA SBIR/STTR Policy Directive, current version. The guidelines presented in this BAA incorporate and make use of the flexibility of the SBA SBIR/STTR Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to the DoD and the private sector. The SBIR/STTR Policy Directive is available [HERE](#).

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

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

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1.0 INTRODUCTION

Navy, Air Force and DMEA, 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 Policy Directive was revised effective May 3, 2023, to incorporate requirements of the SBIR and STTR Extension Act of 2022. This revision is incorporated into this BAA, including the utilization of the Appendix III, Disclosure Questions, as

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Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries”.

Small business concerns must submit Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)” of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns’ disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal.**

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

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

1. Go to projectspectrum.io
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.

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2.3 OUSD(R&E) Critical Technology Areas

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

OUSD(R&E) Critical Technology Areas:

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

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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.

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

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than 30% of the work is performed by the single research institution. For purposes of the SBIR Program, this refers to work conducted by a research institution as a subcontractor to the small business concern. At least two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing small business concern.

Covered Individual

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

Essentially Equivalent Work

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

Export Control

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

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

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foreign country of concern.

Foreign Country of Concern

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

Foreign Entity

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

Foreign Government

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

Foreign Nationals

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

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

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

Fraud, Waste and Abuse

- a. **Fraud** includes any false representation about a material fact or any intentional deception designed to deprive the United States unlawfully of something of value or to secure from the

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United States a benefit, privilege, allowance, or consideration to which an individual or business is not entitled.

- b. **Waste** includes extravagant, careless or needless expenditure of Government funds, or the consumption of Government property, that results from deficient practices, systems, controls, or decisions.
- c. **Abuse** includes any intentional or improper use of Government resources, such as misuse of rank, position, or authority or resources.
- d. The SBIR Program training related to Fraud, Waste and Abuse is available at: <https://www.sbir.gov/tutorials/fraud-waste-abuse/tutorial-1>. See Section 4.17 for reporting Fraud, Waste and Abuse.

Funding Agreement

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

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

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

Certified HUBZone Small Business Concern

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

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

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- 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-

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

Proprietary Information

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

Research Institution

Any organization located in the United States that is:

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

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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.

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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.

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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.

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- 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 submit Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)” of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns’ disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal.**

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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.

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

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

4.6 Conflicts of Interest

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

4.7 Organizational Conflicts of Interest (OCI)

FAR 9.5 Requirements

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

Agency Supplemental OCI Policy

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

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

- The name of the DoD Component office receiving the support;
- The prime contract number;
- Identification of proposed team member (sub-awardee, consultant) providing the support;

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- 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.

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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.

Protests exclusively related to the terms of this BAA must be served to:

osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil

For the purposes of a protest related to a particular topic selection, non-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.

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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.

Size protests regarding the small business status of a selected proposing small business concern may be made to the Small Business Administration in accordance with the procedures in FAR § 19.302.

4.14 Phase I Award Information

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

- a. **Number of Phase I Awards.** The number of Phase I awards will be consistent with the Component's RDT&E budget. No Phase I contracts will be awarded until evaluation of all qualified proposals for a specific topic is completed.
- b. **Type of Funding Agreement.** Each Phase I proposal selected for negotiation and possible award will be funded under negotiated contracts or purchase orders and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making proposing small business concerns for R/R&D work. Firm-Fixed-Price, Firm-Fixed-Price Level of Effort, Labor Hour, Time & Material, or Cost-Plus-Fixed-Fee type contracts can be negotiated and are at the discretion of the Component Contracting Officer.
- c. **Dollar Value.** The Phase I contract value varies among the DoD Components; it is important for proposing small business concerns to review Component-specific instructions regarding award size.
- d. **Timing.** Proposing small business concerns will be notified of selection or non-selection status for a Phase I award by the DoD Component that originated the topic within 90 days of the closing date for this BAA. Please refer to the Component-specific instructions for details.

The SBA SBIR/STTR Policy Directive, Section 7(c)(1)(ii), states that agencies should issue the Phase I award no more than 180 days after the closing date of the BAA. Across DoD, the median time between the date that the 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

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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.

- 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.
- Direct Contact with Topic Authors.** From **November 29, 2023 – January 03, 2024**, 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.
- Topic Q&A.** Once DoD begins accepting proposals on **January 03, 2024**, no further direct contact between proposing small business concerns and topic authors is allowed unless the Topic Author is responding to a question submitted during the pre-release period. Proposing small business concerns may submit written questions through Topic Q&A at <https://www.dodsbirsttr.mil/submissions/login>.

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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 **November 29, 2023**, and closes to new questions on **January 24, 2024, 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.

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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 negotiation for contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible. See Section 5.3.c(11).

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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 (TAB A)

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

5.0 PHASE I PROPOSAL

5.1 Introduction

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

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

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

DSIP provides a structure for providing the following proposal volumes:

Volume 1: Proposal Cover Sheet

Volume 2: Technical Volume

Volume 3: Cost Volume

Volume 4: Company Commercialization Report

Volume 5: Supporting Documents

- a. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1) MANDATORY
- b. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) MANDATORY
- c. Verification of Eligibility of Small Business Joint Ventures (Attachment 3), if applicable
- d. Disclosure of Funding Sources (Attachment 4) MANDATORY
- e. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

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

Volume 6: Fraud, Waste and Abuse Training

All proposing small business concerns must complete the following:

- Volume 4: Company Commercialization Report (upload of CCR from SBIR.gov to DSIP is required for proposing small business concerns with prior Federal SBIR or STTR awards)
- Volume 5(a): Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
- Volume 5(b): Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
- Volume 5(c): Disclosure of Funding Sources (Attachment 4)
- Volume 6: Fraud, Waste and Abuse training.

DO NOT lock, password protect, or encrypt any files uploaded to DSIP.

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>.

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

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

5.2 Marking Proprietary Proposal Information

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

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

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

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

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

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

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

5.3 Phase I Proposal Instructions

a. Proposal Cover Sheet (Volume 1)

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

The Cover Sheet must include a brief technical abstract that describes the proposed R&D project and a discussion of anticipated benefits and potential commercial applications. Each section should be no more than 200 words. **Do not include proprietary or classified information in the Proposal Cover Sheet.** If your proposal is selected for negotiation and

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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

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product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

- b. This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. If Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all the proper approvals have been obtained (see Sections 4.9 - 4.11). **Small Business Concerns proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**
- (4) **Related Work.** Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing small business concern, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposing small business concern's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:
- a. Short description,
 - b. Client for which work was performed (including individual to be contacted and phone number), and
 - c. Date of completion.
- (5) **Relationship with Future Research or Research and Development**
- a. State the anticipated results of the proposed approach if the project is successful.
 - b. Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.
 - c. Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.
- (6) **Commercialization Strategy.** Describe in approximately one page your proposing small business concern's strategy for commercializing this technology in DoD, other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this 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.

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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. The proposal may be deemed nonresponsive if the requested information is not provided. The proposing small business concerns should report all individuals expected to be involved on this project that are considered a foreign national as defined in Section 3 of the BAA. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a 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 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:
- 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.
 - Date of proposal submission or date of award.
 - Title of proposal.
 - Name and title of principal investigator for each proposal submitted or award received.
 - 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.
 - If award was received, state contract number.
 - 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."

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d. Content of the Cost Volume (Volume 3)

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

- (1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
- (2) While special tooling and test equipment and material cost may be included under Phases I, the inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Component Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.
- (3) Cost for travel funds must be justified and related to the needs of the project.
- (4) Cost sharing is permitted for proposals under this BAA; cost sharing is not required, nor will it be an evaluation factor in the consideration of a Phase I proposal.
- (5) A Phase I Option (if applicable) should be fully costed separately from the Phase I (base) approach.
- (6) All subcontractor costs and consultant costs, such as labor, travel, equipment, materials, must be detailed at the same level as prime contractor costs. Provide detailed substantiation of subcontractor costs in your cost proposal. Volume 5, Supporting Documents, may be used if additional space is needed.

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

e. Company Commercialization Report (Volume 4)

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

Te 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

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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.

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- If no file dialog box is present at the bottom of the page that is an indication that **there is no previously uploaded CCR in the DSIP Firm Forms**. To fulfill the DSIP CCR requirement the Firm Admin must follow steps 1-5 listed above to download a PDF of the CCR from SBIR.gov and upload it to the DSIP Firm Forms to be included with all proposal submissions.
- c. If the proposing small business concern has **NO** prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, the upload of the CCR from SBIR.gov is not required and small business concern will select NO. The CCR section of the proposal will be marked complete.

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

f. Supporting Documents (Volume 5)

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

All proposing small business concerns are **REQUIRED** to submit the following documents to Volume 5:

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

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

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

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights
7. Verification of Eligibility of Small Business Joint Ventures (Attachment 3)
8. Other

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

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

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

The effort to complete the required certification clauses includes the proposing small business concern and any contractors that may be proposed as a part of the submission including research partners and suppliers. The proposing small business concerns are strongly encouraged to review the requirements of these certifications early in the proposal development process. Failure to submit or complete the required certifications as a part of the proposal submission process may be cause for rejection of the proposal submission without evaluation.

h. Disclosures of Foreign Affiliations or Relationships to Foreign Countries

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022 and the SBA SBIR/STTR Policy Directive, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award.

Small business concerns must submit Attachment 2 "Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Version 2)" of this BAA in Volume 5 of the proposal submission. Previous versions of Attachment 2 or versions created by other Federal agencies will not be accepted. All small business concern identifying information requested in Attachment 2 must be provided and all questions must be answered. Attachment 2 must also be signed, certifying that information provided is accurate and complete. The Government may require the proposing small business concerns to provide additional information to assist the Government in evaluating the small business concerns' disclosures in Attachment 2.

Small business concerns who: 1) fail to submit Attachment 2 in Volume 5 of the proposal submission; 2) do not use Attachment 2, version 2, as provided in this BAA; 3) do not provide their complete identifying information or do not completely answer all questions in Attachment 2; 4) fail to provide the Government additional information regarding Attachment 2 when requested; or, 5) fail to sign Attachment 2, **will be deemed noncompliant and will not receive an evaluation of their proposal.** DO NOT lock, password protect or encrypt the form when uploading to Volume 5 in DSIP.

For additional details, please refer to Section 2.2 and 4.3.

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i. Certification Regarding Disclosure of Funding Sources

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

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

Small business concerns must also certify that each covered individual who is employed by the small business and listed on the proposal has been made aware of the requirements listed above. **The disclosure and certification must be made by completing Attachment 4 of this BAA and uploading to Volume 5, Supporting Documents of the proposal submission in DSIP.**

j. Fraud, Waste and Abuse Training (Volume 6)

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

6.0 PHASE I EVALUATION CRITERIA

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

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

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

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

Denial of Awards

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

- (A) the small business concern submitting the proposal –
 - (i) has an owner or covered individual that is party to a malign foreign talent recruitment program;
 - (ii) has a business entity, parent company, or subsidiary located in the People’s Republic of China or another foreign country of concern; or
 - (iii) has an owner or covered individual that has a foreign affiliation with a foreign entity located in the People’s Republic of China or another foreign country of concern; and
- (B) the relationships and commitments described in clauses (i) through (iii) of subparagraph (A)—
 - (i) interfere with the capacity for activities supported by the DoD to be carried out;
 - (ii) create duplication with activities supported by the DoD;
 - (iii) present concerns about conflicts of interest;
 - (iv) were not appropriately disclosed to the DoD;
 - (v) violate Federal law or terms and conditions of contracts or other agreements awarded by the DoD; or
 - (vi) pose a risk to national security.

7.0 PHASE II PROPOSAL INFORMATION

7.1 Introduction

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

7.2 Proposal Provisions

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

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

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

7.3 Commercialization Strategy

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

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

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

7.4 Phase II Evaluation Criteria

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

7.5 Phase II Award Information

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

7.6 Adequate Accounting System

To reduce risk to the small business and avoid potential contracting delays, companies interested in pursuing Phase II SBIR contracts and other contracts of similar size with the Department of Defense (DoD), have an adequate accounting system per General Accepted Accounting Principles (GAAP), Generally Accepted Government Auditing Standards (GAGAS), Federal Acquisition Regulation (FAR) and Cost Accounting Standards (CAS) in place. The accounting system will be audited by the Defense

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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.

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.

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- d. **Default.** The Government may terminate the contract if the contractor fails to perform the work contracted.
- e. **Termination for Convenience.** The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.
- f. **Disputes.** Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.
- g. **Contract Work Hours.** The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (receives overtime pay).
- h. **Equal Opportunity.** The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
- i. **Affirmative Action for Veterans.** The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran.
- j. **Affirmative Action for Handicapped.** The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
- k. **Officials Not to Benefit.** No member of or delegate to Congress shall benefit from the contract.
- l. **Covenant Against Contingent Fees.** No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.
- m. **Gratuities.** The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.
- n. **Patent Infringement.** The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
- o. **Military Security Requirements.** The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.
- p. **American Made Equipment and Products.** When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.

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

- q. **Unique Identification (UID).** If your proposal identifies hardware that will be delivered to the government, be aware of the possible requirement for unique item identification in accordance with DFARS 252.211-7003.
- r. **Disclosure of Information.** In accordance with FAR 252.204-7000, Government review and approval will be required prior to any dissemination or publication, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract except within and between the Contractor and any subcontractors, of unclassified and non-fundamental information developed under this contract or contained in the reports to be furnished pursuant to this contract.
- s. **Animal Welfare.** Contracts involving research, development, test, evaluation, or training on vertebrate animals will incorporate DFARS clause 252.235-7002.
- t. **Protection of Human Subjects.** Effective 29 July 2009, contracts that include or may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02 and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b), will incorporate DFARS clause 252.235-7004.
- u. **E-Verify.** Contracts exceeding the simplified acquisition threshold may include the FAR clause 52.222-54 "Employment Eligibility Verification" unless exempted by the conditions listed at FAR 22.2803.

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- v. **ITAR.** In accordance with DFARS 225.7901-4, Export Control Contract Clauses, the clause found at DFARS 252.225-7048, Export-Controlled Items (June 2013), must be included in all BAAs/solicitations and contracts. All awards resulting from this BAA will include DFARS 252.225-7048. Full text of the clause may be found at <https://www.govinfo.gov/content/pkg/CFR-2013-title48-vol3/pdf/CFR-2013-title48-vol3-sec252-225-7048.pdf>.
- w. **Cybersecurity.** Any small business concern receiving an SBIR/STTR award is required to provide adequate cybersecurity on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. To learn about cybersecurity resources for your SBIR/STTR contract visit the Blue Cyber webpage: <https://www.safcn.af.mil/CISO/Small-Business-Cybersecurity-Information/>.
- x. **Safeguarding Covered Defense Information Controls.** As prescribed in DFARS 252.204-7008, for covered contractor information systems that are not part of an information technology service or system operated on behalf of the Government, the SBC represents that it will implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, “Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations”.
- y. **Limitations on the Use or Disclosure of Third- Party Contractor Reported Cyber Incident Information.** As required in DFARS 252.204-7009, the Contractor must agree that certain conditions apply to any information it receives or creates in the performance of a resulting contract that is information obtained from a third-party's reporting of a cyber incident pursuant to DFARS clause 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting (or derived from such information obtained under that clause).
- z. **Notice of NIST SP 800-171 DoD Assessment Requirements.** As prescribed by DFARS 252.204-7019, in order to be considered for award, the SBC is required to implement NIST SP 800-171. The SBC shall have a current assessment (see 252.204-7020) for each covered contractor information system that is relevant to the offer, contract, task order, or delivery order. The Basic, Medium, and High NIST SP 800-171 DoD Assessments are described in the NIST SP 800-171 DoD Assessment Methodology located at https://www.acq.osd.mil/dpap/pdi/cyber/strategically_assessing_contractor_implementation_of_NIST_SP_800-171.html. 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

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- 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

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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.

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(End of clause)

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

DFARS 252.225-7055, Representation Regarding Business Operations with the Maduro Regime, is incorporated into this solicitation. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from entering into a contract for the procurement of products or services with any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the United States Government, unless the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

8.5 Copyrights

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

8.6 Patents

Small business concerns normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 U.S.C. § 205, the Government will not make public any information disclosing a Government-supported invention for a period of five years to allow the awardee to pursue a patent. See also Section 8.7, Invention Reporting.

8.7 Invention Reporting

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

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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

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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.

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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.

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(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:

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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.

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“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.

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(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
(Version 2)**

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. Small business concerns who: 1) fail to submit this form in Volume 5 of the Defense SBIR/STTR Innovation Portal (DSIP) proposal submission; 2) do not use this form, version 2, as provided herein; 3) do not provide their complete identifying information in the table below or do not completely answer all questions in this form; 4) fail to provide the Government additional information regarding this form when requested; or, 5) fail to sign this form, **will be deemed noncompliant and will not receive an evaluation of their proposal**. DO NOT lock, password protect or encrypt this form when uploading to Volume 5 in DSIP.

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	

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.

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

AMENDMENT 2

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

AMENDMENT 2

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-

(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,

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- 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).

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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

AMENDMENT 2

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-

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(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.

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(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)

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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: _____

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☐ 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:	

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[Additional space as needed]

**DEPARTMENT OF THE NAVY (DON)
24.A Small Business Technology Transfer (STTR)
Proposal Submission Instructions**

IMPORTANT

- **The following instructions apply to STTR topics only:**
 - N24A-T001 through N24A-T024
- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
 - The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Select the tab for the appropriate BAA cycle.
 - Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.
- The information provided in the DON Proposal Submission Instructions document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).
- **DON Phase I Technical Volume (Volume 2) page limit is not to exceed 10 pages.**
- 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.

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	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-

		sttr@us.navy.mil or appropriate Program Manager listed in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (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

<u>Topic Numbers</u>	<u>Point of Contact</u>	<u>SYSCOM</u>	<u>Email</u>
N24A-T001 to N24A-T006	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N24A-T007 to N24A-T009	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil
N24A-T010 to N24A-T024	Mr. Steve Sullivan	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@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. Proposals that are

encrypted, password protected, or otherwise locked in any portion of the submission will be REJECTED unless specifically directed within the text of the topic to which you are submitting. 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)
- Cost Sharing: Cost sharing is not accepted on DON Phase I proposals.
- Additional information:
 - Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.
 - Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
 - The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).
- **Company Commercialization Report (Volume 4).** DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.
- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

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

- **Telecommunications Equipment Certification.** Required for all proposing small business concerns. The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As such, all proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume

5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.
- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, “Disclosures of Foreign Affiliations or Relationships to Foreign Countries” and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
 - ☐ Program Description
 - ☐ Proposal Fundamentals
 - ☐ Phase I Proposal
 - ☐ Attachment 2
 - **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
 - ☐ Phase I Proposal
 - ☐ Attachment 4
- 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. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

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

- Not to exceed 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. The Due Diligence Program to Assess Security Risks will be implemented for all Phases.

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 indirect costs, 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. A small business concern selected for an award MUST have an active SAM registration at the time of award or they will be considered ineligible.

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

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposing small business 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.

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 (as stated in the BAA). The Phase I Final Report and Initial Phase II Proposal will be used to evaluate the small business concern's potential to progress to a workable prototype in Phase II and transition the technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

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

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

PHASE III GUIDELINES

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

Navy STTR 24.A Topic Index

N24A-T001	High-Bandwidth Multimode Fiber-Optic Cabling
N24A-T002	In-situ AM-2 Aluminum Mat Repair
N24A-T003	High-Frequency 40 GB/s MWIR and LWIR Metamaterials-based Electro-Optical Modulators for Free-Space Optical Communications
N24A-T004	Automated Performance Monitoring for Rotorcraft Turboshift Engines Using a Multimodel Approach
N24A-T005	Real-time Computational Enhancement of Video Streams
N24A-T006	Manufacturing Method Development of Nanocomposite Steel Wire for Arresting Gear Purchase Cable
N24A-T007	Integrated Environmental Model System for Platform Situational Awareness
N24A-T008	Kilowatt Class Stimulated Brillouin Scattering Reduced Hollow-Core Fiber (HCF) Dip Loop Cable Assembly
N24A-T009	Smart Exhaust Waste Heat Recovery Unit (SEWHRU)
N24A-T010	Subminiature Digital Pitot-static Sensor (SDPSS)
N24A-T011	Corrosion Modeling Analytics and Machine Learning to Promote Corrosion-Informed Design to Reduce Ship Maintenance
N24A-T012	Scalable High Frequency Transmit/Receive Array for Multiple Unmanned Underwater Vehicle and Torpedo Applications
N24A-T013	Adaptive Instructor Aid for Virtual Reality/Augmented Reality Enabled Classroom Training
N24A-T014	Technology to Drive Extreme Runtime in Wearable Devices
N24A-T015	Polarization-enhanced, Long-range, Wide-area, High-resolution Imaging System
N24A-T016	Plasma Assisted Combustion for Enhanced Performance and Operability in Naval Air Vehicles and Weapons
N24A-T017	Soft Robot for Locomotion in Granular Seabed Media
N24A-T018	Inert Impulsive Expendable Acoustic Source (IIEAS)
N24A-T019	Portable Analytics for Multi-Stage Cyber Attack Investigation

N24A-T020	Biological Noise Modeling for Active and Passive Sonar System Performance Predictions
N24A-T021	Syntheticization of Refractory/Transition Metal Diboride & Carbide Precursors for Chemical Vapor Infiltration (CVI) of Ceramic Composites
N24A-T022	Remote Magnetometry with Resonantly Enhanced Multiphoton Ionization (REMPI) Readout
N24A-T023	Scalable Additive Friction Stir (AFS) for Multi-metal Deposition
N24A-T024	Additive Manufacturing of Ferroelectric and/or Ferromagnetic Composite

N24A-T001 TITLE: High-Bandwidth Multimode Fiber-Optic Cabling

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

OBJECTIVE: Design and develop a high-bandwidth multimode optical fiber for avionic and sensor applications.

DESCRIPTION: Current airborne military (mil-aero) core avionics, electro-optic (EO), communications, and electronic warfare systems require ever-increasing bandwidths while simultaneously demanding reductions in space, weight, and power (SWaP). The replacement of shielded twisted pair wire and coaxial cable with earlier generation, bandwidth-length product, multimode optical fiber has given increased immunity to electromagnetic interference, bandwidth, and throughput, and a reduction in size and weight on aircraft. The effectiveness of these systems hinges on optical communication components that realize high-per-lane throughput, low-latency, and large link budget, and are compatible with the harsh avionic environment.

In the future, data transmission rates of 100 Gbps and higher will be required. Substantial work has been done to realize data rates approaching this goal based on the use of multilevel signal coding, but multilevel signal encoding techniques trade off link budget and latency to achieve high-digital bandwidth. To be successful in the avionic application, existing non-return-to-zero (NRZ) signal coding with large link budget and low-latency must be maintained. There has been considerable focus on the transmitters and receivers for future optical interconnects, but limited attention to optimizing the fiber cabling. Current aircraft have a mix of fiber types that were not anticipated for such high-speed operation. Multimode optical fiber is strongly preferred over single mode optical fiber given the environmental and operating conditions. To further future proof the embedded optical cabling, the Navy seeks a new class of multimode optical fiber that can support operation of 100 Gbps and higher NRZ while maintaining efficient coupling to the optical transmitters and receivers and compatibility with military style fiber-optic termini.

The proposed optical cabling must operate across a -55 °C to +165 °C temperature range, and maintain performance upon exposure to typical naval air platform vibration, humidity, temperature, altitude, thermal shock, mechanical shock, and temperature cycling environments. The optical fiber must be compatible with lasers in the 850 to 1500 nm band operating at 100 Gbps and higher NRZ to support bandwidth in excess 10 GHz*km. Optical attenuation loss should be consistent with current OM5 multimode fiber.

PHASE I: Design a multimode optical fiber with bandwidth > 10 GHz*km that is compatible with lasers in the S band (850 to 1050 nm) and the O-band (1260 nm to 1400 nm). Develop differential mode dispersion measurement techniques to profile the optical fiber in both the S and O band. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize the fiber for high-speed operation over temperature. Measure and define specific launch conditions needed to maintain the bandwidth. Characterize link error potential as a function of connector misalignment, transmitter and receiver optical subassembly design, and environmental conditions.

PHASE III DUAL USE APPLICATIONS: Support transition of the technology to military aircraft platforms. Commercial datacenters will be able to use this new fiber optic cable to connect routers and servers.

REFERENCES:

1. IEEE 802.3 Ethernet Working Group. (2023). IEEE 802.3. IEEE. <https://www.ieee802.org/3/>
1. Telecommunications Industry Association (TIA). (2009). TIA-455-203, Revision A: FOTP-203 Light source encircled flux measurement method.
https://global.ihs.com/doc_detail.cfm?item_s_key=00334007&item_key_date=850612&rid=GS
2. Telecommunications Industry Association (TIA). (2003). TIA-455-220: FOTP-220 Differential mode delay measurement of multimode fiber in the time domain.
https://global.ihs.com/doc_detail.cfm?item_s_key=00388929&item_key_date=961131&rid=GS
3. International Electrotechnical Commission. (2019). IEC 60793-2-10 (2019). Optical fibres—Part 2–10: Product specifications—Sectional specification for category A1 multimode fibres. International Electrotechnical Commission (IEC), 7th Edition.
<https://webstore.iec.ch/publication/62020>
4. Telecommunications Industry Association (TIA). (2009). TIA-492AAAD: Detail Specification for 850-nm laser-optimized, 50 μm core diameter/125- μm cladding diameter class Ia graded-index multimode optical fibers suitable for manufacturing OM4 cabled optical fiber.
<https://standards.globalspec.com/std/1194330/TIA-492AAAD>

KEYWORDS: non-return-to-zero (NRZ); multimode fiber; 10 GHz*km; launch condition; the S band (850 to 1050 nm) and the O-band (1260 nm to 1400 nm); fiber optic cable.

N24A-T002 TITLE: In-situ AM-2 Aluminum Mat Repair

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

OBJECTIVE: Evaluate the implementation of a novel repair technique for AM-2 aluminum matting repair in-situ. The idea is to analyze the repair effectiveness by comparing virgin AM-2 specimens to specimens artificially damaged and repaired, in terms of mechanical performance.

DESCRIPTION: Rapid deployment of Expeditionary Airfields (EAF) is critical to expedited military transportation and sustained presence across multiple military theaters around the world. At the core of EAF, utilization of aluminum matting, referred to as EAF AM-2 matting, is essential to lay down for air vehicles to successfully land in a variety of soil environments. Maintenance of such a system ensures prevention of premature structural failure, thereby preventing in-service landing failures and loss of life. However, AM-2 matting is often shipped back to a refurbishment facility for various reasons, one of which includes significant structural damage.

The decision to repair is influenced by the type of damage and the defect size encountered when the matting is damaged. Guidance will be provided to awardees. Damage due to forklift tines are also taken into account, where the maximum allowable hole dimensions for repair are 1.5 in. (3.81 cm) wide by 10 in. (25.4 cm) long. If the matting is damaged, the EAF Marines have to pull up and remove all of the surrounding mat to be able to remove and replace the affected piece. Depending on where the damaged mat is in the airfield the current process of removal and replacement can take a substantial amount of time and labor to complete both while downing that portion of the airfield. With the ability to rapidly repair in situ, the mean time to repair (MTTR) will be greatly decreased, thus improving the Operational Availability.

The EAF Marines are an expeditionary force, therefore a premium is placed on weight, size, and maneuverability of materials, which imposes constraints on any solution. The EAF Marines must be prepared to operate in any feasible climate, a requirement that extends to their equipment as well. AM-2 matting is manufactured in either 6 ft (1.83 m) or 12 ft (3.66 m) by 1.5 in. (3.81 cm) by 2 ft (.61 m) pieces of aluminum and weigh 75 lbs (34.02 kg) or 150 lbs (68.04 kg) respectively. AM2 mats are additionally treated with nonskid coating.

The aim of this STTR topic is to enhance the repair and refurbishment capability of EAF AM-2 aluminum matting. Ultimately, an ideal application would involve on-site repair of holes and cracks that form on AM-2 matting while installed on an airfield. Areas of consideration for a potential solution should include fuel/power consumption (if needed), time to repair, and comparable mechanical properties to undamaged AM-2. The threshold for this effort is to repair the damaged aluminum AM-2 matting utilizing a preferred repair technique or method. The objective is to repair the damaged matting and provide some semblance of a friction surface for the repaired surface area.

PHASE I: Provide a conceptual design for a process for the repair and refurbishment of EAF AM-2 aluminum matting. Prove the engineering and economic feasibility of meeting the stated requirements through analysis and lab demonstrations. Identify specific strategies for meeting performance and reliability goals. Optimize the processing parameters for application to various hole and crack sizes on AM-2 matting specimens. Assess representative macrostructural matting specimens under flexure loading is recommended in this phase. Sustainment or improvement of mechanical properties is to be evaluated with use of the chosen repair method/technique. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Demonstrate prototype performance with AM-2 matting. Provide an estimate of costs including manufacturing. Provide a failure analysis, service life estimate, and assessment of meeting requirements. Using optimized parameters evaluated in Phase I, repairs would ideally be conducted on full-scale AM-2 matting structures (6 ft–12 ft) (1.83 m–3.66 m), and full-scale mechanical testing is to be conducted. Data sets are to be obtained and compared to existing data on AM-2 mechanical analyses.

PHASE III DUAL USE APPLICATIONS: In partnership with the PMA and the Arresting Gear IPT, new repair/refurbishment cost and logistics estimates are to be assessed given the optimal materials and parameters established in the previous phases. This will ultimately prepare the repair method for fielding. Any aluminum paneling or matting that is utilized in commercial systems (e.g., stiffener walls for a train, aircraft fuselage paneling and floorboard repair, building materials and building structures) can be repaired with relative ease without having to replace or even remove the part from the rest of the structure or system.

REFERENCES:

1. Widener, C. A.; Ozdemir, O. C. and Carter, M. “Structural repair using cold spray technology for enhanced sustainability of high value assets.” *Procedia Manufacturing*, 21, 2018, pp. 361-368. <https://doi.org/10.1016/j.promfg.2018.02.132>
2. Chaudhary, B.; Jain, N. K. and Murugesan, J. “Development of friction stir powder deposition process for repairing of aerospace-grade aluminum alloys.” *CIRP Journal of Manufacturing Science and Technology*, 38, 2022, pp. 252-267. <https://doi.org/10.1016/j.cirpj.2022.04.016>

KEYWORDS: aluminum; matting; in-situ; repair; expeditionary; airfield

N24A-T003 TITLE: High-Frequency 40 GB/s MWIR and LWIR Metamaterials-based Electro-Optical Modulators for Free-Space Optical Communications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Sustainment; Trusted AI and Autonomy

OBJECTIVE: Develop tunable metamaterials that enable narrow-linewidth multi-watt laser transmitter, which operate with ultrafast modulation (40 GHz) and high-beam quality in the 4 to 12 μ spectral region, to provide optical communications in RF-denied environments.

DESCRIPTION: Free-space optical (FSO) communication links provide high-data rate, low latency, secure, wireless mobile communication that are difficult to jam or intercept and do not require spectrum management. FSO communication is an especially compelling alternative to a radio-frequency (RF) link with external RF Interference (RFI) in RF-denied and/or contested environments. Most current proposed or deployed FSO systems are in the short wave Infrared (SWIR) regime at around 1.55 μ m due to ubiquity of the laser and optical components customized for fiber-optical communications. Exceptionally high-data rates at this wavelength range are possible when atmospheric effects are not present [Ref 1] and laser-based FSO communication is the leading solution for interconnecting new constellations of low-earth-orbit satellites. Terrestrial FSO links and satellite uplinks have seen some success, but the link budget in the SWIR regime is often limited by optical obscurants such as haze, fog, clouds, atmospheric absorption, and turbulence presence in the atmosphere. SWIR links with stabilized telescopes have been demonstrated to achieve gigabit per second (Gb/s) communication between naval vessels in ship-to-ship and ship-to-shore configurations at ranges of 12 and 45 km (Ref 2), despite the link limitation to 1 km when the visibility was impaired by heavy fog. For FSO laser communications systems operating in the SWIR bands, including 1300 nm and 1550 nm, the photonic wavelength is comparable to the size of aerosols that scatter and attenuate the laser-beam propagation in the channel.

Recent analysis has verified that there are advantages to using long-wave infrared (LWIR) wavelengths for FSO links through the atmosphere [Ref 3]. When the channel transmission is affected by fog, clouds, haze, dust, or turbulence, a near-IR ($\sim 1.55 \mu$ m wavelength) FSO link suffers significantly more attenuation relative to LWIR systems. With the exception of fog and clouds, mid-wave infrared (MWIR) systems share the advantages of LWIR and benefit from higher performance lasers and detectors, as well as reduced diffraction relative to LWIR. Unfortunately, the high-cost, low-bandwidth, and low-output power of otherwise suitable MWIR and LWIR sources has prevented their adoption for this application. Quantum Cascade Lasers (QCLs) and Intraband Cascade Lasers (ICLs) have seen significant development in the past decade, to the point where devices with watt-level output are now feasible at wavelengths covering most of the MWIR, 3-5 μ m and LWIR, 8-14 μ m spectral regions. Unfortunately, the functionality of these devices is limited, particularly for laser communications, due to the lack of an appropriate modulator. The carrier population in a QCL may be modulated to ~ 100 GHz due to ultrafast carrier dynamics, but the optical modulation bandwidth is significantly less than 10 GHz due to the photon lifetime in the cavity. As the cavity is made longer to produce more power, the modulation speed is reduced by increased photon lifetime, as well as the difficulty of modulating the large current, > 1 A, required in a multi-watt device. Furthermore, high-power devices experience beam pointing instability under large-signal modulation [Ref 4]. These problems are solved in near-IR communications through external modulation and optical amplification, but optical amplification that is compatible with a modulated signal is not available over the majority of the spectral ranges of interest, nor has an appropriate modulator been demonstrated.

Optical metamaterials (MMs), sub-wavelength electromagnetic structures that exhibit optical properties not readily found in natural materials [Ref 5], have huge potential for use in LWIR devices where sub-wavelength structures are $> 1 \mu$ m and so may be readily fabricated with well-established lithography.

These materials are presently being explored for numerous applications including tunable filters [Ref 6], multicolor IR imaging [Ref 7], ultracompact IR optical components [Ref 8], and optical switching [Ref 9]. However, to be useful as an active device such as a modulator, the metamaterial must be tunable at speeds greater than 10 GHz. Extremely compact plasmonic devices have been demonstrated for on-chip collimation, as well as other optical functions [Ref 8], but so far appear to be difficult to fabricate and lack tunability.

Recently, tunable metamaterial devices based on carrier depletion have been demonstrated with the fastest published result reaching 1.5 GHz (750 MHz 3-dB bandwidth) and projected operation up to 10 GHz [Ref 10]. Further development of these materials is needed to achieve low-insertion loss, high-modulation depth, and modulation to speeds > 40 GHz. The metamaterial-based optical modulator is a viable and feasible technology and the following metrics are the Higher efficiency, longer FSO link for this project:

	Threshold	Goal	Primary Benefits
Signal bandwidth (3-dB)	> 10 GHz	> 40 GHz	Larger data rate, lower cost per bit
Insertion loss	< 3 dB	< 1 dB	Higher efficiency, longer FSO link
Optical output power	> 0.5 W	> 4 W	Longer FSO link
Optical aperture	> 50 μ	> 500 μ	Lower cost (simpler alignment)
Optical bandwidth	> 10 nm	> 100 nm	Lower cost (wavelength control)
Modulation depth	> 5%	> 90%	Higher efficiency, longer FSO link

PHASE I: Develop concepts for a tunable metamaterial-based optical modulator capable of providing dynamic narrow linewidth tunable properties within the MWIR/LWIR spectral range. It is expected that these concepts will be breadboard demonstrated in order for the tunable metamaterial-based optical modulator to be optimized to operate with a laser transmitter (e.g., QCLs or ICLs).

Demonstrate the feasibility of the proposed tunable metamaterial-based optical modulator concept through numerical simulation and breadboard demonstration of the basic physics of the device compatible with achieving the above topic description threshold performance requirements.

Required Phase I deliverables will include a report with a modeling plan, device designs, and performance goals.

The Phase I effort will include prototype plans to be implemented under Phase II.

PHASE II: Fabricate and demonstrate a prototype system having a laser transmitter operating with a tunable metamaterial-based optical modulator operating in a MWIR or LWIR atmospheric window. The prototype system will be evaluated to determine its capability in meeting the performance goals defined in the Phase I report. System performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters. Evaluation results along with military specification considerations that were not addressed in the Phase I concept design will be used to refine the prototype into a design that will meet this STTR topic description requirements.

PHASE III DUAL USE APPLICATIONS: Finalize packaging for transition to military and commercial applications. Develop a plan and demonstrate capability to fabricate and package devices for military platforms and outline design for typical avionic ruggedness requirements. Perform final avionics integration activities and qualification testing. Demonstrate plan for device manufacturing. Provide support for operational testing and validation and qualify the system for Navy use.

Commercial applications for this technology could include telecommunications, imaging, sensing, satellite communications, fiber-optic networks, wireless networking, terrestrial optical links, infrared dynamic labels, and object identifiers.

REFERENCES:

1. Rensch, D. B., & Long, R. K. (1970). Comparative studies of extinction and backscattering by aerosols, fog, and rain at 10.6 μ and 0.63 μ . *Applied Optics*, 9(7), 1563-1573. <https://doi.org/10.1364/AO.9.001563>
2. Juarez, J. C., Souza, K. T., Nicholes, D. D., O'Toole, M. P., Patel, K., Perrino, K. M., Riggins, J. L. II, Tomey, H. J., & Venkat, R. A. (2018, February). Testing of a compact 10-Gbps Lasercomm system at Trident Warrior 2017. In *Free-Space Laser Communication and Atmospheric Propagation XXX* (Vol. 10524, p. 105240E). International Society for Optics and Photonics. <https://doi.org/10.1117/12.2290143>
3. Delga, A., & Leviandier, L. (2019, February). Free-space optical communications with quantum cascade lasers. In *Quantum sensing and nano electronics and photonics XVI* (Vol. 10926, pp. 140-155). SPIE. <https://doi.org/10.1117/12.2515651>
4. Bewley, W. W., Lindle, J. R., Kim, C. S., Vurgaftman, I., Meyer, J. R., Evans, A. J., Yu, J. S., Slivken, S., & Razeghi, M. (2005). Beam steering in high-power CW quantum-cascade lasers. *IEEE journal of quantum electronics*, 41(6), 833-841. <https://doi.org/10.1109/JQE.2005.846691>
5. Cheben, P., Halir, R., Schmid, J. H., Atwater, H. A., & Smith, D. R. (2018). Subwavelength integrated photonics. *Nature*, 560(7720), 565-572. <https://doi.org/10.1038/s41586-018-0421-7>
6. Jun, Y. C., Gonzales, E., Reno, J. L., Shaner, E. A., Gabbay, A., & Brener, I. (2012). Active tuning of mid-infrared metamaterials by electrical control of carrier densities. *Optics express*, 20(2), 1903-1911. <https://doi.org/10.1364/OE.20.001903>
7. Montoya, J. A., Tian, Z. B., Krishna, S., & Padilla, W. J. (2017). Ultra-thin infrared metamaterial detector for multicolor imaging applications. *Optics express*, 25(19), 23343-23355. <https://doi.org/10.1364/OE.25.023343>
8. Yu, N., Blanchard, R., Fan, J. A., Wang, Q. J., Kats, M., & Capasso, F. (2010, January). Wavefront engineering of semiconductor lasers using plasmonics. In *2010 3rd International Nanoelectronics Conference (INEC)* (pp. 70-71). IEEE. <https://doi.org/10.1109/INEC.2010.5424528>
9. Sharkawy, A., Shi, S., Prather, D. W., & Soref, R. A. (2002). Electro-optical switching using coupled photonic crystal waveguides. *Optics Express*, 10(20), 1048-1059. <https://doi.org/10.1364/OE.10.001048>
10. Pirota, S., Tran, N. L., Jollivet, A., Biasiol, G., Crozat, P., Manceau, J. M., Bousseksou, A., & Colombelli, R. (2021). Fast amplitude modulation up to 1.5 GHz of mid-IR free-space beams at room-temperature. *Nature communications*, 12(1), 1-6. <https://doi.org/10.1038/s41467-020-20710-2>

KEYWORDS: Laser; Modulator; Optical Transceiver; Metamaterial; Tunable; Communications

N24A-T004 TITLE: Automated Performance Monitoring for Rotorcraft Turboshift Engines Using a Multimodel Approach

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

OBJECTIVE: Develop and integrate multiple models using machine learning and artificial intelligence to continuously and accurately estimate and predict power available for rotorcraft turboshaft engines across all aircraft operating conditions.

DESCRIPTION: Accurate estimates of engine health are critical for ensuring safe operation of helicopters supporting heavy-lift operations. Various approaches exist to assess engine health and available power in a rotorcraft context, and the rapid evolution of machine learning and artificial intelligence is further expanding the realm of possible solutions. The development and maturation of algorithms that utilize existing aircraft data parameters and that have the potential for real-time, or near real-time performance, are of considerable interest. In particular, significant operational efficiencies can be obtained if engine performance deterioration can be accurately determined and predicted over a wide range of operating conditions. Maintenance can be planned in advance, with necessary personnel and resources pre-positioned to minimize mission and readiness impacts. Specific aircraft operating conditions that lend themselves to accurate estimation of power available may not occur with regularity, thereby limiting the potential effectiveness of any individual approach. Optimal predictive performance can be achieved by combining multiple models and algorithms via decision-fusion, ensemble learning, and so forth. An ideal solution would also provide the means to monitor and evolve the models over time, support the incorporation of new models, provide interpretability and explainability, and be broadly applicable to different engines.

PHASE I: Design and demonstrate multiple approaches for engine health and/or power available estimation using Navy datasets and commercially available, open-source computing languages and packages (Python, etc.). Design and demonstrate technical feasibility for combining the models using machine learning and artificial intelligence approaches to improve model performance. The raw data may need to be filtered, manipulated, or normalized to enable implementation of the models. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop and demonstrate a multimodel approach for accurately estimating and predicting engine health and/or power available over a wide range of operating conditions. Demonstrate and validate the approach within a Navy data environment in an automated context.

PHASE III DUAL USE APPLICATIONS: Demonstrate scenarios involving model re-training, updating, and incorporation of new models, within the Navy data environment. Develop tools and processes to monitor model performance and assist with long-term management.

This software capability would be broadly applicable to aerospace, turboshaft engines, and could be commercialized as an engine management tool for commercial operators.

REFERENCES:

1. Peddareddygari, L. M. (2020, August). Time to failure prognosis of a gas turbine engine using predictive analytics [Master's thesis, Texas A&M University]. <https://oaktrust.library.tamu.edu/bitstream/handle/1969.1/192563/PEDDAREDDYGARI-THESIS-2020.pdf?sequence=1&isAllowed=y>
2. Simon, D.L., & Litt, J.S. (2008). Automated power assessment for helicopter turboshaft engines. NASA/TM-2008-215270. <https://ntrs.nasa.gov/citations/20080032562>
3. Li, Z., Goebel, K., & Wu, D. (2019). Degradation modeling and remaining useful life prediction of aircraft engines using ensemble learning. *Journal of Engineering for Gas Turbines and Power*,

141(4).

https://c3.ndc.nasa.gov/dashlink/static/media/publication/2018_DegradationModelingRULEnsemble_Wu.pdf

4. Li, Z, Wu, D., Hu, C., & Terpenney, J. (2019). An ensemble learning-based prognostic approach with degradation-dependent weights for remaining useful life prediction. *Reliability Engineering & System Safety* 184, 110-122.
<https://www.sciencedirect.com/science/article/pii/S0951832017308104>
5. Rigamonti, M., Baraldi, P., Zio, E., Roychoudhury, I., Goebel, K., & Poll, S. (2018). Ensemble of optimized echo state networks for remaining useful life prediction. *Neurocomputing*, 281, 121-138.
https://c3.ndc.nasa.gov/dashlink/static/media/publication/2017_12_ESN_Ensemble_NEUCOM.pdf

KEYWORDS: Ensemble Learning; Artificial Intelligence; Machine Learning; Prognostic Health Management; Engine Health Monitoring; Turboshift Engine

N24A-T005 TITLE: Real-time Computational Enhancement of Video Streams

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

OBJECTIVE: Develop and implement efficient computational algorithms for fast, low-latency deblurring, denoising, and super-resolution of video streams under dynamic conditions.

DESCRIPTION: Intelligence, surveillance, and reconnaissance (ISR) and automatic target acquisition (ATA) systems are continuously challenged to view at longer distances. Under long-range conditions, atmospheric disturbances, platform motion, and object motion often introduce blur and other artifacts in the imagery of video streams from ISR missions, limiting effectiveness. With the advance of computation hardware and algorithms, computational methods can be applied to video streams to passively enhance imagery in real time by removing blur and artifacts and in some cases providing super-resolution. These approaches have the potential to be applied to any video stream whether live or recorded. Blind deconvolution techniques are a promising approach [Refs 1-5]. This approach can provide automatic estimation of compensation parameters such as point spread function (PSF), which can then be applied to imagery for enhancement such as the increase in signal-to-noise ratio (SNR). Implementation on efficient and scalable single- or multi-GPU or other processors can ensure real-time operation with minimal latency.

The Navy requires a real-time computational algorithm and implementation for passive video enhancement of video streams under dynamic conditions (e.g., defective pixels, non-uniform backgrounds, clipped objects, dropped frames, abrupt scene changes, significant haze, strong glint, and saturated pixels). Sustained computation rates for imagery with > 1 mega-pixels per frame or more should be 30 Hz (threshold) and 60 Hz (target) with latency of 200 ms (threshold) and 50 ms (target). Power consumption should be less than 150 W (threshold) and 50 W (target) in a compact, reliable compute module. This low size, weight, and power (SWaP) enables integration on mobile platforms and other SWaP-constrained vehicles. The computational algorithm and implementation must be automatic, providing low-latency simultaneous deblurring (100% reduction in PSF width in some cases), denoising (50% increase in SNR in some cases), and in some cases super-resolution, contrast enhancement, and glint suppression of video. The algorithms should show that in some cases deblurring reduces PSF width by 100%, and denoising increases SNR by 100%. The algorithms and hardware should ideally be future-proof and scalable to a range of mission scenarios. Trade-offs in image quality, processing speed, and hardware SWaP should be documented. Minimally this system should include: (a) software framework to use real-time video enhancement for receiving and sending real-time video with network-based message passing protocols and recorded formats; (b) read and write selected image and video file formats; (c) supporting the simultaneous processing of multiple image streams; (d) multi-stream co-aligning (registering) technique for the estimation of arbitrarily large angles of rotation and the estimation of geometric scaling factors (i.e., zoom-in or zoom-out); (e) a Graphical User Interface (GUI) that displays compensated imagery in real time and enables operators with all levels of experience to easily use and configure the system; (f) techniques for mitigating the adverse effects of defects in the raw imagery and objects extending beyond the field of view; (g) techniques for automating the selection of near optimal compensation parameters; (h) performing online Multiframe Blind Deconvolution (MFBD) contrast and feature enhancement, and super-resolving imagery; (i) restoring and displaying turbulence-degraded imagery from live sensor feeds in real time; and (j) tuning of parameters and configuration for sustained, autonomous operation.

PHASE I: Develop a real-time video enhancement approach for tactical optical ISR systems imaging. Perform feasibility analysis of hardware and software for implementations of the system, including a study of types of video streams and under what conditions they can be enhanced and for what types of blurs, noise, and other artifacts. Develop an initial design specification for a prototype system to be

fabricated and tested in Phase II. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, fabricate, and test the prototype system. Demonstrate performance and SWaP that meets the above specifications using Government furnished and/or synthetically generated datasets in either long distance air, land, and/or sea imaging applications as either part of a real-time image enhancement system or as an advanced pre-processing filter for image intelligence analyses.

PHASE III DUAL USE APPLICATIONS: Finalize software with appropriate SWAP-C and form factor based on human factors testing. Determine the best integration path as a capability upgrade to existing or future systems, including software and interfaces required to meet software interoperability protocols for integration into candidate systems as identified by the Navy.

Military Application: Surveillance, Technical Intelligence, Zoom Imaging Systems.

Commercial Application: Security and police surveillance attempting to identify threats and, Medical imaging procedures.

Transition of the STTR-developed products to both DoD and commercial markets, targeting applications where more compact and lighter weight hardware provides an order of magnitude improvement over current technology.

REFERENCES:

1. Levin, A., Weiss, Y., Durand, F., & Freeman, W. T. (2009, June). Understanding and evaluating blind deconvolution algorithms. In 2009 IEEE Conference on Computer Vision and Pattern Recognition (pp. 1964-1971). IEEE.
https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5206815&casa_token=518seBTaEywAAA:ljrcPllDhwZY2p8_iLoIrdcLr3uIVpsIsvlwlm3b63gMfVYLT18Gcq-w1giUZdU_S_m4wND&tag=1
2. Wang, R., & Tao, D. (2014). Recent progress in image deblurring. University of Technology Sydney, 2014. arXiv preprint arXiv:1409.6838. <https://arxiv.org/PSF/1409.6838.PSF>
3. Nasrollahi, K., & Moeslund, T. B. (2014). Super-resolution: a comprehensive survey. Machine vision and applications, 25(6), 1423-1468.
<https://www.proquest.com/docview/2262639045/30B577F3FB10454APQ/1?accountid=28165>
4. Archer, G. E., Bos, J. P., & Roggemann, M. C. (2014). Comparison of bispectrum, multiframe blind deconvolution and hybrid bispectrum-multiframe blind deconvolution image reconstruction techniques for anisoplanatic, long horizontal-path imaging. Optical Engineering, 53(4), 043109. <https://doi.org/10.1117/1.OE.53.4.043109>
5. Koh, J., Lee, J., & Yoon, S. (2021). Single-image deblurring with neural networks: A comparative survey. Computer Vision and Image Understanding, 203, 103134. <https://doi.org/10.1016/j.cviu.2020.103134>

KEYWORDS: Video; Imagery; Processing; Super-Resolution; Deblurring; Denoising; Turbulence

N24A-T006 TITLE: Manufacturing Method Development of Nanocomposite Steel Wire for Arresting Gear Purchase Cable

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

OBJECTIVE: Develop a manufacturing method capable of producing nanocomposite steel wires (steel infused with carbon nanotubes) with requisite volumes to produce metal matrix composite (MMC) arresting gear purchase cable at a cost that is comparable to steel-only cable.

DESCRIPTION: Aircraft are recovered on Navy carriers by means of a steel arresting gear cable that catches the aircraft tailhook. The cable is connected to arresting gear below decks that absorbs the aircraft's kinetic energy and stops the aircraft. Service life of the cable under repeated mechanical loading and degradation-inducing environmental conditions is critical, since the cable is the largest driver of operational cost in the Aircraft Launch and Recovery Equipment (ALRE) program. Service use cycles, as well as corrosion and bend-over-sheave wear and fatigue, are critical performance factors for such cables. To improve these characteristics, the Navy has been investigating composite carbon nanotube (CNT)/steel material as an alternative cable material to steel. The issue is manufacturability – current methods of extruding steel wire require applying 1,400–1,500 °C heat, which would degrade CNTs. The Navy is interested in a novel extrusion process that can effectively produce wire at a maximum 400 °C to protect the CNT properties. Additionally, process costs must be comparable to current steel-only processing costs for the CNT/steel cable to be viable.

The arresting gear cable is comprised of two separate cables: the cross-deck pendant and the purchase cable that is connected via a terminal and pin. The cross-deck pendant is the portion of the cable that is stretched across the landing area and interfaces with the aircraft tailhook. It is approximately 100 feet (30.48 m) long, and is replaced after approximately 125 cycles. The purchase cable is the portion of the cable that is reeved through the fairlead system and the arresting engine below the flight deck. It is comprised of 31 wires in a lang-lay construction, 1-7/16 in. (3.65 cm) in diameter and 2,200 ft (609.6 m) long. It is subject to bending stresses from the many sheaves, which with it is in contact, and is replaced after approximately 1,500 cycles. This composite cable SBIR topic addresses only the purchase cable. Cable construction should match current cable dimensions to facilitate direct replacement. The base metal for a new MMC cable should remain extra improved plow steel or a compositional equivalent. The nominal breaking strength of the composite cable should, at minimum, match the current cable's 215,000 lbs (97,522.35 kg), in addition to improving the bend-over-sheave fatigue life.

The Navy requires the development of a manufacturing method capable of cost-effectively producing composite wires for arresting gear cables. The manufacturing method must be able to produce enough wire to fabricate a test batch of full-scale arresting gear purchase cables by the end of Phase II.

PHASE I: Develop and demonstrate a manufacturing method capable of bulk production of enough MMC wire to manufacture arresting gear purchase cable. Perform wire-wrap testing for ductility, reverse bend testing for fatigue resistance, along with tensile strength and reduction-of-area testing to ensure that all material standards are maintained. Demonstrate production of 100 ft (30.48 m) wire lengths and show scalability to meet the 2,200 ft (670.56 m) requirements for full-scale arresting gear purchase cables. Perform a cost-and-lifecycle analysis to determine any potential savings from extending the life of the purchase cable. Prepare a Phase I Option that, if exercised, will produce a sub-scale arresting gear purchase cable for bend-over sheave lifecycle testing. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Demonstrate manufacturing of full-scale arresting gear purchase cables. Determine maximum production rate and final wire rope properties. Final demonstration shall be on a composite cable in a test

environment representative of the arresting gear aboard ship, (either a test bench or arresting gear at NAVAIR Lakehurst, depending on the availability of non-SBIR funding. During a final demonstration, the composite cable will be cycled to failure, and the prototype must improve current service life and meet current performance requirements, particularly mechanical strength. Prepare a Phase III development plan to transition the technology to the Navy and potential commercial use.

PHASE III DUAL USE APPLICATIONS: Work with the PMA to field the technology, accounting for any requirements, restrictions, or performance parameters. The Arresting Gear IPT and pertinent engineering teams are planned to be synchronized during the entire process.

Commercial systems and infrastructure that requires high-performance load-bearing cables, as well as durable, highly conductive electronics cables can greatly benefit from the efforts in this topic, and can result in additional design flexibility. Elevator cables, bridge cables, electronic wiring, and other cable-supported stabilizing structures are among a few of several commercial applications that can benefit from the results of this topic.

REFERENCES:

1. Wire Rope Technical Board. (2005). Wire rope user's manual, 4th ed. ARE. <https://www.wireropetechnicalboard.org/products/wire-rope-users-manual-4th-edition-electronic>
2. Sloan, F., Bull, S., & Longerich, R. (2005, September). Design modifications to increase fatigue life of fiber ropes. In Proceedings of OCEANS 2005 MTS/IEEE (pp. 829-835). IEEE. <https://doi.org/10.1109/OCEANS.2005.1639856>
3. Sloan, F., Nye, R., & Liggett, T. (2003, September). Improving bend-over-sheave fatigue in fiber ropes. In Oceans 2003. Celebrating the Past... Teaming Toward the Future (IEEE Cat. No. 03CH37492) (Vol. 2, pp. 1054-1057). IEEE. <https://doi.org/10.1109/OCEANS.2003.178486>

KEYWORDS: Manufacturing; nanocomposite; steel; cable; arresting; gear

N24A-T007 TITLE: Integrated Environmental Model System for Platform Situational Awareness

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

OBJECTIVE: Develop an Integrated Environmental Model System (INTEMS) that acquires, aggregates, and validates shore-based environmental predictions for naval platforms systems.

DESCRIPTION: The Navy provides a comprehensive set of global forecasts via Fleet Numerical Meteorology and Oceanography Center (FNMOC), but they are not available on most platforms or accessible to on-board systems. Safety of navigation, mission logistics, operational efficacy, electromagnetic and acoustic sensor performance, and other aspects of maritime operations depend on atmospheric and oceanic conditions that change suddenly, and which are hard to predict. Environmental models, especially shore-based supercomputer models, empower the Navy to capitalize on favorable conditions and to prepare for extreme weather events. This is especially true in shallow littoral environments where conditions such as ocean currents, wind, waves, and eddies are harder to predict and are more impactful. It is therefore desirable to have an integrated environmental model as an on-board system that acquires and provides estimates of current and future environmental conditions as a service to other ship-board systems.

The Program Executive Office Command, Control, Communications, Computers and Intelligence (PEO C4I) currently deploys a powerful environmental modeling computer system named Navy Integrated Tactical Environment System Next (NITES-Next). NITES-Next contains a broad range of tools for tasks such as data maintenance, environmental analysis, Meteorology and Oceanography (METOC) visualization, optical and radio-frequency sensor performance prediction, sonar performance prediction, environmental impact estimation, coastal environment predictions, hazard predictions, and search and rescue tools. These tools are powerful but require an on-platform operator, both to manually access shore-based predictions from FNMOC and to operate the complex modeling software environment. National Oceanic and Atmospheric Administration, on the other hand, utilizes the Environmental Response Management Application (ERMA), a web-based geographic information system (GIS) tool developed to support environmental planning and response efforts. ERMA integrates various types of data, including environmental, weather, and oceanographic information, into a centralized platform. It facilitates real-time visualization, analysis, and collaboration among response teams and stakeholders during environmental incidents such as oil spills, hazardous material releases, and natural disasters. In addition to these capabilities, there is a growing emphasis on Maritime Domain Awareness (MDA) systems, specifically those focused on environmental risks. These MDA systems integrate various data sources, including environmental, weather, and oceanographic information, to provide a comprehensive understanding of potential environmental risks in the maritime domain. By monitoring and analyzing factors such as sea state, wind conditions, ocean currents, and water temperature, MDA systems can identify and assess environmental hazards that may affect naval operations.

The Navy seeks a capability for an integrated environmental system that can passively download, curate, and calculate operational parameters in an ongoing manner, making the data available to NITES, ERMA, MDA or other on-board systems. Despite the name, the current NITES-Next systems are not integrated. They primarily act as decision aids for human operators and do not provide parameters to any on-board sensors or weapon systems. The Navy aims to enhance the integration and automation of environmental data within on-board systems to streamline operations, improve situational awareness, and support timely decision-making across various naval platforms. There is currently no commercial capability that meets the Navy needs.

A solution is needed for an INTEMS that provides pertinent environmental information to ship-board systems as a service. The solution must be capable of ingesting, processing, validating, and publishing

environmental data from potential authoritative data sources such as FNMOC, National Oceanic and Atmospheric Administration, National Weather Service, or Naval Oceanographic office. It must assess the accuracy, feasibility, storage requirements, and computational requirements for each of the processes. Using the shore-based forecasts, climatology, on-board sensors, or algorithms the INTEMS shall provide parameters pertaining to surface currents, surface waves, sea state, abyssal current, salinity, temperature, thermocline depth, wind, visibility (dust, moisture, ice), precipitation, atmospheric pressure, temperature, cloud cover (type, density, height), turbulence, aircraft icing, the boundary layer, and ionospheric conditions effecting electro-magnetic signal propagation.

The INTEMS must be able to incorporate a high-fidelity regional bathymetric map to provide improved predictions of surface currents, surface waves, temperature, and salinity in littoral areas. The INTEMS solution will be implemented, either as software that runs on an on-board Navy computer system, or as a stand-alone computer system, based on computational requirements. It must be able to process graphical or gridded database environmental estimates and forecasts into gridded environmental estimates, which will be provided as a service for other on-board systems, displays, and geophysical databases. To interface with other systems, such as NITES, the INTEMS will be compatible with Open Geospatial Consortium compliant data formats (for example, NetCDF4). The now-casts and forecasts provided by the INTEMS must be available at multiple altitudes and depths with a fine enough resolution to model atmospheric and oceanic boundary layers.

The INTEMS will be required to provide timely global nowcasts and forecasts in situations where shore-based data is fully, partially, or not available. In all cases accuracy shall exceed or match climatology, but when additional shore-based or sensor data is available, the prediction skill should exceed persistence. The system shall provide statistical maximum, minimum, standard deviation, and mean estimates based on climatology and/or incorporated shore-based forecasts. Additional figure of merit shall indicate whether or not shore-based predictions are incorporated and if the data is valid based on its quality, consistency, or inherent unpredictability (due to qualitative factors).

PHASE I: Develop a concept of an INTEMS system. Demonstrate the INTEMS feasibly meets the parameters of the Description through analysis and modeling. The concept will be evaluated based on its soundness of the underlying analysis and the variety of environmental predictions offered. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype INTEMS based on the Phase I concept. Demonstrate functionality under the required service conditions as described in the Description. Demonstrate the prototype performance through the required range of parameters given in the Description. The INTEMS predictions will be evaluated over a multi-week period, conducted by the government and compared against both climatology and measurements occurring at distant weather stations to verify prediction accuracy and figure of merit reliability.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The INTEMS will be ruggedized, finalized, and adapted for integration with ship-board information systems and will undergo certification prior to final product testing on the naval platform. This technology will benefit commercial shipping platforms, oil and gas exploration, and industrial operations in coastal regions by providing essential and up-to-date environmental data that can power decision making and enhance the ability for automated systems and sensors to compensate for environmental conditions.

REFERENCES:

1. Barton, A., Metzger, E. J., Reynolds, C. A., et al. “The Navy's Earth System Prediction Capability: A New Global Coupled Atmosphere-Ocean-Sea Ice Prediction System Designed for Daily to Subseasonal Forecasting”. *Earth and Space Sci* 8, 4 (2021) <https://doi.org/10.1029/2020EA001199>
2. Coelho, E. F., Hogan, P., Jacobs, G., et al. “Ocean current estimation using a Multi-Model Ensemble Kalman Filter during the Grand Lagrangian Deployment experiment (GLAD)”. *Ocean Model* 87 (2017) <https://doi.org/10.1016/j.ocemod.2014.11.001>.
3. Marks, D., Elmore, P., Blain, C. A., et al. “A variable resolution right TIN approach for gridded oceanographic data” *Comp and Geosci* 109 (2017) <https://doi.org/10.1016/j.cageo.2017.07.008>
4. Arbic, B. K. “Incorporating tides and internal gravity waves within global ocean general circulation models: A review”. *Prog Ocean* 206 (2022) <https://doi.org/10.1016/j.pocean.2022.102824>
5. Sekulic, A., Kilibarda, M., Protic, D. et al. “A high-resolution daily gridded meteorological dataset for Serbia made by Random Forest Spatial Interpolation”. *Sci Data* 8, 123 (2021). <https://doi.org/10.1038/s41597-021-00901-2>

KEYWORDS: Fleet Numerical Meteorology; Environmental Modeling; Open Geospatial Consortium; littoral environments; bathymetric map; Navy Integrated Tactical Environment System

N24A-T008 TITLE: Kilowatt Class Stimulated Brillouin Scattering Reduced Hollow-Core Fiber (HCF) Dip Loop Cable Assembly

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

OBJECTIVE: Develop an innovative design and manufacturing approach for a kilowatt (kW) class Stimulated Brillouin Scattering (SBS) reduced Hollow-Core Fiber (HCF) marine connectorized cable assembly with Optical Hull Penetrator (OHP) for submerged operation.

DESCRIPTION: Currently, the Navy has a need for a kW class SBS reduced HCF dip-loop-assembly for Directed Energy (DE) beam delivery. Through separate initiatives, the Navy has developed an SBS reduced HCF bundle capable of achieving the kW transmission per each HCF channel. The ability to connect the number of fibers required has not been achieved in industry, and the hull side kW class connector for the newly developed hull penetration internals does not exist. Reliable and repeatable manufacturing of a fiber cable of this size capable of submerged application when subject to long-duration complex stress states with Navy platforms has yet to be developed. Dip Loop cable assembly shall include seven (7) quad for a total of 28 HCF. Additionally, the cable assembly must be as flexible as an outboard pressure proof hybrid fiber-optic interface cable assembly for undersea application. A kW class cable assembly with connector is an outboard and inboard cable assembly for undersea platforms, terminated at each end with deep submergence molded optical hull penetrator plug connectors, which can handle the kW class laser optical power. A kW class optical cable assembly is defined as a ship-set and provides kW optical interconnection between one Beam Director and one OHP. kW optical cable assemblies shall run within the Universal Modular Mast (UMM) Fairing Cable Handling Assembly (FCHA). Minimum bend radius shall be less than 2 inches of diameter and cable assembly shall not exceed 55 pounds including outboard kW class connector.

PHASE I: Develop a concept and demonstrate the feasibility of an innovative kW class SBS reduced HCF connectorized cable assembly that will be connected with an OHP for submerged operation. Develop the general model of innovative concept and identify the technology for cabling and connection for submerged operation. Accomplish the feasibility through modeling, simulation, analysis, or other formal methods. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver the kW class SBS reduced HCF dip-loop-assembly for DE beam delivery prototype. Through separate initiatives, the Navy has developed an SBS reduced HCF bundle capable of achieving the kW transmission desired. Phase II awardee(s) will coordinate with the company that has developed the SBS reduced HCF fiber. Information on how to purchase the necessary length of the SBS reduced HCF bundle for demonstration and prototype development of the marine connectorized dip-loop-assembly system will be provided to Phase II awardee(s). Demonstrate the broad requirements of the cabling and perform the required marine environment qualification testing to include submerged operation and pressure proof testing. If the performance and technical requirements are met during the evaluation, continue development of the technology utilizing additional Navy-provided performance data.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology to Navy use. The final design will be the kW class SBS reduced HCF dip-loop-assembly for DE beam delivery, which possesses the potential for use in oil and gas Industries.

REFERENCES:

1. Military Specification for Connectors, Electrical, Deep Submergence, Submarine (05-SEP-1984) (MIL-C-24217); http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-C/MIL-C-24217A_49807.

2. Military Specification for Connectors, Plugs, Receptacles, Adapters, Hull Inserts, & Hull Insert Plugs, Pressure-Proof, General Specification For (15-May-1987).” (MIL-C-24231); http://everyspec.com/MIL-SPECS/MIL-SPECS-MIL-C/MIL-C-24231D_8423.
3. Undersea Warfare Chief Technology Office. “Undersea Enterprise (USE) Science & Technology (S&T) Strategic Plan dtd Jan 20, 2010; <http://www.ndia.org/Divisions/Divisions/UnderseaWarfare/Documents/USW%20-%202013%20USW%20STOs.pdf>. https://defenseinnovationmarketplace.dtic.mil/wp-content/uploads/2018/02/USW_Strategy.pdf
4. Sub-cycle detection of incipient cable splice faults to prevent cable damage; Kojovic, L.A.; Williams, C.W., Jr.; Power Engineering Society Summer Meeting, 2000. IEEE Volume 2, 16-20 July 2000 <https://ieeexplore.ieee.org/document/867545>
5. Application of thermoelectric aging models to polymeric insulation in cable geometry; Cooper, E.S.; Dissado, L.A.; Fothergill, J.C.; Dielectrics and Electrical Insulation, IEEE Transactions on [see also Electrical Insulation, IEEE Transactions on] Volume 12, Issue 1, Feb. 2005

KEYWORDS: Stimulated Brillouin Scattering; SBS; hollow core fiber; HCF; optical hull penetrator; OHP; dip-loop-assembly; directed energy; DE; cable connectors; Dip Loop; Cable; outboard; submerged operation

N24A-T009 TITLE: Smart Exhaust Waste Heat Recovery Unit (SEWHRU)

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

OBJECTIVE: Develop and demonstrate a self-cleaning Smart Exhaust Waste Heat Recovery Unit (SEWHRU) for internal combustion engines flue gas ranging in temperature from 500 to 1200 °F, for use in electric generation and/or heating and cooling processes.

DESCRIPTION: A typical diesel engine attains approximately 42% brake thermal efficiency, with approximately 28% of fuel energy dissipated to the environment through engine exhaust flue gas as waste heat. Effective recovery and conversion of the waste heat into useful work would increase the diesel engine's thermal efficiency, resulting in a reduction in the engine's fuel consumption for equivalent work. This STTR topic seeks a SEWHRU to capture and transfer at least 50% of the heat from the exhaust flue gas to an intermediate working fluid, and on to the components that will convert the heat into useful work. WHRUs for legacy internal combustion engines exist commercially as an afterthought for prime movers. The WHRUs are dependent on the prime mover, with a WHRU that consists of a Heat Exchanger (HX) placed directly into the flue gas pathway and expected to work effectively without interfering with the operation of the prime mover. Some WHRUs designs incorporate dampers and a bypass system that redirects the flue gas around the HX; however, the legacy systems do not provide the following features that would be beneficial to the life, efficiency, reliability, and maintainability of the HX:

- Controlled flow rate of the flue gas through the HX
- Controlled flow rate of the working fluid through the HX
- Flue gas treatment for reducing particulate matter and other contaminants
- Even distribution of the flue gas through the HX
- Protective mechanism or process to protect the HX from over heating
- Control mechanism or process that prevents condensation within the HX
- Forced air system to counteract pressure losses
- Modular design to ensure maintainability

The legacy WHRUs that utilize conventional processes to recover waste heat from flue gas are plagued with multiple problems as follows:

- Thermo-mechanical stress due to transient flue gas temperature profiles
- Resonance within the heat exchanger when flow of the secondary fluid is secured
- Maintenance due to fouling and corrosion
- Secondary fluid thermal and pressure constraints, decomposition limits of fluid
- Unrestricted prime mover or plant operations
- Effect on efficiency or power output due to exhaust stack backpressure

A self-cleaning SEWHRU design is needed by the Navy with systems and processes incorporated and synchronized with the prime mover and the waste heat recovery system's operation sequences in order for the WHRU to work effectively.

The WHRU shall transfer heat from the diesel engine's flue gas to a working fluid with an inlet temperature range between 60 and 190 °F. Pressure drops across hot flue gas side of the WHRU shall not exceed 4 inches of water and/or interfere with the prime mover's efficiency. The heat recovery unit design shall be capable of withstanding thermal shock effects when a working fluid at 60 °F enters a 1200 °F heat exchanger. The WHRU shall possess a self-cleaning function that mitigates fouling and corrosion effect from combustion byproducts and operates with minimal operator intervention. Weight and volume of the WHRU shall be comparable or less than the prime mover's weight and size to power ratio. The WHRU shall be utilized in place of a silencer and shall be comparable to or better than the existing silencer in attenuating engine exhaust noise. The WHRU shall be scalable to 4000 Brake Horse-Power (BHP) marine diesel engines.

PHASE I: Develop a concept for a self-cleaning SEWHRU that meets the needs of the Navy as defined in the Description. Evaluate the unit's economic, technical, and manufacturing feasibility and quantify the SEWHRUs efficiency and operating parameters. Demonstrate the design and manufacturing concepts through modeling, analysis, and bench top experimentation where appropriate. Document the ability and impact of scaling engine size. Include in the Phase I final report the technical and economic feasibility of the proposed solution. The Phase I Option, if exercised, should include an initial detailed design and specifications to build a prototype with the Phase II effort.

PHASE II: Develop, fabricate, deliver, and test a prototype of a WHRU at an appropriate scale that captures at least 50% of the heat in the flue gas of a demonstration engine. Demonstrate the ability to withstand the flue gas temperature cycles. Validate analytic models developed in Phase I and evaluate scalability of design up to 4000 BHP. Perform testing activities that include demonstration and characterization of key parameters and objectives at the proposer's facility or other suitable testing facility identified by the offeror. Design the full-scale waste heat recovery unit for a rated diesel engine that fits in place of the existing exhaust stack silencer and integrate the unit with the rated diesel engine. Test the unit to demonstrate the ability to meet the design characteristics. Provide an updated economic and manufacturability study with updated designs that result from developments during prototype testing. Test the waste heat recovery unit in a relevant environment and ensure that the system meets the unique requirements for deployment on a U.S. Naval vessel such as shock and vibration. Analyze the ability to complete more than one prototype with the Phase II funding.

PHASE III DUAL USE APPLICATIONS: Assist the Navy in transitioning the technology to Navy use. Develop a transition strategy through research, analysis, and identification to establish production-level manufacturing capabilities and facilities that will produce and fully qualify a SEWHRU. Based on the results of the cost-benefit analysis, provide an economic and manufacturability study with updated designs that result from developments during prototype testing, DDG(X) may assess potential for design insertion for potential forward fit/back fit application.

This technology has commercial application in the internal and external combustion engine industry, electric power generation industry, and other manufacturing or production process that rejects low grade waste heat into the environment. This technology will enable lowered operation and production costs, reducing effects on the environment.

REFERENCES:

1. HeatMatrix Group BV. "Corrosive flue gas is no longer a show-stopper for heat recovery." Polymer or Stainless Economiser-ECO. November 29, 2021. <https://heatmatrixgroup.com/products/economiser/>
2. U.S. Department of Energy. "Chapter 6: Innovating Clean Energy Technologies in Advanced Manufacturing: Technology Assessments." Quadrennial Technology Review 2015, Chapter 6. November 29, 2021. <https://www.energy.gov/sites/default/files/2016/02/f30/QTR2015-6M-Waste-Heat-Recovery.pdf>

KEYWORDS: Heat Exchanger; Waste Heat Recovery Unit; Internal Combustion Engines; Diesel Engines; Thermal Recovery; Prime Mover

N24A-T010 TITLE: Subminiature Digital Pitot-static Sensor (SDPSS)

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

OBJECTIVE: Develop a subminiature digital pitot-static sensor (SDPSS) that fully integrates all sensing and readout electronics within the body of the probe, improving GPS-denied navigation on small unmanned aircraft systems (UASs).

DESCRIPTION: Aircraft have used pitot-static air-data systems for measurement of airspeed and altitude since the dawn of the aviation era and are essential to safe navigation in US / international airspace as well as operation in GPS-denied environments. Technical limitations of current air-data system create integration challenges that degrade their utility in important DoD and civilian applications, including guidance, navigation, and control of small UASs.

The conventional approach to integration of air data system typically pairs a centralized air-data measurement system, containing mechanical or digital pressure transducers, plumbed with tubing to a relatively simple mechanical probe. Pitot-static probes provide pressure-tight connections to a small hole in the center of the rounded tip (pitot port) and to a ring of holes around the periphery of the probe (static pressure port), usually located about 5 probe diameters aft of the tip.

Pressure altitude is calculated using comparison of the absolute (vacuum referenced) static pressure measurement to standard conditions of the International Standard Atmosphere. Correction for ground-level barometric pressure (e.g., as measured at the local airport) permits estimation of the local altitude above ground level – essential for altitude deconfliction of aircraft, as well as terrain and obstacle avoidance. Correction for non-standard temperature and dew point permits computation of the density altitude, which is an important factor in aircraft performance (e.g., lift, drag, and power).

Using Bernoulli's principle, a differential pressure measurement between pitot (ram air) pressure and static (ambient) pressure indicates the airspeed in the direction of the probe. Correction for installation effects of the probe mounted to the aircraft, compressibility effects at high speed, and air density yields the calibrated, equivalent, and true airspeed, respectively.

Although the pitot-static system has been a reliable component of manned and unmanned aviation for more than a century, several drawbacks persist, especially for integration on very small aircraft, including compact drones in wide usage by DoD and civilian operators. In many cases, these small UASs operate without airspeed / altitude sensing entirely and can only navigate with GPS, leaving them susceptible to GPS interference (intentional or unintentional). Furthermore, operation without (or with a sub-par) pitot-static system can reduce the robustness of the flight controls due to adverse weather and limit the safe flight envelope (reducing efficiency / loiter time or maximum climb / dash performance). These challenges include:

- Physical space occupied by centralized air data computer systems, including individually packaged absolute and differential pressure transducers, signal conditioning, analog-to-digital conversion, and microprocessor, as well as their accompanying mechanical interfaces (tubing, quick disconnects, strain relief bracketry, etc.)
- Hidden failures within pressure plumbing (e.g., leaks or obstructions) due to human error (e.g., pinched tube, contaminated connectors) or operations in a severe environment (e.g., icing, thermal / chemical / UV degradation of plastics)
- Need to provide separate static pressure connection to absolute sensor and reference port of differential pressure sensor, requiring a splitter and additional tubing bulk
- Pressure lags due to long tubing runs in small diameter tubing, degrading the speed, stability, and accuracy of key navigation inputs

- Limited availability of commercial sensors in miniature packages with required accuracy, stability, speed, resolution, and port configuration
- Reliance on separate sensors (or operator inputs) [e.g., outside air temperature] to apply proper correction factors – potentially introducing new sources of error
- Scalability (number of sensors) - challenges above are compounded when multiple sources of air-data measurements are desired or required to achieve desired reliability levels
- Scalability (physical size) – traditional construction relying on physical tubing interconnects between probe and readout device imposes scalability limitations preventing scaling to very small sizes, such as for integration on micro-air vehicles
- Calibration of probes separately from readout equipment creates challenges for traceability and integration

The Navy requires development of a new class of digital pitot-static sensors that sidesteps or mitigates each of these problems. We note that the current state of practice / art in related fields – such as high-performance micro-electromechanical systems (MEMS) manufacturing, widespread commercialization of multi-chip/die integration of heterogeneous elements within the same mechanical packages, and advancements in precision additive manufacturing and computer-aided co-design of electronic and mechanical assemblies – could readily be applied to this problem space to offer compelling solutions.

The sensor assembly should:

- Have an overall outer probe tip shape consistent in proportion with accepted practice for construction of pitot-static tubes
- Fit within a cylindrical volume 0.25 inches in diameter and 5 inches long. Preferably, fit within an objective cylindrical volume 0.125 inches in diameter and 2.5 inches long (or smaller)
- Provide a mating surface / fixturing interface, preferably to a hollow support / extension shaft that adapts to the customer's application (e.g., unmanned aircraft wing, nose, or fuselage mount, wind tunnel fixture, etc.)
- Contain all readout electronics, including but not limited to absolute/ differential pressure / temperature / humidity sensing elements, power / signal conditioning, analog-to-digital conversion, microprocessor, etc.
- Operate off a single, common, coarsely regulated low voltage supply, at low supply current – preferably $< 20 \text{ mA}$ at $3.3 \text{ V} \pm 0.3 \text{ V}$ (not including anti-icing provisions)
- Produce pressure altitude measurements over a full-scale range of at least 1000 to 53,000 feet with an accuracy better than ± 10 feet (-1000 to 20,000 feet) ± 20 feet (20,000 to 29,000 feet), ± 30 feet (29,000 to 41,000 feet), and ± 50 feet (41,000 to 53,000 feet)
- Produce indicated airspeed measurements with an accuracy better than $\pm 5\%$ of the actual indicated airspeed over the full-scale range from 10 knots to 60 knots (low-speed configuration) or over the full-scale range from 30 knots to 180 knots (high-speed configuration)
- Produce outside air temperature (OAT) measurements over a full-scale range of at least $-84 \text{ }^{\circ}\text{C}$ to $+45 \text{ }^{\circ}\text{C}$ with an accuracy better than $1 \text{ }^{\circ}\text{C}$
- Contain design features (e.g., heater, drain holes, coatings) to prevent rain / ice from interfering with proper operation
- Implement a bidirectional digital serial interface capable of supporting multiple addressable sensors on the same bus such as I2C, daisy-chained SPI or UART, CAN, etc.
- Permit addressing of individual sensors (e.g., for configuration / calibration) when sending command or the complete chain (e.g., to poll all sensors for a simultaneous on-demand measurement, or to 'broadcast' a shared configuration parameter)
- Digitally transmit commonly required information (e.g., sensor identification, sensor / correction status, altitude, airspeed, outside air temperature, etc.,) as a single serial data packet
- Transmit and receive data fields as appropriately scaled and signed integers, in binary representation of appropriate bit width, preferably in multiples of 8 bits (one byte)

- Encode / decode multibyte fields with uniform endianness. Endianness may be fixed or selectable by non-volatile configuration parameter.
- Utilize a Fletcher-16 checksum (or any alternative appropriate position-dependent binary checksum) to support the verification of encoded / decoded serial messages
- Respond to serial commands with appropriate acknowledgment / rejection (ACK / NACK) messages
- Provide a mechanism to unambiguously flag transmitted data that may be invalid (e.g., during execution of built-in-test or after detection of an out-of-range condition)
- Provide “factory-programmable” non-volatile storage (e.g., internal sensing element / signal conditioning calibration tables, operating software, and other data as required for operation and evaluation)
- Provide “user-programmable” non-volatile storage for correction coefficients (e.g., sensor installation effects, if known) and other operating parameters (e.g., reference barometric pressure, filtering / smoothing settings, correction types enabled, selection of output units, protocol / bus configurations, etc.)
- Implement a built-in-self-test function, including coverage of hardware, software, and status of non-volatile memory, where feasible
- Provide a method to reset configuration to factory settings
- Support operation in either polled (transmit on demand) or automatic (transmit at a fixed update rate) modes. Preferably, sampling should be time-aligned in either mode, when multiple sensors are daisy chained on the same bus
- Support a standard output data rate of at least 20 Hz. Preferably, higher / lower configurable output data rates may be configurable by the user
- Provide internal analog / digital filtering as required to ensure Nyquist sampling criteria are satisfied at the selected output data rate. Filter designs shall not exhibit overshoot

Note: Digital sensor concepts for measuring aerodynamic parameters typically derived from pitot-static probes using non-pressure based phenomenology (e.g., ultrasonic wave propagation) will be considered.

PHASE I: Define and develop a technical concept that can meet the SDPSS measurement performance and size, weight, and power constraints listed in the Description. Conduct modeling, simulation in order to provide an initial analytical assessment of concept performance. Develop conceptual options for both low-speed and high-speed configurations.

The Phase I Option, if exercised, includes further refinement and/or validation of one conceptual design configuration towards a manufacturable state. This effort may include risk reduction experimentation in a lab environment, in order to address residual feasibility concerns and validate novel aspects of the concept.

PHASE II: Finalize developments of the Phase I SDPSS design and fabricate prototypes for demonstration and validation. Deliver six calibrated prototypes to the government for wind-tunnel verification and/or low-risk flight evaluation (data logging only).

The Phase II Option, if exercised, would mature prototypes further for experimental integration as a primary air data sensor for an unmanned system. Enhancements may include redesign to tailor specifications for the application and/or to meet additional qualifications required for integration (shock, vibe, EMI, etc.).

PHASE III DUAL USE APPLICATIONS: Support the Navy/government to transition the SDPSS technology / units into various unmanned aviation programs within the DoD, with initial emphasis on small aircraft < 55 lbs. Once the technology is proven it may find use a primary or secondary (redundant) air data source on larger and even future manned aircraft.

In the commercial sector, SDPSS is likely to find a market both in civilian unmanned vehicle operations as well as in the general aviation / light sport / experimental aircraft industry due to the reliability and weight savings advantages of a “solid-state” digital air data system.

REFERENCES:

1. Pilot's Handbook of Aeronautical Knowledge. FAA-H-8083-25C. Federal Aviation Administration
2. Merriam, Kenneth and Spaulding, Ellis. “COMPARATIVE TESTS OF PITOT-STATIC TUBES. NACA-TN-546.” National Advisory Committee for Aeronautics, November 1935.

KEYWORDS: SENSORS; MEMS; ELECTRONICS; AIRSPEED; ALTITUDE; ALTIMETER; AIR; DATA; PRESSURE; DIGITAL; TRANSDUCER; PITOT; PITOT-STATIC; AIRSPEED INDICATOR; AUTOPILOT; UNMANNED; AIRCRAFT; SAFETY; NAVIGATION; UAS

N24A-T011 TITLE: Corrosion Modeling Analytics and Machine Learning to Promote Corrosion-Informed Design to Reduce Ship Maintenance

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

OBJECTIVE: Develop (1) protocols algorithms to transform various raw data formats into information-rich features for machine learning (ML), and (2) software and modeling tools for ML that will automatically detect patterns in data; and learn and augment from experience and corrosion-informed models the ability to predict optimal materials selection and/or corrosion control measures to reduce Navy ship maintenance.

DESCRIPTION: A number of Navy ship classes face growing maintenance delays and maintenance costs. Some solutions resort to cannibalization of parts: moving them from one ship to keep another one operational. This is a critical issue as Navy ships are getting fewer steaming hours because of growing maintenance delays and costs. Maintenance delays have resulted in some ships deferring maintenance. Over time this situation has resulted in worsening ship conditions and increased costs to repair and sustain ships. In some cases, maintenance has been deferred to the point where ships have been decommissioned several years ahead of their planned service life. With increasing computer capabilities, growing materials databases, increasing computational capabilities, the growing use and power of ML and artificial intelligence, digital engineering can reduce acquisition timelines and cost, permit more rapid system upgrades, and streamline maintenance. In addition to verified corrosion models in relevant operational environments, failure analysis, inspection reports, documented ‘lessons learned’, and the results of past maintenance practices can be incorporated into the materials database.

The challenge of digital engineering for DoD is attaining knowledge-based integration of data sufficient to decide lifecycle issues. Key elements of digital engineering are developing and compiling materials databases and developing relevant corrosion models that can predict materials behavior and operational life in platform systems operating in marine environments. ML is a powerful subset of artificial intelligence (AI) for systems to learn from data, pattern identification, and decision making. Application of ML tools can enable characterization of materials and informed-corrosion behavior in new ship design and inform Navy Maintenance personnel about options for cost-effective materials or corrosion control methods to lessen future ship maintenance. A key challenge in applying ML algorithms to materials science data is that data comes in many formats. Determining how to featurize and utilize different materials data formats so that prior data can be used as training data for ML algorithms can be difficult. Feature engineering, including extraction, transformation, and informed selection, is critical for improved ML accuracy and increase Fleet operational availability.

PHASE I: Define and develop a concept/approach/framework for feature engineering tools to extract critical information related to corrosion and other degradation pathways (e.g., physical, strength, fatigue resistance, etc.) from multiple formats. Key features may also include material properties, chemistry, and processing variables. Include in the concept/approach/framework appropriate identification classifiers and interactions. Assemble verified corrosion models and other descriptive terms for different materials. Develop a Phase II plan. In a Phase I option, if exercised, demonstrate the feasibility of the proposed concept/approach to provide labeled data output for corrosion/corrosion control options.

PHASE II: Develop, demonstrate, and validate a materials database for supervised (e.g., support vector, neural networks) and unsupervised learning algorithms (e.g., cluster analysis) use for corrosion/corrosion control and life prediction. Ensure that the collective database is able to identify prioritization of features whether it be structural, chemical, and physical properties or AM-related processing-microstructure-property phenomena relative to corrosion phenomena.

PHASE III DUAL USE APPLICATIONS: Transition optimized computational/informatics handling engineering tools for commercialization in ML utilization through original equipment manufacturers (OEMs) or other partnering agreements. Demonstrate the technology to DoD warfare centers/production facilities. The design tool is focused on application in a marine environment so offshore structures such as oil and gas platforms could benefit.

Dual use applications could include aircraft, land vehicles, materials processing entities. Commercialization of this technology may be realized via success in predicting materials service life in marine and modified marine environment in ship systems.

REFERENCES:

1. Witten, Ian; Frank, Eibe; Hall, Mark A. and Pal, Christopher J. "Data Mining: Practical Machine Learning Tools and Techniques (Fourth Edition)." Morgan Kaufmann Series in Data Management Systems, Elsevier, 2000.
<ftp://ftp.ingv.it/pub/manuela.sbarra/Data%20Mining%20Practical%20Machine%20Learning%20Tools%20and%20Techniques%20-%20WEKA.pdf>
2. Ling, Julia, et al. "Machine Learning for Alloy Composition and Process Optimization". (Proceedings of ASME Turbo Expo 2018 Turbomachinery Technical Conference and Exposition.) <https://arxiv.org/abs/1704.07423>
3. LaQue's Handbook on Marine Corrosion, 2nd ed., Electrochemical Society Monograph Series, D.A. Shifler, Ed., John Wiley & Sons (June, 2022)
4. D.A. Shifler, "Designing for Affordable Corrosion Control in Marine Environments", Proceedings of 2023 DoD Corrosion Prevention Technology and Innovation Symposium, August 14-17, 2023, Tucson, AZ.
5. S. Singh, S. Mohan, "AI is Driving Digital Transformation in Engineering", Control Engineering, <https://www.controleng.com/articles/ai-is-driving-digital-transformation-in-engineering>

KEYWORDS: Machine learning; corrosion; modeling; digital engineering; design; maintenance; materials dataset

N24A-T012 TITLE: Scalable High Frequency Transmit/Receive Array for Multiple Unmanned Underwater Vehicle and Torpedo Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Integrated Sensing and Cyber;Sustainment

OBJECTIVE: Develop a configurable, scalable, adaptable, and affordable High Frequency SONAR array technology based upon efficient and affordable textured ceramic materials to offer benefits of improved performance in more compact form factors.

DESCRIPTION: Textured transduction ceramic materials based on lead magnesium niobate-lead titanate (PMN-PT) are an emerging transduction material with properties and performance characteristics superior to those of legacy lead zirconate titanate (PZT), offer additive manufacturing advantages that translate to unique performance and applications opportunities, and are more affordable than the higher performing and less available single crystal materials. The advent of textured ceramics has proven to be a boon to the Navy in stimulating investments that are affordably and effectively refreshing the critical national infrastructure that is acoustic transduction. The space, weight, power, performance, and cost tradeoff space has been altered by textured ceramic materials in a way that is succeeding in overcoming reluctance to considering the risk and cost of new acoustic transduction devices. On autonomous vehicles, maximum sustained performance at the lowest cost is the objective. Making multiple uses of the same, best array of acoustic sensors within an open architecture communication and control architecture to best and most affordably perform multiple missions is an opportunity large enough to subsume multiple stovepipes in legacy capabilities. While not yet so mature, compositions of textured PZT materials are of interest, but only to the extent that documented experience with the proposed material formulation is cited. Designs appropriate to future multi-mission heavy-weight torpedoes but which can be scaled / configured to meet the HF search and acoustic communications requirements of next generation UUVs and concept for their employment in the performance of a variety of missions including Mine Warfare (MIW), Naval Special Warfare (NSW), and Explosive Ordnance Demolition (EOD), while simultaneously offering higher performance back-fit options are a priority are a principal objective. Government rights to a sensor and array design concept so that stove pipes in both future and legacy systems can be mitigated is another high priority objective.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq.* (1993). <https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004>

PHASE I: Develop a scalable HF acoustic transducer concept that is configurable as an acoustic transmit/receive array suited to both legacy acoustic communications and heavyweight torpedo detection and homing applications. Demonstrate a robust, manufacturable, and affordable design for individual transducer elements that are consistent with a scalable array concept that is appropriate for consideration

as options for both legacy UUV and heavyweight torpedo applications, but which offer scalable, and configurable future performance improvement and mission capability options.

PHASE II: Construct an HF array of such sensors suitable to some legacy or future application. Evaluate the cost and performance envelope made possible by the innovative application of textured ceramics in some new or existing array concept for which the Navy has government use rights. Alignment of the physical characteristics of the design to a form that can be tested on a UUV or torpedo platform of specific, relevant interest to a transition customer agreeable to collaborative testing is expected. The transition application for the customer / collaborator at Phase II, including perhaps a different or additional transition customer at Phase III, is likely to have corresponding security and export control restrictions.

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

PHASE III DUAL USE APPLICATIONS: Deliver an affordable and fundamentally new performance capability for both commercial and Navy / Marine Corps and commercial high frequency SONAR and for Navy / Marine Corps acoustic communications that could not before have been achieved on the basis of space, weight, and power constraints. Alternatively, the Phase III application might well be one intended to remedy a situation of prohibitive cost for a legacy capability. The transition customer would provide detailed specifications for the transducers and for the array extent and geometry.

REFERENCES:

1. Eckstein, Megan. (29 October 2015). "Navy Planning Torpedo Restart, Would Be Modular Design With Multiple Payloads." USNI News, 29 October 2015.
2. Butler, J.L. and Sherman, C.H. "Transducers and Arrays for Underwater Sound." Springer, 2016.

KEYWORDS: open architecture; textured ceramics; acoustic communication; acoustic transducer; acoustic array; high frequency

N24A-T013 TITLE: Adaptive Instructor Aid for Virtual Reality/Augmented Reality Enabled Classroom Training

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

OBJECTIVE: Develop a system for real-time monitoring of student performance and performance-driven instructional adaptation within an immersive (that is, virtual or augmented reality enabled) training experience.

DESCRIPTION: Virtual Reality (VR) and Augmented Reality (AR) are becoming more common in Navy training as instructional media that provide visually immersive training conditions, both in the classroom for individual training and in team dynamic settings. This has the advantage of exposing the student to visual operational conditions that are motivationally immersive and hard to replicate or train to in purely live training. While VR and AR technologies are modern and alluring, use of these technologies alone does not ensure training effectiveness. Furthermore, their introduction may insulate an instructor from fully observing and adaptively interacting with the student, reducing natural and traditional student/instructor experiences. A body of knowledge in basic research addresses the effective use of VR/AR, including the need to monitor student performance and adapting the pace or content of instructional material based on this [Ref 1]. This STTR topic seeks to develop a VR/AR learning system that adapts to the student based on the competency of the student's performance and yields a learning gain that is significantly better than current training methodologies. Toward this end, the aim is to develop a working prototype and a student performance measurement approach that can be generalized across a range of classroom adaptive training environments where VR and AR could be applied.

PHASE I: Determine a technical approach to monitor competency of student performance while using wearable VR or AR instructional media and use such information to inform and adapt instructional content. Determine the metrics to measure student performance shortfalls, and for assessing system training effectiveness. Include designs of baseline measures that would be administered before training and a comparison measure after introducing this new approach, using any current Navy Use Case. Phase I accomplishments will be presented to cognizant ONR Program Officers for feedback before initiating Phase II activity.

PHASE II: Apply the Phase I approach to a representative Navy classroom training environment where VR and/or AR are, or could be, used. Implement the technical approach in a prototype and collect metrics for baseline comparison. The government will provide a representative Navy VR/AR classrooms environment if the performing team does not have access to or insight into the content and design of Navy-relevant classroom settings.

PHASE III DUAL USE APPLICATIONS: Assess the training value of the approach developed in Phase II, comparing it with VR or AR-based training without the assessment and adaptivity of this approach. If the approach developed is demonstrated to be significantly better in training efficacy (speed and/or level of the students' content mastery) based on criteria agreed on by ONR and Fleet representatives, demonstrate the system to leadership in the Fleet Training Wholeness Program of Record. Commercialization opportunities should be explored in Phase II and pursued in Phase III. Potential markets that would be interested in this technology include aviation, maintenance, law enforcement, and the medical field.

REFERENCES:

1. Mayer, R.E., Makransky, G., & Parong, J. (In press). The promise and pitfalls of learning in immersive virtual reality. *International Journal of Human-computer Interaction*, Volume 39, 2023

- Issue 11: Trends in Adaptive Interactive Training Systems.
<http://www.tandfonline.com/doi/abs/10.1080/10447318.2022.2108563?journalCode=hihc20>
2. Landsberg, C.R., Mercado, A.D., Van Buskirk, W.L., Lineberry, M. & Steinhauer, N. (2021). Evaluation of an adaptive training system for submarine periscope operations. Proceedings of the Human Factors and Ergonomics Society. 56(1), 2422-2426.
 3. Metzler-Baddeley, C., & Baddeley, R. J. (2009). Does adaptive training work?. Applied Cognitive Psychology, 23, (2), 254-266.

KEYWORDS: Virtual reality; augmented reality; Adaptive training; Instructional media; immersive environments; classroom training

N24A-T014 TITLE: Technology to Drive Extreme Runtime in Wearable Devices

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

OBJECTIVE: Develop a software technology to be coupled with an existing hardware technology in the form of a fieldable, wearable device that enables the onboard analyses of sleep and performance indicators that impact militarily relevant performance and reduces both battery consumption and storage requirements.

DESCRIPTION: Wearable devices offer the DoD novel information to support readiness of Service Members, informing health and safety risks [Refs 1-2]. Currently DoD lacks the ability for continuous remote monitoring (e.g. physiological) to inform readiness metrics under austere military conditions due to power supply limitations of commercially available wearable devices. Addressing this gap will support feedback to the individual Service Member for improved individual performance and resilience, personnel wellness across the unit, and ultimately, to inform and support decisions affecting training, readiness, and mission planning [Ref 3].

The objective of this STTR topic is to develop a software application that can be incorporated with existing wearable devices (e.g. Android) to enable continuous remote monitoring in austere military environments. Operational environments that involve movements, such as maritime, where induced environmental motion make detection of activity levels or sleep periods particularly challenging should be addressed in device selection. Devices, at a minimum, should continuously capture heart-rate, heart-rate variability, activity/motion, timing of sleep periods and asleep/awake status across the 24-hour day, for a duration of at least 30 (threshold) or 60 (objective) days without charge.

The software application should provide onboard computing and processing of sleep and fatigue data utilizing emerging commercial applications, such as tinyML, to significantly reduce power consumption and data size. Data should be formatted in a way that can be interpreted and ingested in a database agnostic manner, and support rapid transmission to a local server. Data transmission should be conducted via wireless (e.g. Bluetooth) means. The development of this technology will greatly improve the ability to field wearable devices for long periods of time in disrupted, disconnected, intermittent and low-bandwidth environments; where understanding readiness state is critical, but ability for device recharging may not be operationally feasible.

PHASE I: Define, develop, and demonstrate ability to run software application on a commercially available wearable device that enables initial improvement for reduce power consumption and data size, and a plan for transmitting data wirelessly to local server. Define plan for reaching desired battery life with required data collection (e.g. sleep) measures, and ability to test at multiple milestones within both lab and home/operational environments. Define plan to completely turn off device in emission controlled conditions: manually (Threshold) and remotely (Objective). Phase I will result in a proof of concept for testing/demonstration only, no human subjects testing will occur.

PHASE II: Testing and fielding of software application with at least 50 devices within lab and home/operational environments to support verification and validation testing of power consumption rates, data formatting, and other time synchronization between device and local server. Additional testing for data transfer speeds of sleep start and stop times, and health-related summary and other time series data covering a period of 24-hours to 72-hours between devices and a disconnected database infrastructure. The prototypes applications—that meet the transmission needs, onboard computing, and extended runtimes—will be demonstrated in a military relevant environment. Additionally, the developed application and combined wearable will need to be interoperable with existing DoD wireless

infrastructure. The prototype device will need to manage wireless transmission of health and readiness status information over a wireless link while maintaining an extended runtimes; and maintain sufficient on-device memory storage to retain multiple weeks' worth of summary information, processed sleep and performance indicators, and synchronize the saved information to the DoD support infrastructure. Interface specifications will be done in collaboration with Navy/DoD to define and develop appropriate wireless interfaces in existing data infrastructure. Provide a detailed plan that will outline the verification of the wearable device, it's sensing capabilities, communication protocol, and validation of the onboard sleep and performance analyses. The wearable device should provide at a minimum but not limited to, heart-rate, hear-rate variability, activity/motion, and asleep/awake health status information. Details of the device requirements will be provided to the Phase II awardee(s). Provide a detailed plan that will occur for testing and evaluation (to include data type, frequency, and structure).

PHASE III DUAL USE APPLICATIONS: Integrate Phase II prototypes into deployed Naval vessels and transition finalized product to the Naval Surface Force (SUFOR). Plan for longitudinal evaluation of the Phase II prototype devices in an operational environment. This evaluation will consist of a cross comparison of the prototype function across two (or more) ships of different class and where appropriate include Marines and other service members embarked on warships (e.g., Destroyer vs. Amphibious Assault Ship) across the Operational Deployment Cycle/Optimized Fleet Response Plan Cycle. Outline the ability to mass produce, support, and service the developed wearable devices.

Dual uses in the commercial sector include sporting teams, extreme athletes, and emergency services (Fire, EMS).

REFERENCES:

1. Fried, Karl E. "Military applications of soldier physiological monitoring." *Jour of Sci and Med in Sport*, 2018 Nov, 21(11), p.1147.
2. Stepheson, Mark et al. "Applying Heart Rate Variability to Monitor Health and Performance in Tactical Personnel: A Narrative Review." *Int J Environ Res Public Health*, 2021 Jul 31, 18(15), p. 8143. doi: 10.3390/ijerph18158143
3. Saxon, Leslie et al. "A Novel Digital Research Methodology for Continuous Health Assessment of the Special Operations Warfighter: The Digital cORA Study." *J. Spec Oper Med.*, 2022 Dec 16; 22(4), pp. 78-82. doi: 10.55460/4SSJ-AHIB.

KEYWORDS: Physiological monitoring, sleep, fatigue, wearables, human performance, extended battery life

N24A-T015 TITLE: Polarization-enhanced, Long-range, Wide-area, High-resolution Imaging System

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

OBJECTIVE: Develop polarization-based techniques to improve target detection and identification and scene clutter characterization at long-range and over a wide field-of-view.

DESCRIPTION: Detection and identification of small targets at long range on the ocean surface is challenging due to wave clutter, reduced observation time from shadowing, and often poor target contrast. To enhance target detection and identification, the USN seeks to exploit the additional information content provided by polarization. Specifically, 3D polarization imaging has improved significantly in recent years as multiple strategies have been developed to resolve the polar and azimuthal angular ambiguities [Ref 1]. Measurement of polarization often provides increased discrimination of man-made objects from nature backgrounds, while the 3D variant could increase the likelihood of positive identification. Moreover, many new polarization-based techniques have been developed in recent years that could significantly increase performance over the conventional Stokes vector analysis, which alone often yields favorable results, but only for specific applications.

Within the scope of this STTR topic, the USN seeks to develop a 3D polarization imaging system to significantly improve long-range detection and identification of targets in maritime clutter from surface-ship platforms. In principle, all wavelength bands from the UV to mm-wave will be considered, although transmission and depolarization with passage through the atmosphere in the maritime environment should be considered. Novel polarization techniques, such as point-spread-function engineering [Ref 2] or speckle correlation [Ref 3], which could potentially improve depth resolution or sampling rate, are also of interest. The use of multi-point correlation functions, such as the complex degree of mutual polarization [Ref 4] or other polarization correlation functions, would be of interest if these techniques can be used to enhance target identification or discrimination in clutter. In addition to the development of imager hardware, a processing component can be anticipated, which could exploit local measurements of the environment, such as ocean wave power spectra or the air-sea temperature jump, to enable optimization of data acquisition and interpretation [Ref 5].

PHASE I: Develop a preliminary design of hardware and algorithms for a novel polarization-based imaging and sensing system that significantly exceeds the current state-of-the-art and enables improved detection and ID of small targets in a maritime environment at ranges beyond 1 km. Targets of shorter range are not of interest under this topic. Additionally, proposed solutions can explore polarization techniques combined with other techniques to further augment 3D image formation. The design should be supported by ample modelling and simulation results to justify construction in Phase II and by risk mitigation experiments as needed.

PHASE II: Develop a hardware/software realization of the design proposed under Phase I. Laboratory based testing should be completed under the Phase II effort to demonstrate the performance of the system.

PHASE III DUAL USE APPLICATIONS: Refine the design of improved ruggedness, size, weight, and power needs to broadly enable use of the system. Produce a sufficiently rugged system to enable field testing under relevant maritime conditions.

REFERENCES:

1. Li, X et al. "Polarization 3D imaging technology: a review." *Frontiers in Physics*, 9 May 2023.

2. Ghaneka, B. et al. "PS2F: Polarized Spiral Point Spread Function for Single-Shot 3D Sensing." IEEE Transactions on Pattern Analysis and Machine Intelligence, 1 – 12, 29 August 2022.
3. Du, Y. et al. "Accurate dynamic 3D deformation measurement based on the synchronous multiplexing of polarization and speckle." Optics Letters 48 (9) ,2329 (2023).
4. Eshaghi, M. and Dogariu, A. "Discriminating randomly polarized fields." Optics Letters 45 (7), 1970, (2020).
5. Shaw, J.A. and Churnside, J.H. "Scanning-laser glint measurements of sea-surface slope statistics." APPLIED OPTICS 36 (18), 4202, (1997).

KEYWORDS: infrared imaging; polarization; polarimetric imaging; infrared; IR; electro-optical/infrared; EO/IR; maritime sensing

N24A-T016 TITLE: Plasma Assisted Combustion for Enhanced Performance and Operability in Naval Air Vehicles and Weapons

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

OBJECTIVE: Develop, demonstrate, and validate a novel Plasma Assisted Combustion (PAC) device that can be integrated into future naval air platforms and weapons propulsion systems.

DESCRIPTION: The Office of Naval Research seeks development and demonstration of an innovative PAC system to improve the performance, efficiency, and operability of gas turbine engines in naval aircraft. The primary goal of this STTR topic is to identify and explore advanced combustion technologies that will enable significant improvements in performance, fuel efficiency, operational capabilities, and integration with various fuel types, while maintaining or enhancing reliability, maintainability, and safety. The target application for this technology is gas turbine primary combustors, augmentors, rotating detonation combustors, and inter-turbine burners. A brief description of these devices is provided below:

1. Primary Combustor: The primary combustor is where most of the combustion in a gas turbine occurs. Fuel is injected and ignited at high temperatures and pressures and the products drive the turbine stages of the engine.
2. Augmentor: The augmentor, or afterburner, is used to significantly increase the thrust of military aircraft at the expense of fuel efficiency. Fuel is injected in the exhaust stream and ignited to accelerate the exhaust gas existing the engine. These types of combustors take up a significant amount of volume and weight on military aircraft.
3. Rotating Detonation Combustors (RDCs): RDCs use a continuous detonation wave to burn a fuel-air mixture. The rotating detonation wave enables shorter combustion lengths and the device could theoretically produce a pressure rise, which is beneficial to the engine cycle. These type of devices are often difficult to operate and control.
4. Inter-Turbine Burners (ITBs): In an ITB, fuel is added and combusted between stages of a multi-stage turbine to raise the enthalpy of the flowfield in a compact space. While not as efficient as a primary combustor, the ITB is useful for scenarios where additional thrust is needed (similar to the Augmentor). ITBs are challenging to design because of the aerodynamic and pressure changes caused by turbine stage rotation.

Targeted and controllable combustion in naval aviation gas turbine engines is desirable since they provide thrust over a wide operational envelope for critical mission phases such as takeoff, supersonic cruise, and combat while being weight and volume constrained. Combustor length is typically constrained by the combined resonance time required to atomize, vaporize, mix, heat, and react liquid fuels with oxygen molecules at high flow rates, without blowing the flame out of the desired burn location.

A plasma assisted combustor uses plasma discharges to initiate and stabilize combustion, leading to more efficient fuel burning and improved combustion performance. This innovative technology can potentially lower the ignition temperature while enabling faster and more stable combustion. Additionally, electrically driven and controlled plasma may be used to actively control combustion properties. These improvements could yield significant benefits for naval aircraft including increased operational range, reduced fuel consumption, enhanced mission capabilities, and better component reliability. Specific goals for this effort include:

1. Increased combustion efficiency: Achieve a significant improvement in combustion efficiency relative to traditional combustor designs.
2. Decreased burning length: Decreasing the combustion resonance time will enable shorter combustor designs, which reduce the size and weight of the engine.
3. Improved operational flexibility: Develop a PAC system that can adapt to various operating conditions and fuel types.

4. Acceptable reliability and maintainability: Develop a PAC system that maintains or improves upon the reliability and maintainability of conventional systems, with a focus on minimizing downtime and maintenance costs.
5. Scalable and ready for integration: Design a PAC system that can be readily integrated into future naval aircraft, with the ability to scale the technology for different engine sizes and configurations.

Please note that the Office of Naval Research is specifically interested in liquid Jet fuel PAC solutions for this STTR topic, not gaseous. Although gaseous fuels may be used to minimize risk, they should not be the emphasis of this work.

PHASE I: Conduct a comprehensive feasibility study and develop a conceptual design for the proposed PAC system. Thoroughly explore existing and emerging plasma assisted combustion technologies Assess their applicability to naval aircraft. The research and development efforts in Phase 1 should focus on the following key areas:

1. Literature review and technology assessment: Perform a thorough review of the current state of the art in plasma assisted combustion, including research publications, patents, and ongoing research projects in both academia and industry. Identify and assess the most promising plasma generation methods, plasma-fuel interaction processes, and combustion enhancement techniques that have potential for integration into naval aircraft gas turbine engines
2. Analysis of critical technical challenges: Identify the critical technical challenges associated with developing a PAC system for naval aviation gas turbine engines. These challenges may include, but are not limited to, plasma generation methods, plasma-fuel interaction, combustion stability, integration with engine components and systems, and the ability to adapt to various operating conditions and fuel types. Propose innovative solutions to address these challenges, and evaluate the feasibility of these solutions in the context of the overall PAC system design.
3. Conceptual design: Develop a conceptual design for the liquid Jet fuel PAC system, incorporating the lessons learned from the literature review and technology assessment. The design should clearly illustrate the key components and subsystems of the PAC system, their function and operational requirements. Preliminary engine integration requirements and scaling constraints should also be identified.
4. Preliminary benefits and cost assessment: Quantify the performance benefit and cost impact of using a PAC over existing combustor technology in a Navy-like engine. Among others, the analysis should consider factors such as combustion resonance time, combustion efficiency, operability envelope, fuel consumption, reliability, and maintainability. Please note that performers will need to use their own tools and cycle models to conduct these types of studies.
5. Risk assessment and mitigation: Identify potential risks associated with the development testing, and implementation of the PAC system, including technical, operational, and programmatic risks. Develop a risk mitigation plan that outlines the strategies and measures that will be employed to address these risks throughout the course of the project.
6. Development plan and schedule: Develop a detailed plan and schedule for the subsequent phases of the project, including Phase II (Prototype Development and Preliminary Testing) and Phase III (Full-Scale Testing and Validation). This plan should outline the specific tasks and milestones that will be completed in each phase, the resources and expertise that will be required, and the anticipated timeline for completion.
7. Program cost analysis: Conduct a preliminary cost analysis for the development and testing of the PAC system, including estimates for research and development, prototyping, and testing costs.
8. Close collaboration with original engine manufacturers is highly encouraged starting in Phase I.

Upon completion of Phase I, the resulting feasibility study and conceptual design will serve as the foundation for the subsequent phases of the project, providing a clear roadmap for the development and testing of the PAC system in naval aircraft gas turbine engines.

PHASE II: Develop a prototype PAC system based on the conceptual design from Phase I and conduct preliminary testing to assess its performance, efficiency, and adaptability to various operating conditions and fuel types. Perform design refinement, testing, and optimization, with the goal of addressing the critical technical challenges identified in Phase I and demonstrating the potential operational improvements and benefits of the PAC system. The research and development efforts in Phase II should focus on the following key areas:

1. Detailed design and component selection: Develop a detailed design for the liquid jet fuel PAC system, including the selection of appropriate materials, components, and subsystems that meet the requirements for each test. This design process should involve a thorough evaluation of various plasma generation techniques, plasma-fuel interaction strategies, and combustion enhancement approaches, with the goal of selecting the most promising and feasible options for a Navy PAC system.
2. Prototype fabrication: Fabricate a prototype PAC system based on the detailed design, using advanced manufacturing techniques and materials, as required. Performers are expected to collaborate with engine manufacturers, materials suppliers, and other relevant stakeholders to ensure relevance and facilitate technology transition.
3. Preliminary bench-scale testing: Conduct preliminary bench-scale testing of the prototype PAC system using liquid jet fuels to assess its performance, efficiency, and adaptability to various operating conditions and fuel types.
4. Data analysis and design optimization: Analyze the data collected during the preliminary bench-scale testing to identify any areas of the prototype's design that required refinement or optimization. This analysis should involve a thorough evaluation of the PAC system's performance, efficiency, and adaptability, as well as its overall impact on engine operation, maintenance, and safety. Based on this analysis, refine and optimize the design of the PAC system to address any identified issues and maximize its potential benefits for naval aircraft gas turbine engines.
5. Updated risk assessment and mitigation: Revisit the risk assessment and mitigation plan developed in Phase I, and update it based on the results of the prototype development and preliminary testing. This update should include any new risk mitigation strategies and measures that have been employed during the course of Phase II.
6. Phase III planning: Develop a detailed plan for Phase III (Full-Scale Testing and Validation), outlining the specific tasks, milestones, and resources that will be required to conduct full-scale testing of the optimized PAC system, validate its performance and efficiency improvements, and develop a plan for integrating the system into future naval aircraft gas turbine engines.

Upon completion of Phase II, the resulting optimized prototype PAC system will serve as the basis for the subsequent Phase III, demonstrating the potential benefits and feasibility of implementing this advanced combustion technology in naval aircraft gas turbine engines.

PHASE III DUAL USE APPLICATIONS: Conduct full-scale testing of the optimized PAC system in a relevant engine environment, validating its performance, efficiency, and operability improvements. The research and development efforts in Phase III should focus on the following key areas:

1. Full-scale testing: Conduct full-scale testing of the optimized liquid jet fuel PAC system in a representative engine environment, evaluating its performance under different operating conditions and using various fuel types.
2. Performance validation: Validate the performance, efficiency, and operational improvements achieved by the PAC system through rigorous data analysis. Compare the results with traditional combustor designs to better quantify the benefits and drawbacks of the new technology. Evaluate

the PAC system's capability to meet the predefined goals and requirements established during Phase I and Phase II.

Upon completion of Phase III, the resulting validated PAC system will be ready for detailed engine integration studies and manufacturing readiness level maturation. Ideally, this effort will result in significant combustion performance and operability improvements over the state of the art. Improvements in combustion efficiency, fuel consumption, and operational flexibility make it an attractive solution for commercial aviation. In commercial aviation, fuel efficiency is a critical concern for airlines. Implementing PAC technology in aircraft engines could significantly reduce fuel consumption and emissions, leading to substantial cost savings for airlines and reduced environmental impact. Furthermore, enhanced combustion efficiency and operability could enable the use of alternative and sustainable fuels, supporting the aviation industry's ongoing effort to transition towards more environmentally friendly energy sources. PAC could also improve ground based power generation.

REFERENCES:

1. Starikovskaia, S. M. "Plasma-assisted ignition and combustion: nanosecond discharges and development of kinetic mechanisms." *Journal of Physics D: Applied Physics*, 47(35), 353001. <https://iopscience.iop.org/article/10.1088/0022-3727/47/35/353001/meta>
2. Li, M.; Wang, Z.; Xu, R.; Zhang, X.; Chen, Z. and Wang, Q. "Advances in plasma-assisted ignition and combustion for combustors of aerospace engines." *Aerospace Science and Technology*, 117, 106952, 2021. <https://www.sciencedirect.com/science/article/pii/S1270963821004624>
3. Sun, W. and Ju, Y. "Nonequilibrium plasma-assisted combustion: a review of recent progress." *J. Plasma Fusion Res*, 89(4), 2013, pp. 208-219. http://www.jspf.or.jp/Journal/PDF_JSPF/jspf2013_04/jspf2013_04-208.pdf
4. Starikovskiy, A. and Aleksandrov, N. "Plasma-assisted ignition and combustion." *Progress in Energy and Combustion Science*, 39(1), 2013, pp. 61-110. <https://www.sciencedirect.com/science/article/pii/S0360128512000354>
5. Ju, Y. and Sun, W. "Plasma assisted combustion: Dynamics and chemistry." *Progress in Energy and Combustion Science*, 48, 2015, pp. 21-83. <https://www.sciencedirect.com/science/article/pii/S0360128514000781>
6. Ju, Y. and Sun, W. "Plasma assisted combustion: Progress, challenges, and opportunities." *Combustion and Flame*, 162(3), 2015, pp. 529-532. <https://www.sciencedirect.com/science/article/pii/S0010218015000280>

KEYWORDS: Plasma Assisted Combustor (PAC), Gas Turbine Engines, Combustor, Combustion Efficiency, Fuel Consumption, Plasma, Rotating Detonation, inter turbine burning

N24A-T017 TITLE: Soft Robot for Locomotion in Granular Seabed Media

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

OBJECTIVE: Develop a soft robot capable of untethered, autonomous locomotion within granular media in shallow sea-floor environments.

DESCRIPTION: Expeditionary forces often work within the littoral environment, to include manipulation of soft, murky, and complex seabed. It is common for these seabed environments to prove difficult for sensors to penetrate for a full understanding of the bathymetry and shallow water regime. The ability to utilize a system which, when deployed by a diver, or from an autonomous vehicle, can work within and on the seabed, penetrating the sediment to help expeditionary users better understand the bottom habitat. This STTR topic seeks to develop a soft robot capable of untethered, autonomous locomotion within granular media in shallow sea-floor environments. The robot should be able to operate with an onboard power source and control system that can permit up to 2 hours of movement and 72 hours of stationary sensing. The robot should be capable of movement within submerged sand up to a depth within 1 meters of the sand surface, and horizontal movement up to 10 meters, on a single battery charge.

A proposed operational task for such robots would be surveying underwater soil regions by following movement trajectories that are pre-defined (e.g., a grid trajectory), or sensory feedback determined (e.g., follow path of low soil resistance). This task requires the ability to move in multiple directions and to incorporate sensor feedback into basic control algorithms for robot movement. The specific military impact will be to enable the detection, characterization and possibly neutralization of buried mines on the seafloor, and locate attached buried wires, although these would not be the specific tasks within this STTR topic. There would also be future opportunities for seabed sensing, communication, and ISR roles.

PHASE I: Conduct a study on the feasibility of a biologically inspired power-autonomous vehicle design, with a focus on mobility mechanism and power source. This should draw on prior biological research on subterranean locomotion kinematics, dynamics, and granular-body interactions. Identify the most promising actuation mechanism, including power requirements and expected lifetime. Conduct a design study of the feasibility of different sustainable power sources (e.g., solar, mechanical energy scavenging, microbial fuel cells) and specify the expected mission duration. Identify materials with surfaces that resist fouling. Develop a Phase II plan.

PHASE II: Fully develop and fabricate a prototype, according to the requirements stated in the Description. Evaluate the design via in-water tests conducted in a realistic submerged soil environment, targeting the listed performance objectives, including vertical and horizontal digging range and stiffness gradient sensing, via untethered operations. At a minimum, the prototype testing shall consist of (1) basic operability testing, (2) grid survey, (3) range/endurance trials, and (4) object detection. The awardee may propose other tests needed to demonstrate the benefits of their design perform analyses to establish reliability, identify areas needing further improvement, if necessary, and analyze manufacturing scalability in order to transition the design into a useful product for the Navy.

PHASE III DUAL USE APPLICATIONS: Apply the knowledge gained in Phase II to build a prototype ready for field testing. Test the prototype according to the Phase II test goals. This technology would have dual use for seabed geotechnical measurements, geology, oceanography, and fisheries.

REFERENCES:

1. Ortiz, D.; Gravish, N. and Tolley M. T. "Soft Robot Actuation Strategies for Locomotion in Granular Substrates." IEEE Robotics and Automation Letters, 4:3, pp. 2630-2636.

2. Dorgan, K.M. “The biomechanics of burrowing and boring.” J. Exp. Biol., vol. 218, no. Pt 2, January 2015, pp. 176-183.
3. Naclerio, N.D.; Karsai, A.; Murray-Cooper, M.; Ozkan-Aydin, Y.; Aydin, E.; Goldman, E.I. and Hawkes, E.W. “Controlling subterranean forces enables a fast, steerable burrowing soft robot.” Science Robotics, vol. 6, no. 55, 2021, p. eabe2922.
4. Ge, J. Z.; Calderón, A. A.; Chang, L. and Pérez-Arancibia, N. O. “An earthworm-inspired friction-controlled soft robot capable of bidirectional locomotion.” Bioinspiration & Biomimetics, 14(3), 036004, 2019.
5. Martinez, A et al. “Bio-inspired geotechnical engineering: principles, current work, opportunities and challenges.” Géotechnique, Volume 72 Issue 8, August, 2022, pp. 687-705.

KEYWORDS: soft robotics; seabed; granular media; underwater soil; autonomous; locomotion, burrowing

N24A-T018 TITLE: Inert Impulsive Expendable Acoustic Source (IIEAS)

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

OBJECTIVE: Develop an expendable impulsive underwater sound source without explosives or combustible gas packaged in A-size sonobuoy and/or Signal, Underwater Sound (SUS) form factor.

DESCRIPTION: High-energy impulsive underwater acoustic sources such as air-guns, sparkers, or explosive/implosive charges are used for oil and gas exploration, seabed characterization, and underwater target detection. Explosive charges, such as the SUS source, are especially convenient for being compact and mobile for easy deployment by surface or airborne platforms. SUS is routinely used to conduct transmission loss experiments used to determine bottom loss parameters which are used in databases for seabed bottom properties. A typical SUS charge contains the chemical compound trinitrotoluene, TNT; a chemical compound used as an explosive material requiring special handling. However, it's been shown that impulsive sound sources, such as created by the implosion of lightbulbs, can be useful for transmission loss or seabed characterization experiments. This STTR topic seeks development of an impulsive sound source without explosives or combustible gas packaged in A-size sonobuoy and/or SUS form factor.

PHASE I: Develop an impulsive underwater acoustic source concept that does not explosives or combustible gas. The source shall exhibit a Peak Source Level greater than or equal to 190 dB//1 μ Pa@1m at water depths of 10 – 200 m or deeper. Energy Spectral Density should be within +/- 10 dB re 1 μ Pa²/Hz @ 1 m from 30 Hz to greater than or equal to 20 kHz. The concept should describe the mechanistic underpinnings of the source and support it with models and simulations. Simulations should demonstrate the source level and spectral content for as a function of depth in a representative ocean environment.

PHASE II: Develop, build, and demonstrate a hardware version of the source concept resulting from Phase I. The demonstration source does not have to be expendable, but should demonstrate the capabilities for source level and spectral characteristics stated in the requirements. Demonstrate that the impulsive source signature is repeatable and predictable for a given source depth. Develop a capability for triggering the source at a specific depth over the range specified. Develop a plan in consultation with the Navy for demonstrating the source to include compliance with environmental regulations. After demonstrations, develop a design for an expendable version of the source with form factors compatible with A-size sonobuoy and SUS.

PHASE III DUAL USE APPLICATIONS: The expected transition will be an inert impulsive expendable underwater acoustic source that can be used for transmission loss surveys, geotechnical surveys, and other naval or civil applications. The inert nature of the source will make handling much safer than currently used sources. Phase III tasking shall include refining the prototype design and fabrication of a near-final product suitable for testing. Sufficient test articles should be manufactured to establish repeatability of the specified source characteristics. An at-sea experimental test and evaluation plan shall be developed and executed in consultation with the sponsor. Test articles meeting the SUS form factor can be demonstrated by being deployed by hand or with the use of a suitable launcher from the deck of a ship. Test articles meeting the A-size sonobuoy form factor must demonstrate compatibility with standard launch tubes with a test plan developed in consultation with the platform operator. In their final forms, the SUS form factor is expected to be used for operational surveys or in support of basic and applied research. The A-size sonobuoy form factor can be dropped from helicopters for ASW search and or environmental characterization.

REFERENCES:

1. Heard, Garry J.; McDonald, M.; Chapman, N.R. and Jashke, L. "Underwater Light Bulb Implosions – A useful acoustic source." Oceans '97. MTS/IEEE Conference Proceedings Page(s), Vol.2, 1997, pp. 755-762. DOI: 10.1109/OCEANS.1997
2. Chapman, N.R. "Source levels of shallow explosive charges." J. Acoust. Soc. Am., 84(2),1988, pp. 697-702 DOI.org/10.1121/1.396849
3. McNeese, A.R.; Lee, K.M.; Sagers, J.D.; Lee, M.J. and Wilson, P.S. "Experimental observations of a rupture induced underwater sound source." J. Acoust. Soc. Am. 148(4), 2020, pp. EL370–EL374. doi.org/10.1121/10.0002259

KEYWORDS: Underwater Acoustics; Sound Propagation; Sound Source; Geoacoustic Inversion; Bubble pulse; Implosion

N24A-T019 TITLE: Portable Analytics for Multi-Stage Cyber Attack Investigation

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

OBJECTIVE: Develop forward-deployed portable analytics to automate initial stages of cyber attack investigation in connectivity-disadvantaged tactical platforms. The technology is needed to reconstruct attack stories, distilling the most important related events from vast quantities of low-level system and network data.

DESCRIPTION: As cyber attacks continue to escalate in complexity and Advanced Persistent Threat (APT) actors shift to using low-and-slow multi-stage attacks, cyber intrusion detection has come to be treated as a Big Data problem. Modern approaches require that a wide variety of information and sensor streams come together in an integrated analysis environment, with human and machine analytics combing the data feeds, hunting for needles in the haystack.

However, in connectivity-disadvantaged tactical environments, all of the fine-grained cyber event data (interface calls, low-level system logs, packet captures, event attestation, etc.) generated by a platform's information systems is unable to be streamed back to a centralized repository in a timely manner. This results in limitations for cyber attack investigations: either central analysis relies on incomplete, untimely, or reduced-precision data, or analytics expecting a global picture have to be pushed out to edge nodes, simultaneously reducing their effectiveness and separating them from the cyber hunt experts best equipped to make use of them.

To better address the problem of conducting effective Defensive Cyber Operations (DCO) on systems where connectivity is Denied, Degraded, Intermittent, or Limited (DDIL), new technology is needed to enable a multi-stage forensics approach to cyber event analysis and investigation. To feed later stages of analysis, portable analytics designed to be edge deployed need to be developed that distill the rich, onboard system and network event data, enabling the platform to make the most efficient use of any upstream connection.

The analytics must not rely on having any backhaul connectivity or onboard operator expertise beyond a most basic set of hints such as an operator noticing that a service crashed or that a subsystem was behaving oddly. The analytics should seek out connections and sequences in the system and network data that map to possible attack tactics, techniques, and procedures (TTPs), then bundle relevant data for priority offboarding to a more centralized analysis platform where it could be further triaged.

PHASE I: Define and develop a concept for automated rapid cyber forensics that can enable multi-stage cyber attack investigation and meet the constraints outlined in the Description. Provide a model of how the analytics would feed the cyber event distillation. Phase I Option, if exercised, would develop the initial distillation capability to create the full prototype in Phase II.

PHASE II: Develop a containerized portable analytic capability to validate the concepts defined in Phase I. Demonstrate attack story reconstruction and key data distillation by ingest on several different types of system and network data. The prototype should be deployable on a connectivity-disadvantaged edge node and able to inform a cyber big data platform by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Integrate the Phase II developed portable analytics prototype to a program as a component to a DCO system. Field containerized analytic with appropriate data ingestors and capability to integrate with existing data fabrics. Commercial use includes cyber security analysis in various sectors such as automotive, IoT, robotics, agricultural, and industrial control.

REFERENCES:

1. Alsaheel, A.; Nan, Y.; Ma, S.; Yu, L.; Walkup, G.; Celik, Z.B.; Zhang, X. and Xu, D. "ATLAS: A sequence-based learning approach for attack investigation." 30th USENIX Security Symposium, 2021.
2. Pei, K.; Gu, Z.; Saltaformaggio, B.; Ma, S.; Wang, F.; Zhang, Z.; Si, L.; Zhang, X. and Xu, D. "Hercule: Attack story reconstruction via community discovery on correlated log graph." Proceedings of the 32nd Annual Conference on Computer Security Applications (ACSAC), 2016.
3. Navarro, J.; Deruyver, A. and Parrend, P. "A systematic survey on multi-step attack detection." Computers & Security, 76, 2018, pp.214-249.
4. Hassan, W.U.; Nouredine, M.A.; Datta, P. and Bates, A. "Omegalog: High-fidelity attack investigation via transparent multi-layer log analysis." Network and distributed system security symposium (NDSS), 2020.
5. Milajerdi, S.M.; Gjomemo, R.; Eshete, B.; Sekar, R. and Venkatakrishnan, V.N. "Holmes: real-time apt detection through correlation of suspicious information flows." IEEE Symposium on Security and Privacy (IEEE S&P), 2019.

KEYWORDS: Cyber, Defensive Cyber Operations, Forensics, Sequence Learning, Situational Awareness, Artificial Intelligence/Machine Learning, AI/ML, Denied, Degraded, Intermittent, or Limited, DDIL

N24A-T020 TITLE: Biological Noise Modeling for Active and Passive Sonar System Performance Predictions

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

OBJECTIVE: Develop a biologic noise model compatible with Navy standard acoustic propagation packages (CASS and RAM) and highlight existing available and/or lacking biologic diversity density databases. The model should be applicable for both active and passive sonar performance predictions by including both the biologic vocalizations and scattering properties as a function of frequency.

DESCRIPTION: The Department of the Navy (DON) seeks to develop and demonstrate new reliable and computationally efficient biologic noise models for use within sonar performance prediction modeling packages such as CASS-GRAB or RAM-PE. Underwater acoustic energy is often dominated by shipping noise (low frequencies) and wind-wave noise (midrange frequencies (MF)). There are existing noise models and techniques for both of these predominate noise sources. However, in some geographical areas, biologics can be the limiting noise source. This can occur in passive sensing when produce vocalizations in the frequency bands of interest (LF and MF) which can be louder than the other noise sources. For active sonar, scattering from biologics can also cause significant clutter to sonar screens and impact the Pd/Pfa for the system. This STTR topic aims to identify existing, applicable or available biologic diversity density databases, to propose any new data bases that should be considered, select a processing technique in order to determine the statistical representation of noise contribution from biologics vocalization, integrate the developed model into a DON tactical decision aid (TDA), and ultimately have the model accredited for the Oceanographic and Atmospheric Master Library (OAML).

PHASE I: Develop the initial model architecture, conceptual design, and the algorithms necessary to demonstrate a Technical Readiness Level (TRL) of 3. This should include:

- Identification of applicable biologic databases and proposal of any new databases that should be considered
 - Selection of processing technique to determine statistical representation of noise contribution from biologics vocalizations to the levels produced, spatial location of sources, and time dependencies (such as diurnal patterns)
 - Case example for a representative sonar system
- Put forward a model development and validation plan for subsequent phases of the effort.

PHASE II: Further mature biologic noise model based on the Phase I design(s) validated to TRL 5 (Phase II Base), TRL 6 (Phase II Option, if exercised). Validation criteria include required computational load, accuracy, processing time, spatial and temporal resolution, and compatibility with Navy TDAs. Upon completion of Phase II, the developed model and a technical report outlining function and validation/verification of performance should be delivered to the Department of the Navy.

PHASE III DUAL USE APPLICATIONS: Align Phase III efforts with the program of record to integrate the results of the Phase II work. This includes the productionization of source code, incorporation of algorithms to Navy systems (where feasible), and adjusting model requirements based on needs of the operational environment.

Dual-use applications include coordination with other governmental partners for oceanographic monitoring and data collection (such as National Oceanic and Atmospheric Association (NOAA)) and university partners using data for pedagogical and/or research purposes.

REFERENCES:

1. Hildebrand, John A. et al. "An empirical model for wind-generated ocean noise." The Journal of the Acoustical Society of America 149, 4516, 2021. <https://doi.org/10.1121/10.0005430>
2. Collins, Michael D. "Users Guide for RAM Versions 1.0 and 1.0p." NRL
3. Keenan, R. "An Introduction to GRAB Eigenrays and CASS Reverberation and Signal Excess." OCEANS 2000 MTS/IEEE Conference and Exhibition. Conference Proceedings (Cat. No.00CH37158), Providence, RI, USA, 2000, pp. 1065-1070 vol.2.
4. Farcas, Adrian et al. "Validated shipping noise maps of the Northeast Atlantic." Science of The Total Environment Volume 735, 15 September 2020, 139509. <https://doi.org/10.1016/j.scitotenv.2020.139509>

KEYWORDS: Ocean Acoustics, Marine Biology, Oceanographic Models, Modeling, Tactical Decision Aids, SONAR Systems

N24A-T021 TITLE: Synthetization of Refractory/Transition Metal Diboride & Carbide Precursors for Chemical Vapor Infiltration (CVI) of Ceramic Composites

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

OBJECTIVE: Develop a stable, scalable synthesis route for a refractory diboride precursor suitable for evaporation in a Chemical Vapor Infiltration (CVI) system.

DESCRIPTION: Properties of refractory/transition metal diborides have attractive coating options for extreme applications with melting temperatures above 3200°C, high hardness, and excellent thermal oxidation resistance. Metal diborides such as hafnium, zirconium, tantalum, iridium, etc. have no commercially available single source CVI precursor. Depositing metal diboride via chemical vapor deposition routes such as CVI offer a viable method of integration into Ceramic Matrix Composite (CMCs) with respect to protective interface coatings. Commercial availability of refractory metal boride precursors to support epitaxial deposition is non-existent and development efforts are scarce. This STTR topic aims to develop stable, repeatable and scalable routes for new precursors for integration into existing large scale CVI systems. This research is critical for domestic development of key precursors identified to have the potential for significant advancements in Ultra High Temperature CMC processing.

PHASE I: Demonstrate synthesis route and basic precursor properties (vapor pressure, melting/freezing temperature, density, etc.) using modeling, characterization and experimentation. Determine repeatable and projected scalability of formulation.

PHASE II: Optimize process and demonstrate repeatability. Determine projected scalability of compound formulation. Begin Chemical Vapor Deposition (CVD) deposition studies. Evaluate deposition temperature range for amorphous and crystalline coatings and associated data showing crystallinity, grain size and stoichiometry. Initiate infiltration studies.

PHASE III DUAL USE APPLICATIONS: Continue infiltration studies, modelling the infiltration process to determine optimal conditions (T, P, flow) to optimize densification of fiber preforms. Determine methods and measures to ensure reproducibility for scaling to larger preform sizes. Dual use activities could include commercial access to space components, as well as other high temperature applications in the energy and materials processing communities.

REFERENCES:

1. Coltelli, Maria Beatrice and Lazzeri, Andrea. "Chemical vapour infiltration of composites and their applications." Chemical Vapour Deposition (CVD): Advances, Technology and Applications, CRC Press, July 2019, p. 363. <https://www.routledge.com/Chemical-Vapour-Deposition-CVD-Advances-Technology-and-Applications/Choy/p/book/9780367780111#>
2. Aguirre, Trevor G.; Lamm, Benjamin W.; Corson L. Cramer, Corson L. and Mitchell, David J. "Zirconium-diboride silicon-carbide composites: A review." Ceramics International, Volume 48, Issue 6, 15 March 2022, pp. 7344-7361. <https://doi.org/10.1016/j.ceramint.2021.11.314>

KEYWORDS: Precursors, coatings, chemical vapor deposition, chemical vapor deposition, organometallics, ceramic matrix composites

N24A-T022 TITLE: Remote Magnetometry with Resonantly Enhanced Multiphoton Ionization (REMPI) Readout

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

OBJECTIVE: Demonstrate atomic magnetometry in air using radar Resonantly Enhanced Multiphoton Ionization (REMPI) readout of ^{129}Xe quantum states.

DESCRIPTION: Remote magnetometry has recently been demonstrated at 100+ kilometers using sodium atoms in the mesosphere [Refs 1,2]. At this high altitude, the naturally occurring alkali atoms are at low pressure making the environment similar to atomic measurements inside of traditional vapor cells. As in conventional atomic magnetometers [Refs 3,4,5], first pumping with circularly polarized light depopulates all but one hyperfine sublevel of the ground state creating a net polarization. Next, the polarized spins precess at the Larmor frequency that is directly proportional to the strength of the magnetic field. The constant of proportionality is the gyromagnetic ratio, which is a known atomic physics constant for a specific atomic isotope. Finally, the atoms fluoresce producing a readout signal. This STTR topic seeks to demonstrate atomic magnetometry with atoms in the air at sea level. Historic work has identified ^{129}Xe as a naturally occurring species in air with a long nuclear spin lifetime that could be used for magnetometry [Ref 6]. Like other species in the air, the transition energy to the first excited state in xenon is a vacuum ultraviolet (VUV) transition [Refs 7,8,9] but commercially available ultrashort pulse lasers can generate intensities above $1 \text{ GW}/\text{cm}^2$ for efficient multi-photon excitation using visible blue light. While the ~ 100 picosecond time between collisions in air is too short for fluorescence and the xenon concentration is too low for stimulated emission, recent work has used ultrashort pulse lasers to demonstrate Resonance Enhanced Multi-Photon Ionization (REMPI) in air. Thomson scattering of radar off the resulting low-density plasma (i.e., radar REMPI) could remotely readout the ionized electrons for a standoff magnetometry signal [Refs 10,11]. In this method, the laser wavelength provides the selectivity, and the radar intensity determines the sensitivity. Initial proposals should present a specific plan for reading the spin of a hyperfine ^{129}Xe ground state, including the planned energy levels that will be utilized for three-photon radar REMPI.

PHASE I: Demonstrate radar REMPI detection of ^{129}Xe using three-photon excitation in a vapor cell, ideally down to a pressure of 1×10^{11} atoms/cc or show how this sensitivity could be achieved. Assess the time for spin to transfer from an excited electron to the nuclear spin during REMPI readout. Present a plan to demonstrate an all-optical standoff magnetometry measurement in a vapor cell including optical polarization and radar REMPI readout of the ^{129}Xe .

PHASE II: Demonstrate remote magnetometry using radar REMPI readout with ^{129}Xe in a vapor cell [Ref 12]. Publish a journal article ideally demonstrating the measurement in air (with the naturally occurring ^{129}Xe concentration at 23 ppb) or clearly present how a measurement in air could be accomplished.

PHASE III DUAL USE APPLICATIONS: Explore methods to improve the measurement sensitivity, study schemes to increase the pumping efficiency and polarization with pressure broadened lines at atmospheric pressure, theoretically understand the spin transfer time relative to quenching from collisions, and advance methods to decrease the laser energy requirements. Commercial applications include trace gas detection for air quality monitoring, combustion characterization, and magnetic mapping for geophysical prospecting.

REFERENCES:

1. Kane et al. "Laser Remote Magnetometry Using Mesospheric Sodium." JGR Space Physics 123, 8, 2018.

2. Bustos et al. "Remote sensing of geomagnetic fields and atomic collisions in the mesosphere," Nature Communications 9, 3981, 2018.
3. Sheng et al. "Subfemtotesla Scalar Atomic Magnetometry Using Multipass Cells.," PRL 110, 160802, 2013.
4. Patton, B. et al. "A remotely interrogated all-optical 87Rb magnetometer." APL 101, 083502. 2012.
5. Degenkolb, Skyler M. "Optical Magnetometry Using Multiphoton Transitions." University of Michigan Dissertation 2016. <https://deepblue.lib.umich.edu/handle/2027.42/135807>
6. Happer, William. "Laser Remote Sensing of Magnetic Fields in the Atmosphere by Two-Photon Optical Pumping of Xe129." (1978), <https://physics.princeton.edu/atomic/happer/Publications.html>
7. Saloman, E.B. "Energy Levels and Observed Spectral Lines of Xenon, Xe I through Xe LIV." Journal of Physical and Chemical Reference Data 33, 765. 2004.
8. D'Amico, G. et al. "Isotope-shift and hyperfine-constant measurements of near-infrared xenon transitions in glow discharges and on a metastable Xe(3P2) beam." PRA 60, 6, 1999.
9. G. Grynberg, G. "Three-photon absorption: selection rules and line intensities." Journal de Physique, 40 (10), 1979, pp. 965-968.
10. Zhang, Zhili et al. "Coherent microwave scattering from resonance enhanced multi-photon ionization (radar REMPI): a review." Plasma Sources Sci. Technol. 30, 103001, 2021.
11. Galea, Christopher A. "Coherent Microwave Scattering from Laser-Generated Plasma in External Magnetic Field and Weakly Ionized Plasma Environments." Dissertation Princeton University, 2021.
12. Breeze, Stephen et al. "Coatings for optical pumping cells and short-term storage of hyperpolarized xenon.," JAP 87, 8013, 2000.

KEYWORDS: Quantum; atomic; magnetometry; radar; multi-photon; ultrashort pulse laser; trace gas detection; plasma; ionization; remote sensing

N24A-T023 TITLE: Scalable Additive Friction Stir (AFS) for Multi-metal Deposition

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

OBJECTIVE: Develop a portable or scaled-down / aircraft scale sized friction stir deposition system that is able to structurally repair spot sizes or through holes down to 0.25” in diameter on 0.125” thick aluminum, titanium, and high-strength steel.

DESCRIPTION: Rendering forging-like instead of casting-like properties, additive friction stir deposition (AFSD) is an emerging solid-state metal additive manufacturing process uniquely capable of large-scale metal additive manufacturing, cladding, and structural repair. Friction stir deposition systems are able to deposit high-quality aluminum, titanium and high-strength steel alloys, but current commercial systems as supplied by manufacturers like MELD and BOND use tool heads with a large surface area, approximately 1-1.25” in diameter [Ref 1]. This scale is useful for larger volume material deposition but is too large for the repair of most components on Navy and Marine Corps aircraft, which have small, localized damage areas of < 1”. In addition, this large tool geometry requires large backing forces to support a repair, which is likely going to be excessive for thin cross-section aircraft parts, potentially leading to part deformation during deposition [Ref 2]. The currently available systems are also very large and not practical for potential remote or portable use on aircraft.

PHASE I: Develop a concept for a friction stir deposition system that can deposit aluminum, titanium, and high-strength steel in areas < 1 square inch on substrates that are 0.125” thick. Capture relevant machine parameters and deposition data to support modeling/model development; such as high-resolution time-history data of the various parameters. At minimum, establish empirical/curve-fitting formulas to enable structural applications. Prepare a report to ONR and NAWCAD on design(s) and modeling. and prepare a Phase II testing plan.

PHASE II: Construct a prototype friction stir deposition system and assess the material properties, of the deposition of aluminum 7050-T7451, Ti6-4, and AerMet 100 alloys. Assess the properties of repaired 7050-T7451, Ti6-4, and AerMet 100 substrates using feed stock of the same alloys. Provide a report that documents the design of the prototype system, results of system performance, and results of material testing for the three alloys. Provide a Phase III plan to ONR and NAWCAD for prototype evaluation. Provide a prototype friction stir deposition system to NAWCAD for evaluation.

PHASE III DUAL USE APPLICATIONS: Assemble a full friction stir deposition system and demonstrate output meeting key deposition and material parameters, to include at least full mechanical properties related to strength and fatigue. Deliver a full friction stir deposition system to NAWCAD and a comprehensive final report containing the design, deposition, and process and testing data to ONR and NAWCAD.

The development of a scalable or portable AFSD print head with multi-metal capability would be directly applicable to in-situ repair of commercial structures for aviation and other vehicle platforms alike.

REFERENCES:

1. MELD Manufacturing. www.meldmanufacturing.com
2. Yu, Hang Z. “Additive Friction Stir Deposition.” Elsevier, Cambridge, MA, 2022. ISBN:978-0-12-824374-9.

KEYWORDS: Friction stir deposition, aerospace alloys, reduced scale, portable, in-situ, sustainment

N24A-T024 TITLE: Additive Manufacturing of Ferroelectric and/or Ferromagnetic Composite

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

OBJECTIVE: Develop a process for additive manufacturing of ferroelectric and/or ferromagnetic composites for High Power Microwave (HPM) applications. The composites should be comprised of at least 50% ferroelectric and/or ferromagnetic material. The final print should be free of large voids ($> 1 \mu\text{m}^3$) and have a shortest dimension of at least one inch. The final sample should be close to final dimensions and have a resolution of $< 1\text{mm}$.

DESCRIPTION: Ferroelectric and ferromagnetic materials are utilized in various ways for HPM development; nonlinear transmission lines (NLTLs), high energy density capacitors, high voltage delay lines, tunable antenna arrays, etc. The development of additive manufacturing and 3D printing has provided inexpensive alternatives to traditional fabrication and prototyping. Currently there are no additive manufacturing processes that provide a prototyping capability for ferroelectric and/or ferromagnetic materials. Currently these ceramic and ferrite materials must be sintered and machined resulting in expensive prototyping and innovation due to material brittleness. Possible solutions include, but are not limited to, Stereolithography (SLA), Fused Deposition Modeling (FDM), and Selective Laser Sintering (SLS).

Production of the materials can be done using any innovative way but must produce a composite with electrical and/or magnetic properties of at least 90% of the ferroelectric and/or ferromagnetic inclusion. Electrical breakdown is a common critical failure mechanism for components in HPM systems that can result when voids are present in the materials. The final prints should be free of all voids greater than $1 \mu\text{m}^3$.

KEY ADDITIVE MANUFACTURING COMPONENT PARAMETERS

Will be negotiated with each proposal depending on submitted design.

- Smallest print dimension > 1 inch
- Resolution of print < 1 mm
- Material to print ferroelectric and/or ferromagnetic
- Electromagnetic properties = 90% inclusions
- Final dimensions should be = 95% of completed component
- o Some post processing is acceptable

PHASE I: Develop design and strategies for an additive manufacturing process of ferroelectric and/or ferromagnetic composites for HPM applications. Perform cost analysis of various options. Determine compatibility with use of ferroelectric and/or ferromagnetic materials. Evaluate sample preparation (whether it is powder, resin, or filament). Evaluate print parameters. Provide a convincing way forward for a Phase II effort.

PHASE II: In consultation and with ONR approval, determine possible limitations of chosen path. Perform prints to evaluate the following parameters

- Permittivity and/or permeability
- Electrical breakdown strength
- Resolution of print

Perform the preliminary work necessary to prepare for high-power testing and characterization in Phase III.

PHASE III DUAL USE APPLICATIONS: In consultation and with ONR approval, proceed to printing multiple structures to be used as NLTLs, capacitors, inductors, tunable metamaterials, and/or delay lines

for evaluation. In consultation and with ONR approval, test and characterize at high power. ONR may also dictate the location and government assets used to verify the test and characterization.

REFERENCES:

1. Benford, James; Swegle, John A. and Schamiloglu, Edl. "High Power Microwaves, Third Edition." CRC Press, 2016.
2. "Advances in High Voltage Engineering." IET. ISBN 0852961588, 2004.
3. "High Voltage Engineering: Fundamentals." Newnes, 2000. ISBN 0-7506-3634-3.
4. Fairbanks, Andrew J.; Darr, Adam M. and Garner, Allen L. "A review of nonlinear transmission line system design." IEEE Access, vol. 8, 2020, pp. 148606-148621.
5. Rangel, Elizete G Lopes; Rossi, José O; Barroso, Joaquim J; Yamasaki, Fernanda S and Schamiloglu, Edl. "Practical constraints on nonlinear transmission lines for RF generation." IEEE Trans. Plasma Sci., vol. 47, no. 1, 2018, pp. 1000-1016.

KEYWORDS: High Power Microwave; HPM weapons; Nonlinear Transmission Lines; NLTLs; Additive Manufacturing; Ferroelectrics; Ferromagnetics

**DEPARTMENT OF THE AIR FORCE
24.A SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) Phase I
PROPOSAL SUBMISSION INSTRUCTIONS**

Amendment 2

This Amendment modifies the DAF STTR Phase I instructions as follows:

1. The export control statement previously associated with topic SF24A-T005 is deleted in its entirety.
2. The export control statement previously associated with topic SF24A-T006 is deleted in its entirety.

All other terms and provisions of the DAF STTR Phase I instructions remain unchanged as a result of this Amendment.

**DEPARTMENT OF THE AIR FORCE
24.A SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) Phase I
PROPOSAL SUBMISSION INSTRUCTIONS**

Amendment 1

This Amendment modifies the DAF STTR Phase I instructions as follows:

1. The Period of Performance (PoP) associated with the Phase I portion of the topic AF24A-T003 is **12 months**.
2. The Phase I Description and Phase II description are altered to indicate that this is a **STTR** topic.
3. The export control statement previously associated with topic SF24A-T004 is deleted in its entirety.

All other terms and provisions of the DAF STTR Phase I instructions remain unchanged as a result of this Amendment.

**DEPARTMENT OF THE AIR FORCE
24.A SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) Phase I
PROPOSAL SUBMISSION INSTRUCTIONS**

The Air Force intends these Phase I proposal submission instructions to clarify the Department of Defense (DoD) Broad Agency Announcement (BAA) as it applies to the topics solicited herein. **Offerors must ensure proposals meet all requirements of the STTR 24.A BAA posted on the Defense SBIR/STTR Innovation Portal (DSIP) at the proposal submission deadline date/time.**

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

- The DoD Program BAA is located at: <https://www.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>.

Complete proposals **must** be prepared and submitted via <https://www.dodsbirsttr.mil/submissions/> (DSIP) on or before the date published in the DoD SBIR 24.A BAA. Applicants are responsible for ensuring proposals comply with the requirements in the most current version of this instruction at the proposal submission deadline date/time.

The DAF recommends early submission, as computer traffic gets heavy near the proposal submission date/time and could slow down the system. **Do not wait until the last minute.** The DAF is not responsible for incomplete proposal submission due to system lag or inaccessibility. Please ensure contact information, i.e., names/phone numbers/email addresses, in the proposal is current and accurate. The DAF is not responsible for ensuring notifications are received by firms for which this information changes after proposal submission without proper notification. Changes of this nature shall be sent to the Air Force SBIR/STTR One Help Desk.

Please ensure all e-mail addresses listed in the proposal are current and accurate. The DAF is not responsible for ensuring notifications are received by firms changing mailing address/e-mail address/company points of contact after proposal submission without proper notification to the AF. **If changes occur to the company mail or email addresses or points of contact after proposal submission, the information must be provided to the AF SBIR/STTR One Help Desk.** The message shall include the subject line, "24.A Address Change".

Points of Contact:

- General information related to the AF SBIR/STTR program and proposal preparation instructions, contact the AF SBIR/STTR One Help Desk at usaf.team@afsbirsttr.us.
- Questions regarding the DSIP electronic submission system, contact the DoD SBIR/STTR Help Desk at dodsbirsupport@reisystems.com.
- For technical questions about the topics during the pre-announcement and open period, please reference the DoD SBIR 24.A BAA.
- Air Force SBIR/STTR Contracting Officer (CO):
 - Mr. Daniel J. Brewer, Daniel.Brewer.13@us.af.mil

General information related to the AF Small Business Program can be found at the AF Small Business website, <http://www.airforcesmallbiz.af.mil/>. The site contains information related to contracting opportunities within the AF, as well as business information and upcoming outreach events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers (PTACs), <http://www.ptacus.us.org>. These centers provide

Government contracting assistance and guidance to small businesses, generally at no cost.

PHASE I PROPOSAL SUBMISSION: The DoD STTR 24.A Broad Agency Announcement, <https://www.dodsbirsttr.mil/submissions/login>, includes all program requirements. Phase I efforts should address the feasibility of a solution to the selected topic's requirements.

The complete proposal must be submitted electronically through DSIP. Ensure the complete technical volume and additional cost volume information is included in this sole submission. The preferred submission format is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. VIRUS-CHECK ALL SUBMISSIONS.

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit www.sam.gov. A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its representations and certifications are up-to-date to avoid delay in award.

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

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

PHASE I PROPOSAL FORMAT

Complete proposals must include all of the following:

Volume 1: DoD Proposal Cover Sheet

Note: If selected for funding, the proposal's technical abstract and discussion of anticipated benefits will be publicly released. Therefore, do not include proprietary information in this section.

Volume 2: Technical Volume

Volume 3: Cost Volume

Volume 4: Company Commercialization Report

Volume 5: Supporting Documents

Volume 6: Fraud, Waste, and Abuse Training

DoD PROPOSAL COVER SHEET (VOLUME 1)

Complete the proposal Cover Sheet in accordance with the instructions provided via DSIP. The technical abstract should include a brief description of the program objective(s), a description of the effort, anticipated benefits and commercial applications of the proposed research, and a list of keywords/terms. The technical abstract of each successful proposal will be submitted to the Office of the Secretary of Defense (OSD) for publication and, therefore, must not contain proprietary or classified information.

TECHNICAL VOLUME (VOLUME 2):

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

The Phase I Technical Volume page/slide limits identified for the topics do not include the Cover Sheet, Cost Volume, Cost Volume Itemized Listing (a-h). The Technical Volume must be no smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins. Only the Technical Volume and any enclosures or attachments count toward the page limit. In the interest of equity, pages/slides in excess of the stated limits will not be reviewed. The documents required for upload into Volume 5, "Other", do not count toward the specified limits.

Key Personnel: Identify in the Technical Volume all key personnel who will be involved in this project; include information on directly related education, experience, and citizenship.

- A technical resume of the principal investigator, including a list of publications, if any, must be included
- Concise technical resumes for subcontractors and consultants, if any, are also useful.
- Identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors, or consultants.
- Identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For all non-U.S. citizens, in addition to technical resumes, please provide countries of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project, as appropriate. Additional information may be requested during negotiations in order to verify the foreign citizen's eligibility to participate on a contract issued as a result of this announcement. **Note:** Do not upload information such as Permanent Resident Cards (Green Cards), birth certificates, Social Security Numbers, or other PII to the DSIP system.

Phase I Work Plan Outline

NOTE: The DAF uses the work plan outline as the initial draft of the Phase I Statement of Work (SOW). Therefore, **do not include proprietary information in the work plan outline.** To do so will necessitate a request for revision, if selected, and may delay contract award.

Include a work plan outline in the following format:

Scope: List the effort's major requirements and specifications.

Task Outline: Provide a brief outline of the work to be accomplished during the Phase I effort.

Milestone Schedule

Deliverables

Progress reports

Final report with SF 298

COST VOLUME (VOLUME 3)

Cost information should be provided by completing the Cost Volume in DSIP and including the Cost Volume Itemized Listing specified below. The Cost Volume detail must be adequate to enable Air Force personnel to determine the purpose, necessity and reasonability of each cost element. Provide sufficient information (a.-g. below) regarding funds use. The DSIP Cost Volume and Itemized Cost Volume Information will not count against the specified page limit. The itemized listing also may be submitted in Volume 5 under the "Other" dropdown option.

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

b. **Other Direct Costs:** This category includes, but is not limited to, specialized services such as machining, milling, special testing or analysis, and costs incurred in temporarily using specialized equipment. Proposals including leased hardware must include an adequate lease v. purchase justification.

c. **Direct Labor:** Identify key personnel by name, if possible, or by labor category, if not. Direct labor hours, labor overhead and/or fringe benefits, and actual hourly rates for each individual are also necessary for the CO to determine whether these hours, fringe rates, and hourly rates are fair and reasonable.

d. **Travel:** Travel costs must relate to project needs. Break out travel costs by trip, number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each, should be reflected. Recommend budgeting at least one trip to the Air Force location managing the contract.

e. **Subcontracts:** Involvement of consultant in the project's planning and/or research stages may be appropriate. If so, describe in detail and include information in the Cost Volume. A minimum of 40% of each STTR project must be conducted by the SBC and a minimum of 30% of the effort performed by the single partnering Research Institution. Deviations from these performance of work requirements are not permitted. The STTR funded work percentage calculation considers both direct and indirect costs after removal of the SBC's proposed profit. Support subcontract costs with copies of executed agreements. The documents must adequately describe the work to be performed. At a minimum, include a Statement of Work (SOW) with a corresponding detailed Cost Volume for each planned subcontract. Additionally, see DoD SBIR 23.3 BAA for more information regarding the required Allocation of Rights Agreement.

f. **Special Tooling, Special Test Equipment, and Material:** The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness to the work proposed. Special tooling and special test equipment purchases must, in the CO's opinion, be advantageous to the Government and relate directly to the effort. These toolings or equipment should not be of a type that an offeror would otherwise possess in the normal course of business. These may include items such as innovative instrumentation and/or automatic test equipment.

g. **Consultants:** Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without negotiations. . Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. If there are questions regarding the award document, contact the Phase I CO identified on the cover page. The Government reserves the right to reopen negotiations later if the CO determines doing so to be necessary.

COMPANY COMMERCIALIZATION REPORT (VOLUME 4)

Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD STTR 24.A BAA for full details on this requirement. Information contained in the CCR will not be considered by the Air Force during proposal evaluations.

SUPPORTING DOCUMENTS VOLUME (VOLUME 5)

The following documents are required for all proposal submissions:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1 to the DOD SBIR 24.A BAA)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2 to the DOD STTR 24.A BAA)
3. Disclosure of Funding Sources (Attachment 4 to the DOD STTR 24.A BAA)

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

1. DD Form 2345: For proposals submitted under export-controlled topics, either International Traffic in Arms or Export Administration Regulations (ITAR/EAR), a copy of the certified DD Form 2345, Militarily Critical Technical Data Agreement, or evidence of application submission must be included. The form, instructions, and FAQs may be found at the United States/Canada Joint Certification Program website, <http://www.dla.mil/HQ/InformationOperations/Offers/Products/LogisticsApplications/JCP/DD2345Instructions.aspx>. DD Form 2345 approval will be required if proposal is selected for award.
2. Verification of Eligibility of Small Business Joint Ventures (Attachment 3 to the DOD STTR 24.A BAA)
3. Technical Data Rights Assertions (if asserting data rights restrictions)

FRAUD, WASTE, AND ABUSE TRAINING (VOLUME 6)

Note that the FWA Training must be completed prior to proposal submission. When training is complete and certified, DSIP will indicate completion of the Volume 6 requirement. The proposal cannot be submitted until the training is complete.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TAB A)

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

AIR FORCE PROPOSAL EVALUATIONS

Proposals will be evaluated for overall merit in accordance with the criteria discussed in the 24.A BAA. DAF is seeking varying technical/scientific approaches and/or varying and new technologies that would be responsive to the problem statement(s) and area(s) of interest in the topic. Multiple procurements are planned and anticipated to be awarded as a result of the topic, each proposal is considered a separate procurement and will be evaluated on its own merit, and that the Government may award all, some, or none of the proposals. Any per-award or per-topic funding caps are budgetary estimates only, and more or less funding may become available. Funding decisions are made with complete disregard to the other awards under the same topic.

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

DAF USE OF SUPPORT CONTRACTORS

Restrictive notices notwithstanding, proposals may be handled for administrative purposes only, by support contractors TEC Solutions, Inc., APEX, Oasis Systems, Riverside Research, Peerless Technologies, HPC-COM, Mile Two, Montech, Wright Brothers Institute, and MacB (an Alion Company). In addition, only Government employees and technical personnel from Federally Funded Research and Development Centers (FFRDCs) MITRE and Aerospace Corporations working under contract to provide technical support to AF Life Cycle Management Center and Space and Missiles Centers may evaluate proposals. All support contractors are bound by appropriate non-disclosure agreements. Contact the AF SBIR/STTR CO Daniel J. Brewer (Daniel.Brewer.13@us.af.mil) with concerns.

PROPOSAL STATUS AND FEEDBACK

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal Number and Topic Number referenced.

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

IMPORTANT: Proposals submitted to the DAF are received and evaluated by different organizations, handled by topic. Each organization operates within its own schedule for proposal evaluation and selection. Updates and notification timeframes will vary. If contacted regarding a proposal submission, it is not necessary to request information regarding additional submissions. Separate notifications are provided for each proposal.

The Air Force anticipates that all proposals will be evaluated and selections finalized within approximately 90 calendar days of solicitation close. Please refrain from contacting the BAA CO for proposal status before that time.

Refer to the DoD STTR 24.A BAA for procedures to protest the Announcement. As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Air Force SBIR/STTR Contracting Officer Daniel J. Brewer, Daniel.Brewer.13@us.af.mil.

AIR FORCE SUBMISSION OF FINAL REPORTS

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

PHASE II PROPOSAL SUBMISSIONS

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

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

periods, and proposal content will be specified in the Phase II request for proposal.

NOTE: The DAF primarily makes STTR Phase I and II awards as Firm-Fixed-Price contracts. However, awardees are strongly urged to work toward a Defense Contract Audit Agency (DCAA)-approved accounting system. If the company intends to continue work with the DoD, an approved accounting system will allow for competition in a broader array of acquisition opportunities, including award of Cost-Reimbursement types of contracts. Please address questions to the Phase II CO, if selected for award.

All proposals must be submitted electronically via DSIP by the date indicated in the Phase II proposal instructions. Note: Only ONE Phase II proposal may be submitted for each Phase I award.

AIR FORCE SBIR/STTR PROGRAM MANAGEMENT IMPROVEMENTS

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

Air Force STTR 24.A Topic Index

Topic Number	Topic Name	Maximum Value*	Maximum Duration (in months)**	Technical Volume Page Limit***
AF24A-T001	Computer-Aided Tool for Wrapping Periodic Elements onto Doubly-Curved Surfaces	\$180,000.00	6	20
AF24A-T002	Automated SysML Model Development	\$180,000.00	6	20
AF24A-T003	Test Noise Reduction / Energy Capture Study	\$180,000.00	6 12	20
SF24A-T004	Integrated Lasers and Non-Magnetic Isolators for Optical Clock Technologies	\$180,000.00	6	20
SF24A-T005	High Throughput Visible-Wavelength Multispectral Filter Arrays via Spectral Multiplexing	\$180,000.00	6	20
SF24A-T006	Low Size, Weight, and Power, High Flux Atomic Source for Scalable Manufacturing	\$180,000.00	6	20
SF24A-T007	SPoC Resilient Basing	\$180,000.00	6	20

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

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

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

AF24A-T001 TITLE: Computer-Aided Tool for Wrapping Periodic Elements onto Doubly-Curved Surfaces

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

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

OBJECTIVE: The next generation of airborne platforms will make extensive use of planar periodic electromagnetic structures to manipulate various electromagnetic interactions with surfaces of an air vehicle. In almost all cases, it is desired to wrap these structures over the complex and irregular surfaces of these air-vehicle platforms. However, conforming planar periodic structures over doubly-curved and irregular surfaces causes the planar periodic electromagnetic structures unit cells to become deformed, which alters their electromagnetic properties in an undesirable way.

The objective of this topic is to develop a general-purpose software tool that can wrap any planar periodic structure over any surface while minimizing or eliminating any of the unit cells from being deformed. The tool shall use solid models as inputs and outputs to maximize compatibility with other software.

DESCRIPTION: Future warfighting includes an incredibly complex, contested, and often hostile electromagnetic spectrum environment through which our airborne platforms will operate. Planar periodic structures can be employed to manipulate electromagnetic interactions with the surface of a vehicle. To utilize / cover the full surface area of a platform without any gaps, it is desired to wrap the periodic structures over irregular and doubly-curved surfaces [1]. Unfortunately, doing this also deforms the unit cells of the periodic structures, which alters their electromagnetic properties.

In recent years, several algorithms have been demonstrated with the ability to bend, twist, conform and otherwise spatially vary periodic structures in a special way that minimizes unintended deformations to the unit cells [1,2]. These algorithms have been used to wrap frequency preferred surfaces over doubly-curved surfaces while preserving the electromagnetic performance of the unit cells [1]. Such periodic structures can be called preservational spatially-variant lattices (PSVLs).

It is desired to create a general purpose software tool that can wrap any planar periodic structure over the surface of any object in a way that preserves the size, shape and spacing of the unit cells, all using solid modeling. Meshes are highly problematic because they can contain many errors, such as being non-manifold (e.g. not air tight), and they are less compatible with commercial CAD and simulation software. The inputs and outputs of the Phase II software tool shall be solid models to maximize compatibility with other software and avoid errors that arise when manipulating meshes.

PHASE I: In Phase 1, the performer shall conceptualize a software tool that offers a user the capability to wrap any planar periodic structure over any surface as a PSVL. The software tool shall take as inputs solid models of the unit cell and the surface over which to generate the PSVL. The performer shall lay out a software tool development strategy for implementation during the Phase II effort.

PHASE II: The Phase II effort shall develop and demonstrate a software tool that offers a user the capability to wrap any planar periodic structure over any surface as a PSVL. The software tool shall take as inputs solid models of the unit cell and the surface over which to generate the PSVL. The software tool shall export a solid model of the PSVL that can be directly and easily imported into manufacturing and simulation software. Any proposals using meshes as inputs or outputs will not be considered for funding. The Phase II software shall provide a modern user interface. The performer shall address how the PSVL software could be parallelized for computationally intensive jobs, operated in secure cloud environments suitable for DOD and defense contractors, and connected to manufacturing software during a Phase III effort.

PHASE III DUAL USE APPLICATIONS: Operating air platforms through complicated and hostile electromagnetic environments is a high priority for the Air Force. The Phase III will focus on complete maturation and commercialization of the technology including a user-friendly interface and integration with manufacturing software.

REFERENCES:

1. Valle, Cesar L., Gilbert T. Carranza, and Raymond C. Rumpf. "Conformal Frequency Selective Surfaces for Arbitrary Curvature." *IEEE Transactions on Antennas and Propagation* (2022);
2. Digaum, Jennefir L., et al. "Tight control of light beams in photonic crystals with spatially-variant lattice orientation." *Optics express* 22.21 (2014): 25788-25804.;

KEYWORDS: Planar; conformal mapping; periodic structures; spatially-variant; electromagnetics; irregular surfaces; planar periodic electromagnetic structures.

AF24A-T002 TITLE: Automated SysML Model Development

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

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

OBJECTIVE: Obtain the ability to ingest Microsoft Word, Microsoft Excel, Adobe PDF, and use AI/ML to create a SysML Model in Cameo Enterprise Architecture based off selected fields and relationships.

DESCRIPTION: Deliver a tool that has the capability to be integrated with existing IDE that performs the above SysML Modeling requirement.

PHASE I: Develop a tool that is beginning to ingest documents of various data types and establish relationships based off AI/ML methodologies that is capable of graphical modeling.

PHASE II: Tool must exhibit capability of USAF personnel to ingest documents and form all operations required of the tool to result in a graphical SysML Model within Cameo Systems Architecture without dependency on the tool developer.

PHASE III DUAL USE APPLICATIONS: Tool must have the ability to integrate with IDE and be distributed to all USAF personnel necessary to operate.

REFERENCES:

1. Schevchenko, N. (2020, December 21). An introduction to model-based systems engineering (MBSE). SEI Blog. <https://insights.sei.cmu.edu/blog/introduction-model-based-systems-engineering-mbse/>;
2. What is the systems modeling language (SysML)? SysML.org. <https://sysml.org/sysml-faq/what-is-sysml.html>;

KEYWORDS: SysML; MBSE; Automated Modeling; Graphical Modeling

AF24A-T003 TITLE: Test Noise Reduction / Energy Capture Study

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

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: Development of potential solutions for noise reduction and energy recapture to be used in future engine test cell designs. Documented Analysis of Alternatives and sub-scale system should be produced to demonstrate the optimized solution.

DESCRIPTION: Initial study to determine the feasibility and identification of potential solutions for the incorporation of energy capture and advanced noise reduction in future ACETC facility plans in an effort to comply with the Air Force's goal of 100% carbon-free electricity by 2030. The testing of jet engines produces an immense amount of heat, vibration, and air. There is potential opportunity to capture the forced air and heat to recycle energy. To protect those working in the facility and provide a safe working environment, advanced noise reduction solutions should be considered to avoid the need of excessive PPE.

PHASE I: This will be a ~~SBIR~~ STTR phase I project with a 24 12 month Period of Performance. This project will evaluate jet engine test energy recapturing and noise reduction. The scope of the project validation through computer modeling and verification through a developed subscale physical model utilizing a minimal of 20 pound thrust jet engine to analyze energy recapture and noise reduction. PMXG is open to evaluations of all energy recapturing opportunities as well as all noise reduction opportunities, through a documented Analysis of Alternatives. Noise measurements are expected to be in Decibel (db). Final electrical recapture is expected to be in Watts. Sub-scale computer model will be generated/developed by applicant, demonstrating the test envelope, engine, air flow, electric consumption, electric production, a noise levels. It is important to keep air flow in the test envelope laminar, so the performance of the engine is not compromised. An optimized demonstration of physical sub-scale model with measured electrical and noise parameters is expected as part of the deliverable. An initial study, multiple presentations, a working prototype (with 20 lb-thrust or higher engine test) and air flow monitoring and noise level readings are some milestones in this project.

PHASE II: This will be a ~~SBIR~~ STTR phase II project with a 24 month Period of Performance. This project will demonstrate a feasibility plan, implementation plan, and a demonstration of a functional physical sub-scale model (with 20 lb-thrust or higher engine test) with physical measurements. Documented Analysis of Alternatives shall be evaluated to show a robust poka-yoke design to optimize airflow constraints and reduce backflow opportunities, utilizing the physical sub-scale model for confirmation. Airflow, noise reduction and energy production shall be evaluated for variations in Type, Model, Series (TMS) engines. It is important to keep air flow in test envelope laminar, so the performance of the engine is not compromised. Scalability plans for test cell, engine, models and supporting documents shall be provided to Air Force jet engines to project requirements. Simulation models will be delivered with editable features to the test cell and TMS for internal Government use. Implementation plans to store captured energy into a local sub-station will be a deliverable. The optimized demonstration of physical sub-scale model with measured electrical and noise parameters is

expected as part of the deliverable. Applicate will provide the Government formal studies, multiple presentations, a working optimized prototype (with 20 lb-thrust or higher engine test) with air flow monitoring, energy recapturing and noise level readings, scalability plans are some milestones in this project.

PHASE III DUAL USE APPLICATIONS: This will be a SBIR phase III project is to integrate design elements, where feasible, into the Agile Common Engine Test Cell (ACETC) construction projection. This “Test Cell of the Future” concept opens up the perfect aperture to explore innovative green technology ideas and actively seek to reduce known safety challenges. If economically feasible, these concepts could apply to the commercial industry, especially for new construction opportunities. With construction conceptionally planned to begin in CY29, the opportunity to change tomorrow starts with today.

REFERENCES:

1. Energy Capture;
2. Noise Reduction;

KEYWORDS: Energy; Green; Noise Reduction; Jet Engine; Test; Energy Capture

SF24A-T004 TITLE: Integrated lasers and non-magnetic isolators for optical clock technologies

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

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

OBJECTIVE: Development of a low size, weight, and power photonically integrated laser system that includes a narrow linewidth (under 10 kilohertz) laser natively at 778.1 nanometers, specifically the rubidium two-photon transition frequency, and a non-magnetic or minimally magnetic on-chip optical isolator with at least 30 decibels of isolation. The device should be packaged in a standard enclosure such as a butterfly package with all electrical connections made, and fiber-coupled with at least 40 milliwatts out of a polarization-maintaining fiber.

DESCRIPTION: Atomic clocks have seen a revolution in technology over the past decade as they have pushed towards chip-scale sizes, allowing them to be used in communications, navigation, and other defense-related technologies [1]. Future technologies such as clocks for "5G" networks and future Global Navigation Satellite System architectures could potentially incorporate more advanced clocks. Optical clocks such as the rubidium two-photon clock offers potential improvements over current chip scale clocks and surpass rubidium atomic frequency references [2]. One limiting factor in future, more advanced optical clocks is the development of the needed laser technology. Optical clocks require narrow linewidths down to kHz linewidths for the rubidium two photon optical clock, or even more narrow for other optical clocks such as strontium. These devices must be optically isolated to ensure the narrow linewidth and to avoid reflections causing unwanted lasing modes. Current systems typically employ a series of free space or fiber coupled components to achieve narrow linewidths and high optical power [2], but they can be susceptible to vibrations and shock. Furthermore, these systems typically have optical isolators with large magnetic fields, limiting the compactness of the device due to the effect of the magnetic field on the atoms. Recently, there have been advancements in each individual area such as narrow linewidth lasers [3, 4], on-chip non-magnetic isolators [5, 6], and new integration techniques [7]. The creation of such a device will not only enhance the manufacturability of the clock and lower the overall size, weight, and power, but it will also increase the environmental robustness to effects such as shock and vibration [8]. However, these devices have not been integrated into a single photonically integrated package. The DoD seeks the development of a photonically integrated circuit that includes a narrow linewidth laser and an on-chip non-magnetic optical isolator in a single package to serve the needs for next generation optical clocks.

PHASE I: Initial design and simulation of a sub-10 kilohertz linewidth laser at 778.1 nanometers, specifically the rubidium two-photon transition frequency, as well as a non-magnetic or minimally magnetic on-chip optical isolator with greater than 30 decibels of isolation and a fiber-coupled output greater than 40 milliwatts. Also a method for integrating the devices into a single package, either heterogeneous or hybrid integration, that allows for mass fabrication, ideally at the foundry level.

PHASE II: Packaged device with a sub-10 kilohertz linewidth laser at 778.1 nanometers, specifically the rubidium two-photon transition frequency, integrated with a non-magnetic or minimally magnetic on-chip isolator that provides at least 30 decibels of isolation, and fiber coupled. The means of integration should

allow for mass fabrication, ideally at a foundry level. It should provide at least 40 milliwatts out of a polarization-maintaining fiber with greater than 25 decibels polarization extinction ratio. The packaging should contain all electrical connections and thermal control, and be mounted in a standard style enclosure, such as a butterfly package, with a polarization maintaining fiber out. At least 2 prototypes are expected to be delivered.

PHASE III DUAL USE APPLICATIONS: These devices will be extremely useful for a variety of applications such as next generation optical and atomic clocks, but will require further testing for shock and vibration, acceleration sensitivity, radiation tolerance, etc.

REFERENCES:

1. Kitching, J., Chip-scale atomic devices, *Appl. Phys. Rev.* 5, 031302 (2018);
2. Lemke, N., Martin, K., Beard, R., Stuhl, B., Metcalf, A., Elgin, J., Measurement of Optical Rubidium Clock Frequency Spanning 65 Days, *Sensors* 22, 1982 (2022);
3. Corato-Zanarella, M., Gil-Molina, A., Ji, X. et al. Widely tunable and narrow-linewidth chip-scale lasers from near-ultraviolet to near-infrared wavelengths. *Nat. Photon.* 17, 157–164 (2023);
4. Chauhan, N., Isichenko, A., Liu, K. et al. Visible light photonic integrated Brillouin laser. *Nat Commun* 12, 4685 (2021);
5. Tian, H., Liu, J., Siddharth, A. et al. Magnetic-free silicon nitride integrated optical isolator. *Nat. Photon.* 15, 828–836 (2021);
6. White, A.D., Ahn, G.H., Gasse, K.V. et al. Integrated passive nonlinear optical isolators. *Nat. Photon.* 17, 143–149 (2023);
7. Tran, M.A., Zhang, C., Morin, T.J. et al. Extending the spectrum of fully integrated photonics to submicrometre wavelengths. *Nature* 610, 54–60 (2022);
8. Niffenegger, R.J., Stuart, J., Sorace-Agaskar, C. et al. Integrated multi-wavelength control of an ion qubit. *Nature* 586, 538–542 (2020).;

KEYWORDS: Laser; integrated photonics; optical clock; optical isolators

SF24A-T005 High Throughput Visible-Wavelength Multispectral Filter Arrays via Spectral Multiplexing

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

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

OBJECTIVE: To design and fabricate a multiplexing multispectral filter array covering the visible wavelengths that achieves a higher optical throughput than a narrowband array with equivalent bandwidth and spectral resolution.

DESCRIPTION: Describe the work you would like to see accomplished to meet the objective stated above. Character limit 25,000.

NOTE: Please do not write any Acronyms in the Topic Description. Spell out everything. Also no mathematical symbols.

To design and fabricate a multiplexing multispectral filter array covering the visible wavelengths that achieves a higher optical throughput than a narrowband array with equivalent bandwidth and spectral resolution.

Current visible-wavelength multispectral filter array technologies suffer from low light throughput because every pixel on the sensor only measures a single wavelength at a single spatial location. Multiple pixels are then considered together to construct the spectral signature over that group of pixels. This approach, while intuitive, leads to low light levels as the spectral resolution increases, since each pixel sees an ever-smaller piece of the object spectrum. The result of this is that high spectral resolution hyperspectral video becomes difficult due to the high integration times necessary to measure the signal. To resolve this issue, the performer will design and fabricate a visible-wavelength multiplexing multispectral filter array, where each filter is sensitive to many wavelengths at once. The performer will then mount their fabricated array onto an off-the-shelf monochromatic camera and demonstrate scene sampling and demosaicking. Success will be defined by the SNR, integration time, and spectral resolution and bandwidth compared to those of an off-the-shelf narrowband multispectral filter array.

PHASE I: Modeling and simulation will be performed to determine a recipe for depositing a multiplexing filter array onto glass. The simulated filter transmission spectra will be used to model the sampling and demosaicking of a standard hyperspectral test image. Facilities for filter array fabrication will be identified by the performer.

PHASE II: The multispectral filter array will be fabricated using the facilities identified by the performer during the Phase I. The performer will then characterize the array and align and mount it to a calibrated sensor. Hyperspectral measurements will then be acquired by the camera, demosaicked to recover the hyperspectral datacube, and then compared to imagery of the same scene acquired with an off-the-shelf pushbroom hyperspectral camera. The Phase II deliverable will be the fabricated filter array attached to the provided sensor.

PHASE III DUAL USE APPLICATIONS: The spatial and spectral resolution of a camera with the affixed filter array will be characterized. A mounting system will be built for the camera to allow it to be attached to an off-the-shelf drone. A field test will be performed in which hyperspectral video of multiple moving ground targets with diverse spectral content will be acquired from a drone.

REFERENCES:

1. Harwitt, M. and Sloane, N., "Hadamard Transform Optics," Academic Press, 1979;
2. Oliver, J. et al., "Filters with random transmittance for improving resolution in filter-array-based spectrometers," Opt. Expr., 21(4), 2013;
3. Bian et al., "A low-cost integrated hyperspectral imaging sensor with full temporal and spatial resolution at VIS-NIR wide range," arXiv, arXiv:2306.11583v1, 2023.;

KEYWORDS: Multispectral Filter Array; Multiplexing Optics; Hyperspectral Imaging; Remote Sensing; Optical Filter Fabrication; Optical Coatings

SF24A-T006 TITLE: Low Size, Weight, and Power, High Flux Atomic Source for Scalable Manufacturing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

~~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 thermal atom beam sources with a high-brightness atomic flux density (greater than 10^{10} atoms/second per 10,000 micrometer-squared cross sectional area) with a minimum total flux greater than 10^{10} atoms/second and suitable for atomic sensing, atomic clocks, or other quantum devices of interest to the Department of Defense. The atom source should be compatible with mass-production techniques with preference being given to devices that can be integrated with established chip-alignment processes and procedures. The atomic sources should focus on simplicity and should use either no lasers or very simple laser configurations. The width of the transverse velocity distribution of the atoms emitting from the source should be no greater than 5 meters/second. Atomic beam sources developed under this topic should achieve the aggressive flux and velocity metrics within a total volume of 250 microliters with a viable path to achieve all metrics within a total device volume of 100 microliters. Preference will be given to sources that are able to reduce and control the longitudinal velocity as well as the transverse velocity.

DESCRIPTION: Atom-based sensors and clocks have shown tremendous promise in laboratory based experiments. In addition, atom-based quantum information processing nodes are likely to be necessary for short term quantum memory storage and transduction between different quantum systems. For clocks and sensors, the signal to noise ratio is typically improved in these devices by using laser cooling to produce a narrow velocity distribution that is within the Doppler width of the atoms or the linewidth of the laser. Using lasers for cooling is a well established technique but often increases the size and complexity of the device due to optical constraints. Several types of past and present atomic devices have avoided laser complexity by using filtered thermal atomic beams as the basis of atomic clocks and inertial sensors. For future atomic sensors that have low size, weight, and power (SWaP) that maintain high performance there needs to be a low-complexity, very compact atomic source with a well defined and narrow velocity range that uses no lasers, or greatly reduced laser paths, to produce a high brightness atomic flux. Ideally, this device will be suited for scalable manufacturing or fabrication techniques and could be compatible to integrate with established chip alignment processes. The device should produce greater than 10^{10} atoms/second with a transverse velocity width less than 5 meters/second. The total size should 100 microliters including heaters and vacuum enclosure. Preference will be given to sources that are able to control the longitudinal velocity as well as the transverse velocity.

PHASE I: Develop necessary plans and concepts to create a high-flux atomic source suitable for atomic sensing, atomic clocks, or other quantum devices while meeting performance metrics highlighted in the objectives of this topic. The designs and concepts should clearly identify how the required performance metrics will be met while simultaneously meeting the required Size, Weight and Power metrics. The plans and concepts should include a clear and convincing pathway towards low-cost, scalable production. This plans should also conceptualize how the atomic source designs could provide advantage over state of the art for a relevant atomic device, such as an atomic inertial sensor, compact atomic clock, or other

quantum information processing device.

PHASE II: Instantiate and demonstrate a functioning prototype meeting the required specifications as described in the topic objectives and as represented by finalized plans and concepts initially developed in Phase I. Perform experiments and analyze results to establish the performance of the device and compare versus the desired topic objectives and demonstrate the adequacy of the device concepts. Demonstrate the feasibility of low-cost, scalable production of the high-flux atom devices still capable of achieving all performance specs identified in the objectives. Develop contacts with potential customers and develop a transition plan supporting future Phase III activity. Provide regular communication to the government sponsor to demonstrate progress and to ensure government understanding of risk mitigation.

PHASE III DUAL USE APPLICATIONS: Mature the prototype technologies developed in Phase II to include ease of integration into full quantum devices. It is anticipated that the devices developed under this effort would be geared towards integration into low Size, Weight, and Power thermal-beam sensors, such as those being developed by the Defense Innovation Unit and the Office of the Under Secretary of Defense for Research and Engineering (OUSD R&E). Phase III efforts should focus on integration into full-quantum systems with prospective transition partners. The contractor will transition the solution for very low Size, Weight, and Power, highly scalable atom sources to a broad range of government and civilian users.

REFERENCES:

1. Li, C., Chai, X., Wei, B. et al. Cascaded collimator for atomic beams traveling in planar silicon devices. Nat Commun 10, 1831 (2019). <https://doi.org/10.1038/s41467-019-09647-3>;
2. Martinez, G.D., Li, C., Staron, A. et al. A chip-scale atomic beam clock. Nat Commun 14, 3501 (2023). <https://doi.org/10.1038/s41467-023-39166-1>;
3. T L Gustavson et al 2000 Class. Quantum Grav. 17 2385. <https://doi.org/10.1088/0264-9381/17/12/311>;

KEYWORDS: low SWaP atom sources; scalable atom sources; atom beam sources; high flux atom sources

SF24A-T007 TITLE: SPoC Resilient Basing

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

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

OBJECTIVE: 1.) Digital Transformation AI/ML Capabilities and Automation: Adopt existing technologies or new technologies that increase the efficiency of decision making and routine processes for space professionals in mission accomplishment
2.) Critical Infrastructure Technologies: Adopt technologies which predict and automate critical infrastructure asset stressors and failures to link power projection capabilities with mission assurance goals.

DESCRIPTION: Historically, suitability for new space operation mission growth was assessed in a stovepiped and data constrained fashion. Recent data indicates that shared, whole building systems have reached capacity, thereby potentially impacting or delaying critical mission system or technology upgrades. Space Base Delta 1, in concert with Delta 6, would like to develop an interactive digital twin of the critical infrastructure (e.g., cooling, power, HVAC) that supports space operations within SBD 1. This digital twin would be used for the following activities: facility space planning, what-if analyses for loading and resiliency, real-time monitoring of critical nodes, development of smart maintenance best practices, energy analysis/efficiency, exercise / wargame support.

PHASE I: Demonstrate through analysis the ability to perform the functions outlined in the Phase II.

PHASE II: Step 1: Develop an interactive model of a facility or piece of infrastructure supporting space operations. Identify and scope infrastructure at New Boston Space Force Station to convert into a digital twin. Develop an interactive digital twin prototype and implement use-cases (facility space planning, what-if analyses). Capture lessons learned to scale to a larger system-of-systems at Schriever SFB, CO. Step 2: Add sensors into infrastructure in order to enable smart monitoring of infrastructure performance. Focus on primarily HVAC and electrical equipment. Goal is to detect anomalous conditions that foreshadow a failure. Use data to feed predictive maintenance models. Step 3: Develop an AI-augmented situational awareness and decision tool for SBD 1's Civil Engineering Squadrons to command and control smart base infrastructure. Tool could be used on all USSF SBDs as well as USAF bases. Create roadmap to scale to all DAF bases and GSUs.

PHASE III DUAL USE APPLICATIONS: Transition pilot program to AFMC for sustainment funding. Scale pilot program to other SBD 1, 2, and 3 installations.

REFERENCES:

1. SBD 1_B400 Power - Cooling Assessment MSG_FINAL.pdf;
2. BOS Digital Transformation Strategy (as of 3 March 2023) (CUI version).pptx;
3. SpOC Near Term Top Challenges Memo.pdf;

KEYWORDS: Artificial Intelligence; AI; Machine Learning; ML; Automation; Smart City; Smart Base; digital twin; BOS; Resiliency; Smart Maintenance; what-if analysis; Resilient Basing

**Defense Microelectronics Activity (DMEA)
2024.A Small Business Technology Transfer (STTR)
Proposal Submission Instructions**

INTRODUCTION

The Defense Microelectronics Activity (DMEA) SBIR/STTR Program is implemented, administrated, and managed by the DMEA Office of Small Business Programs (OSBP). Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) STTR Program BAA. DMEA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

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

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

Specific questions pertaining to the administration of the DMEA SBIR/STTR Program and these proposal preparation instructions should be directed to: DMEA Acting SBIR/STTR Program Manager (PM), Mr. Tien Dang, at osd.mcclellan-park.dmea.list.smbus@mail.mil.

PHASE I PROPOSAL GUIDELINES

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

DMEA intends for Phase I to be only an examination of the merit of the concept or technology that still involves technical risk, with a cost not exceeding \$197,283.00. The technical period of performance for the Phase I effort should be no more than six (6) months.

A list of the topics currently eligible for proposal submission is included in this section followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. The topics are directly linked to DMEA's core research and development requirements.

Please ensure that your e-mail address listed in your proposal is current and accurate. DMEA cannot be responsible for notification to companies that change their mailing address, e-mail address, or company official after proposal submission.

PROPOSAL VOLUMES:**Proposal Cover Sheet (Volume 1)**

Required per the DoD STTR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed twenty (20) pages and must follow the formatting requirements provided in the DoD STTR Program BAA. Technical volumes exceeding twenty (20) pages will be deemed non-compliant and will not be evaluated.

Content of the Technical Volume

Read the DoD STTR Program BAA for detailed instructions on proposal format and program requirements. When you prepare your proposal submission, keep in mind that Phase I should address the feasibility of a solution to the topic. Only UNCLASSIFIED proposals will be accepted.

DMEA will evaluate and select Phase I proposals using the evaluation criteria contained in Section 6.0 of the DoD STTR Program BAA. Due to limited funding, DMEA reserves the right to limit awards under any topic, and only proposals considered to be of superior quality will be funded.

Cost Volume (Volume 3)

The Phase I Base amount must not exceed \$197,283.00. DMEA will conduct a price analysis to determine whether cost proposals, including quantities and prices, are fair and reasonable. Contractors should expect that cost proposals will be negotiated. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

The on-line cost volume for Phase I proposal submissions must be at a level of detail that would enable DMEA personnel to determine the purpose, necessity, and reasonability of each cost element. Provide sufficient information (a. through h. below) on how funds will be used if the contract is awarded. Include the itemized cost volume information (a. through h. below) as an appendix in your technical proposal. The itemized cost volume information (a. through h. below) will not count against the page limit on Phase I proposal submissions.

- a. **Special Tooling and Test Equipment and Material:** The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component; unless it is determined that transfer of the title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.
- b. **Direct Cost Materials:** Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, price, and where appropriate, purposes.
- c. **Other Direct Costs:** This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include leased hardware, must provide an adequate lease versus purchase justification or rationale.
- d. **Direct Labor:** Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.
- e. **Travel:** Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, and per diem. Indicate the destination, duration, and purpose of each trip.

- f. **Cost Sharing:** Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal.
- g. **Subcontracts:** Involvement of university or other consultants in the planning and /or research stages of the project may be appropriate. If the offeror intends such involvement, describe the involvement in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases, or usage fees and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer. Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., Cost Volume). At the very least, a statement of work with a corresponding detailed cost volume for each planned subcontract must be provided.
- h. **Consultants:** Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. Deviations from the POW requirements are not permitted.

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 DMEA during proposal evaluations.

Supporting Documents (Volume 5)

All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries
3. Disclosure of Funding Sources

Please refer to the DoD Program BAA for more information.

PHASE II PROPOSAL GUIDELINES

Phase II proposals may only be submitted by Phase I awardees. Phase II is the prototype/demonstration of the technology that was found feasible in Phase I. DMEA encourages, but does not require, partnership and outside investment as part of discussions with DMEA sponsors for potential Phase II efforts.

The Technical Volume is not to exceed forty (40) pages and consists of a single PDF file with your firm name, topic number, and proposal number in the header of each page. All documentation should use no smaller than 10-point font on standard 8.5" X 11" paper with one-inch margins and not be in two-column format. Do not include blank pages.

Phase II proposals may be submitted for an amount not to exceed \$1,315,219.00. The technical period of performance for the Phase II effort shall be no more than twenty-four (24) months.

Phase I awardees may submit a Phase II proposal without invitation not later than sixty (60) calendar days

following the end of the Phase I contract. The Phase II proposal submission instructions are identified in the Phase I contract, Part I – The Schedule, Section H, Special Contract Requirements, “STTR Phase II Proposal Submission Instructions”.

All Phase II proposals must have a complete electronic submission per the Proposal Volumes area listed in Phase I. Your proposal must be submitted via the submission site on or before the DMEA-specified deadline or it will not be considered for award.

Due to limited funding, DMEA’s ability to award any Phase II, regardless of proposal quality or merit, is subject to availability of funds. Please ensure that your proposal is valid for 120 days after submission. Any extension to that time period will be requested by the Contracting Officer.

A Phase II contractor may receive up to one additional, Sequential Phase II award for continued work on a project. The additional, Sequential Phase II award has the same guideline amounts and limits as an initial Phase II award. Sequential, Phase II proposals shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by the Acting DMEA SBIR/STTR Program Manager in advance.

DMEA STTR PHASE II ENHANCEMENT PROGRAM

To encourage transition of STTR into DoD systems, DMEA has a Phase II Enhancement policy. DMEA’s Phase II Enhancement program requirements include up to one-year extension of existing Phase II and up to \$657,610.00 matching STTR funds. Applications are subject to review of the statement of work, the transition plan, and the availability of funding. DMEA will generally provide the additional Phase II Enhancement funds by modifying the Phase II contract.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

DMEA does not provide Discretionary Technical and Business Assistance (TABA).

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 of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA.

Refer to the DoD 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:

DMEA Acting SBIR/STTR Program Manager (PM):

- Name: Mr. Tien Dang
- Email: osd.mcclellan-park.dmea.list.smbus@mail.mil

DMEA STTR 24.A Topic Index

DMEA24A-001 Monolithic SDR SoC for SATCOM

DMEA24A-001 TITLE: Monolithic SDR SoC for SATCOM

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

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

OBJECTIVE: Development of a monolithic Radio Frequency (RF) System-on-Chip (SoC) Software Defined Radio (SDR) Integrated Circuit (IC) transceiver for satellite communications (SATCOM) meeting specific defense needs and supportive of global navigation satellite system (GNSS), internet-of-things (IoT) edge-computing, and artificial intelligence (AI) processing technologies and applications.

DESCRIPTION: There are few commercially available, monolithic, SDR-SoCs on the market [1][2], and those that exist, though highly capable, can be cost prohibitive and are not optimized for low size, weight, and power (SWaP) DoD applications, such as small handheld devices where ultra-low power and reduced form-factor are major design considerations. Furthermore, a review of prior awarded SBIR/STTR topics demonstrates that defense specific needs for low SWaP SDR devices have routinely been met through a modular approach of integrating commercial-of-the-shelf (COTS) devices [3]. However, further SWaP optimization can only be achieved through higher levels of SoC integration with efficient architecture execution in supportive modern semiconductor technologies that include sufficient intellectual property (IP) offerings. Though SDR construction varies, the typical SDR architecture consists of a RF frontend, a field programmable gate array (FPGA) for baseband signal processing, and microprocessor or microcontroller for SDR control and power management. While continued advances in analog-to-digital (ADC) converter and digital-to-analog converter (DAC) designs have fueled RF SoC frontend innovations, such as direct-sampling of RF signals [4][5], and with the availability of processor core IP more commonplace in modern technology nodes, FPGA fabrics may not be most effective for on-chip baseband signal processing. While FPGAs are capable of meeting the high performance and reconfigurability requirements of SDRs, this comes at the expense of area and power dissipation due to their inherent structure. Furthermore, the powerup and reconfiguration latencies of FPGAs can be an issue in applications where wakeup time and agile tuning are required. To address these issues, taking advantage of advances in semiconductor scaling, application specific baseband processing, typically accomplished by the FPGA, may be more efficiently accomplished through on chip digital signal processing (DSP) techniques.

PHASE I: The purpose of the Phase I effort is to: determine the feasibility (cost, schedule, and performance) related to the development of the SDR-SoC; identify technological issues (availability of IP, etc.) to be addressed through innovations; and, develop a Phase II proposal for development activities toward the realization of the SDR-SoC from design to qualification, with the goal of meeting the following performance specifications:

1. General:
 - a. Off-state leakage current: $< 10 \mu\text{A}$
 - b. Sleep conditions must be specified along with projected sleep current.
 - c. Active power management with ability to shutdown/sleep system components.
 - d. Peak Power Dissipation: $< 1 \text{ W}$
 - e. Chip area: 5mm x 5mm

2. RF Frontend:
 - a. Transceiver tuning range: 100 MHz to 6 GHz
 - b. At least 1 Tx and 1 Rx channel
 - c. 40MHz Bandwidth
 - d. Anti-aliasing filters
 - e. 14 bit DAC, 14 bit ADC or better
3. DSP Engine:
 - a. Programmable DSP module floating point, 64 MACs running at 500MHz or better.
4. Processor Core:
 - a. ARM Cortex9 or better or RISC-V core with support for bootable Linux OS, external storage, UART, USB, I2C, SPI, network interfaces.

Furthermore, due to national security considerations the use of a DMEA accredited Trusted Supplier for Foundry Services is preferred, but not required, when considering feasibility options. Phase-I feasibility study should also be inclusive of programming software for the DSP module and front end, and supported Linux distribution(s).

PHASE II: The purpose of the Phase II effort is to: execute on the Phase I proposed developmental activities and innovations needed to advance the SDR-SoC concept; demonstrate working silicon; and develop a Phase III product commercialization plan, including potential non-DoD customers. Phase II outcomes will result in the design for fabrication, fabrication, package, assembly, test, qualification, and delivery of functional prototypes, including supporting design development and user-required software, data, and documentation, of either the fully functional monolithic SDR-SoC or necessary IP block(s) required to advance the monolithic SDR-SoC concept.

PHASE III DUAL USE APPLICATIONS: The objective of Phase III effort is to pursue commercialization objectives resulting from the Phase II developments. Other Phase III activities may include follow-on non-SBIR/STTR funded R&D (ATSP, OTA) or production contracts for developed products intended for use by the DoD.

REFERENCES:

1. Xilinx, <https://www.xilinx.com/products/silicon-devices/soc/rfsoc.html>: August, 2023.
2. Analog Devices, <https://www.analog.com/en/product-category/rf-agile-sdr-transceivers.html>: August, 2023.
3. DoD SBIR/STTR Program, SBIR/STTR Award Data search, <https://www.sbir.gov/sbirsearch/award/all>; search keywords: SDR, SDR + Low SWaP, SDR + SATCOM: August, 2023.
4. A. M. A. Ali et al., "A 12-b 18-GS/s RF Sampling ADC With an Integrated Wideband Track-and-Hold Amplifier and Background Calibration," in IEEE Journal of Solid-State Circuits, vol. 55, no. 12, pp. 3210-3224, Dec. 2020, doi: 10.1109/JSSC.2020.3023882.
5. L. Fang, X. Wen, T. Fu and P. Gui, "A 12-Bit 1 GS/s RF Sampling Pipeline-SAR ADC With Harmonic Injecting Cross-Coupled Pair Achieving 7.5 fJ/Conv-Step," in IEEE Transactions on Circuits and Systems I: Regular Papers, vol. 69, no. 8, pp. 3225-3236, Aug. 2022, doi: 10.1109/TCSI.2022.3169508.

KEYWORDS: Software Defined Radio (SDR); System on Chip (SoC); Satellite Communications (SATCOM); Integrated Circuit (IC); Internet of Things (IoT); edge computing; Artificial Intelligence (AI); Global navigation satellite system (GNSS).