VERSION 3

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

IMPORTANT

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

INTRODUCTION

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

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

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

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information

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

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

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

PHASE I SUBMISSION INSTRUCTIONS

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

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

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

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Proposal Volumes. The following six volumes are required.

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

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

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

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

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

NOTE: G&A, if proposed, will only be attributed to the proposing firm.

- Subcontractor Costs (numerator for subcontractor calculation):
  - Total Subcontractor Costs (TSC)
- Total Cost (denominator for either calculation)

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

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

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

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

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

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

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

PHASE I EVALUATION AND SELECTION

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

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

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

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

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

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

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

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

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

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

ADDITIONAL SUBMISSION CONSIDERATIONS

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

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

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

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

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

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

TABA must NOT:

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

TABA requests must be included in the proposal as follows:

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

Proposed values for TABA must NOT exceed:

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

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

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

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

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

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

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

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

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

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that

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

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

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

SELECTION, AWARD, AND POST-AWARD INFORMATION

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

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

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

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

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

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

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

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

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

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

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

PHASE II GUIDELINES

Evaluation and Selection. All Phase I awardees may submit an **Initial** Phase II proposal for evaluation and selection. The evaluation criteria for Phase II is the same as Phase I. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable) will be used to evaluate the proposer's potential to progress to a workable prototype in Phase II and transition technology to Phase III. Details on the due

date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

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

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

PHASE III GUIDELINES

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

VERSION 3

Navy SBIR 22.2 Phase I Topic Index

N222-087	Performance and Safety Improvement of the Li-ion 6T Battery
N222-088	Integrated High Power Generation for the Joint Light Tactical Vehicle
N222-089	Celestial Navigation System for Long Range Unmanned Surface Vessels

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

N222-111	Advanced Manufacturing of Piezoelectric Textured Ceramic Materials
N222-112	Low-profile High-Frequency Maritime Antenna
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N222-121	Compact Sensor for Non-Destructive Propellant Mechanical Property Evaluation
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N222-124	Secure Data Module for Leave-Behind Applications
N222-125	Development of a Shore Based Information System (SBIS) Interface Software
N222-126	Compact Boost Motor Propellant Stabilizer Sensor
N222-127	Innovative Manufacturing/Materials in Hypersonic Thermal Protection

	Systems
N222-128	Development of Hypersonic Glide Body Deployable Antennas

VERSION 3

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

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

TECHNOLOGY AREA(S): Materials / Processes

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

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

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

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

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

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

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

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VERSION 3

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

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

TECHNOLOGY AREA(S): Ground / Sea Vehicles

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

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

The system requirements are:

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

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

PHASE II: Develop a full-scale prototype for evaluation. Evaluate the prototype through bench or lab testing to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirement for the integrated power generation system. System performance shall be demonstrated through prototype evaluation and modeling or analytical methods over the required

range of parameters including numerous deployment cycles. Evaluate the results of the demonstration and refine the design as necessary. Conduct on-vehicle testing in a relevant environment. Evaluate and compare the results to Marine Corps requirements. Prepare a Phase III development plan to transition the technology for Marine Corps use.

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

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

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

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VERSION 3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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VERSION 3

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

VERSION 3

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

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

TECHNOLOGY AREA(S): Materials / Processes;Sensors

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

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

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

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

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

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

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

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VERSION 3

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

OUSD (R&E) MODERNIZATION PRIORITY: Networked C3

TECHNOLOGY AREA(S): Electronics; Sensors

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

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

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

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

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

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KEYWORDS: antenna; high frequency; maritime

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

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

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

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

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

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

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

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

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

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

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

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

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

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VERSION 3

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

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VERSION 3

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

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

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

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

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

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

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

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

PHASE II: Produce prototype hardware based on experiments or modeling results and initial plans created in Phase I. Demonstrate production of riblets with the prototype system. Depending on technology maturity, perform riblet production demonstrations that could focus on both conventional and/or more complex three-dimensional geometries for improved performance. Production demonstration can be done on flat coupons as small as 12”x12”, though scale-up issues should be considered. Validate that the riblet geometry produced by the prototype system meets the requirements in the Description. This could be done with laser profilometer or scanning electron microscope measurements. Conduct low-speed wind tunnel testing or other low-cost drag testing. Measure the aerodynamic drag reduction achieved with the completed coupon or multiple coupons. Complete larger panel testing and subsequent wind tunnel testing

at flight conditions that match those of Navy aircraft flight profiles, focused on cruise conditions. Develop plans for integration of the prototype into a system for creating large areas of riblets on surfaces with complex curvature. Integration issues should include consideration of aircraft surface normals that may have any direction relative to gravity (e.g., upper surfaces, lower surfaces, and vertical surfaces).

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

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

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

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VERSION 3

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

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

TECHNOLOGY AREA(S): Ground / Sea Vehicles

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

OBJECTIVE: Develop a rugged, quiet, transom- or deck-mounted, retractable electric propulsion system for high-speed planing craft such as the 11m Rigid Hull Inflatable Boat (RHIB) or Special Operations Craft – Riverine (SOCR).

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

• The APU system shall provide a minimum thrust at varying speeds as indicated below:
Speed (kts) 3.5 4.0 4.5 5.0 5.5
Thrust (lb) 113 338 553 725 890
• The propeller/impeller shall be designed to minimize underwater acoustic noise and eliminate cavitation.
• The propeller shall provide a minimum Overall Propulsive Coefficient (OPC) of approximately 0.55
• Rim or Hub Driven Thruster/waterjet, transom- or deck-mounted with a quiet, automated deployment/retraction mechanism with draft not exceeding that of existing fixed propulsor.
• The system will utilize Open-Source Control System Code capable of integration into vessel's power management system and existing propulsion control system including steering.
• Permanent magnet motor and controller with drive frequency and primary harmonics greater than 50 kHz.
• The controller shall be quiet and will be engineered and designed for use in bi-directional applications (AC to DC and DC to AC).
• A portable electrical storage system (ESS) will be provided by the proposer for temporary installation on the target platform for the purpose of all performance trials and should have the capacity to propel the platform at 5.5 kts for approximately 4 hours on a single charge.
• The system shall be acceptable for use in various harsh marine environments, and be capable of continuous operation in 0-45°C seawater.
• The system will be capable of handling dynamic shock loads frequently experienced by small craft during operation (6.0-7.0 G's depending on vessel operation parameters).
• The system shall be constructed from materials acceptable and proven for use in marine/offshore applications using galvanically compatible materials to minimize corrosion to ABS standards.
• The APU system must be designed to minimize weight and space because deck and transom space as well as weight margins on target platforms are extremely limited.

• All seals and bearings will be capable of operating without deleterious effects in bodies of water with high levels of turbidity, silt, and sand.

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

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

PHASE II: Revise and refine the system designs. Fabricate a proof-of-concept demonstrator (vendor-designed power and drive train) to be installed and tested on either a SOCR or 11mRHIB (proposer choice). (Note: U.S. Navy personnel will participate in these tests so that multiple Phase II systems can be evaluated.) Test for thrust, speed, endurance vs payload, and acoustic trials in protected (SS0) conditions on a test platform provided by ONR during the demonstration period. Acoustic trial data will be classified as they will be performed on Navy platforms.

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

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

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

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

VERSION 3

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

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

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

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

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

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

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

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

PHASE I: Develop and/or demonstrate method(s) for synthesizing high purity CLS powder that is suitable for densification to maximize optical performance. Develop powder characterization metrics and measurement procedures for attributes such as stoichiometric composition, particle size and morphology, rheological properties, etc. Demonstrate the relation between intended Ca:La stoichiometry and measured stoichiometry and any replacement of sulfur by oxygen. Demonstrate the repeatability of obtaining an

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

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

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

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

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

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VERSION 3

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

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

TECHNOLOGY AREA(S): Materials / Processes

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

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

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

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

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

PHASE III DUAL USE APPLICATIONS: Validate AI/ML tools for a different metal alloy to test AI/ML tools. Engagement with an OEM is highly encouraged. Commercial applications of additive

manufacturing can be found in a wide range of commercial sectors such as: aerospace, shipping, transportation, rail, automotive, medical, etc. This technology would be applicable to identifying defects in critical metallic applications across all the sectors.

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

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VERSION 3

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

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

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

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

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

DESCRIPTION: Analysts supporting naval missions develop actionable intelligence from an extensive array of data sources. National Intelligence, Surveillance, and Reconnaissance (ISR) assets such as Global Hawk and Predator have proven invaluable in multiple theaters of interest. These systems provide high resolution sensory content that has been used to detect adversarial activities, such as movement of fighters and weapons, implanting decoys and IEDs, or gathering of key leaders. Unfortunately, multimodal streaming contents are time consuming to analyze, cumbersome to annotate, and distribute for further review, analysis, or approval. For example, the large size of the video files encourages segmenting of the video data into small pieces containing highly valuable and sensitive information. When this is done, metadata links are broken, causing the loss of temporal- and geo-tracking – both of which are important for further refinement of intelligence and value evidentiary information in support of ongoing operations. Threat assessment efforts require a multi-disciplinary approach that can automatically ingest and process structured and unstructured data from an expanding array of sensors and information sources. Automated content tagging and multimodal sensor fusion are critical components of proactive threat assessment and course of action determination. This SBIR topic seeks development of novel AI metadata methods to

automatically create, explicitly document, manage, control, and preserve time-critical sensory content for the development of actionable intelligence. Synchronization of different data types and formats will be an important component. Metadata promotes assessment of the captured behavioral indicators and observables of potentially threating activities. The multi-attribute metadata provides an aggregated array of chronicled indicators that brings into focus the likelihood of a specific entity or group being engaged in the identified hostile activity, as basis for concern. Analysts can then assess the gathered observables to justify additional ISR operations, precautionary defensive measures, or preemptive actions. This technology will be an essential building block for a seamless all-domain interactive offensive and defensive kill chain.

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

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

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

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

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

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

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

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

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

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

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

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KEYWORDS: Artificial Intelligence; Metadata; Machine Learning; Kill Chain; Intent; Geospatial; Temporal

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VERSION 3

N222-119 TITLE: Next Generation Infantry Heads-up Displays for Close-Air Support

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

TECHNOLOGY AREA(S): Human Systems; Information Systems

OBJECTIVE: Develop next-generation heads-up displays (HUDs) to provide training aids, operational tools, and situation awareness (SA) visualizations to improve the speed and quality of decision making by Marine Corps Ground Forces, specifically for close-air support (CAS) and call-for-fire (CFF).

DESCRIPTION: Ground forces must make rapid decisions in complex situations, such as requesting CAS, deconflicting airspace, and providing target information. In these situations, keeping heads-up and aware of the changing dynamics is critical. HUDs take advantage of augmented reality (AR) technologies to overlay information onto the battlefield and enhance SA. While HUD and AR systems have made progress in the past several years [Refs 1, 2], further innovation is required to develop systems for ground forces conducting CAS during daytime training and operations [Refs 3, 4]. Proposed solutions are sought to refine hardware and software requirements for Marine Corps use cases and deliver functional HUDs or HUD prototypes for next-generation AR HUD systems that can serve both as training aids and operational tools in CAS scenarios.

These systems must have maximum utility to Marines while maintaining survivability in a variety of complex environments. The display must be unobtrusive and mountable on existing Marine Corps helmet Night Vision Goggle (NVG) rails. The general device requirements are: (1) a low-cost (< $10,000) optical or video-see through HUD that is rugged (e.g., for outdoor use); (2) has a small form-factor; (3) is very low weight; (4) has ultra-low electronic power requirements; and (5) is capable of high-resolution operation. Specific device optical requirements include: (1) field-of-view (FOV) approaching 120 degrees width and 80 degrees height; (2) a blended, high-resolution 60 pixel/degree Field of View (FOV) across the foveated display area; and (3) a head-mounted display (HMD) with a refresh frame rate above 90 Hz. For requirements of form-factor size and weight, power requirements, and high-resolution operation (general device requirements 2-5), we are not identifying specific targets in this topic call. The solicitors expect performers to make trade-offs between the listed requirements and justify their decisions during Phase I. Priority should be given to higher resolution, lower latency, and smaller size and weight (in that order).

Proposals must detail how hardware and software systems will address physical ergonomics [Ref 5] and cognitive performance (i.e., situation awareness, decision making [Ref 6]) concerns for use in training and operations by Marine Corps Infantry. Proposals do not need to detail development of a complete AR system, but they must describe how they will investigate and evaluate their proposed hardware and software innovation. Development should be done with technologies that have little-to-no licensing fees for development or execution (e.g., Unity), and focus primarily on HUD systems, not AR-related technologies (e.g., tracking, object insertion, etc.). The training and operational use case of interest is Marine Corps CFF and CAS missions, which include challenging circumstances such as bright sunlight, uncertain geography, and translation between map coordinates and the real world.

PHASE I: Develop a concept for a low-cost (< $10,000), high-performance HUD to superimpose computer-generated information on an individual’s view of the real world. Demonstrate the feasibility of the selected concept (hardware/software HUD-centric system) to meet Marine Corps infantry needs through a set of specific Phase I deliverables.

Standard deliverables that are a part of every SBIR Phase I contract include: (1) kick-off brief; (2) progress reports; and (3) a final report. Additional deliverables include: (1) an initial prototype; (2) a

computer aided design (CAD) mechanical design package showing the top-level device and all major sub-assemblies anticipated; and (3) trade-off design decisions and associated justification for system design and human factors considerations.

PHASE II: Develop at least two working proof-of-concept HUDs for the Marine Corps. Conduct critical design reviews. Demonstrate that initial capabilities are sufficient for existing AR training applications. Facilitate evaluation of the prototypes to determine their capability to meet Marine Corps needs and requirements for an augmented reality HUD.

Deliverables include: (1) a final bill-of-materials (BOM); (2) all CAD drawings, hardware schematics, software source code; and (3) at least two proof of concept devices for evaluation.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the HUD system. Support the Marine Corps with integrating the HUD into existing AR training devices. Assist with certifying and qualifying the HUD system for Marine Corps use. Assist in writing Marine Corps device user manual(s) and system specifications/materials. As appropriate, focus on scaling up manufacturing capabilities and commercialization plans. Specific examples of commercial markets that could use this technology include manufacturing, law enforcement, and other hands-on tasks in time-critical domains.

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KEYWORDS: Augmented Reality; AR; Virtual Reality; VR; Heads-up-display; HUD; Training; Infantry; Close-Air Support; CAS; call-for-fire; CFF

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VERSION 3

N222-120 TITLE: Next-generation Underwater Life-support System (Rebreather)

OUSD (R&E) MODERNIZATION PRIORITY: Biotechnology

TECHNOLOGY AREA(S): Biomedical; Human Systems; Materials / Processes

OBJECTIVE: Develop a next-generation underwater life-support system (rebreather) with improved oxygen supply and/or carbon dioxide removal.

DESCRIPTION: Open circuit self-contained underwater breathing apparatus (SCUBA) wastes much of the usable oxygen (O2) in divers' bottled gas and produces bubbles that limit its use in covert operations. The closed circuit underwater breathing apparatus (CCR) extends dive times and supports covert operations by eliminating telltale bubbles. Carbon dioxide (CO2) scrubbers contribute much to the overall size and weight of rebreather rigs. Rebreather fatalities may result when divers exceed capacities of either scrubbers or oxygen bottles. Therefore, the Navy seeks new technologies that will improve rebreather safety and mission endurance by reducing the limitations and risks associated with present CO2 scrubbing materials and compressed oxygen gas. Due to size and power constraints, new chemical processes will be needed. Ideal features for the final product form factor would be modular, no larger than current rebreather components, low power requirements (not to exceed 2 kg Li-ion battery); and include appropriate sensors and control systems. System needs to produce oxygen and/or scrub CO2 at a rate to match metabolic rates of an active diver in missions lasting up to 10 hours. Note that a functional system must scrub CO2 effectively for the full duration of the mission, but oxygen production may be supplemented by bottled oxygen to meet full mission duration.

PHASE I: Develop a concept for a life-support breathing apparatus that improves oxygen supply and/or CO2 removal improved underwater life-support system (rebreather). Demonstrate feasibility through analysis and limited laboratory demonstrations. Provide energy estimates matched to human metabolic demands, energy source, cost of system, cost per dive, and reliability estimates, including lifetime expectancy and lifetime cost estimate. The required Phase I deliverables will include: 1) a research plan for the engineering the design of the life support system; 2) a preliminary prototype, either physical or virtual, capable of demonstrating capability of the design; and 3) test and evaluation plan including data collection guidelines and identification of proper controls. Important considerations should include ability to resist corrosion and fouling. Phase I will provide key information about the uses and limitations of the system and could include rapid prototyping and/or modeling and simulation.

PHASE II: Develop, demonstrate, and validate the life support system prototype based on the Phase I design concept. The system should be tested under expected operational environmental conditions (e.g. temperatures, pressures; potential contaminants. Ideal features for the final product form factor would be modular, no larger than current rebreather components, low power requirements (not to exceed 2 kg Li-ion battery); and include appropriate sensors and control systems.

PHASE III DUAL USE APPLICATIONS: Develop prototype into a functional system as agreed to by an appropriate sponsor. Operationally relevant conditions (e.g., greater depths and prolonged dives) may necessitate additional development. System would have value for commercial/recreational diving as well as potentially life support systems for underwater manned vehicles or facilities.

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2. Selective production of oxygen from seawater by oxidic metallate catalysts. T. P. Keane and D. G. Nocera, ACS Omega 2019, 4, 12860–12864

VERSION 3

KEYWORDS: Oxygen generation, electrochemistry, carbon dioxide scrubbing

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VERSION 3

N222-121 TITLE: Compact Sensor for Non-Destructive Propellant Mechanical Property Evaluation

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

TECHNOLOGY AREA(S): Materials / Processes; Sensors

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

OBJECTIVE: Develop a compact sensor capable of operating safely in an energetic environment that collects data that can be used to determine the mechanical state of solid rocket propellant in a non-destructive manner. The sensor will take data that can be used to infer the mechanical state of solid rocket motor propellant and be used in the analysis of propellant grain integrity.

DESCRIPTION: Solid rocket motors employed by the Navy use propellants that must withstand all of the structural loads the motors are exposed to during transport, storage, stowage, and operation. The motors are designed to meet/exceed these load requirements. However, age and environmental exposure can alter the response of the propellant to these structural loads. The Navy has a need for a compact sensor or a suite of sensors that can collect data that can be used to infer the mechanical state of solid rocket motor propellant in a non-destructive manner. Such a sensor would be used to inspect the propellant of solid rocket motor assemblies in a rapid fashion. Understanding the mechanical state of the solid rocket motor propellant allows for a better evaluation of the health of the propellant and provide greater fidelity in aging trend evaluations. In addition to the sensor(s), an insertion system that can place the sensor at different locations on the propellant surface of a solid rocket motor system will need to be designed. The needed R&D is the miniaturization of the sensor head (on the order of inches) and the development of an insertion system compatible with solid rocket motor assemblies currently deployed by the Navy.
A sensor or a sensor suite that can perform the required measurements will address the difficulty of non-destructively evaluating the mechanical state of the propellant grain while having limited access to the interior of the solid rocket motor assembly. This technology will avoid the current need to disassemble the solid rocket motors and avoid all associated costs with disassembly and reassembly. The technology will minimize or eliminate (preferred) the need to attach the inspection equipment to the solid rocket motor. All of these features will allow measurements to be taken on substantially more available solid rocket motor assets as opposed to the current limited number of assets assigned to the monitoring program.

This SBIR topic is focused on the development of a compact, highly mobile sensor that can collect the data needed to determine fundamental (gross or bulk) material properties, such as the modulus for elastic and elastic-plastic deformation. The propellant is a highly filled elastomer that contains organic and inorganic solids, plasticizers, and stabilizers, held together by a polymeric binder. The proposed approach may employ a miniature version of an indentation testing technique or leverage a completely different method. Proposed methods should minimize the need for attachment to the solid rocket motor. The proposed sensor would move to the correct measurement position. The sensor then measures the resisting force being applied by the material on the contact head. In this mode, the contact head is moved to fixed required depth. In another mode, the contact head is moved at a constant rate while measuring the

resisting force. The sensor should meet low power, low voltage, and the Navy's HERO (Hazards of Electromagnetic Radiation to Ordnance) requirements for on-shore use [Ref 6]. The sensor should be capable of being maneuvered through the confined area of a nozzle and be used in the interior of a solid rocket motor. The sensor system must be capable of being calibrated prior to use. The insertion system must be capable of placing the sensor at multiple locations, up to several meters into the solid rocket motor or preferably a mobile system capable of moving to the correct location for measurement. The insertion system should be simple to install and minimize the number of personnel and amount of support equipment needed for measurements. The sensor and insertion assembly must be capable of intermittent usage for a period of ten years.

PHASE I: Develop a technical concept for a propellant mechanical property sensor. Proposed design concepts should be completed during Phase I. Laboratory-scale demonstrations to verify the proposed sensor concept(s) should be completed. Modeling should be completed to verify proposed concept(s) can meet size/volume constraints while providing the correct data. The laboratory testing and modeling must be satisfactorily completed to transition from Phase I to Phase II. Identify risks to the technical approach and develop/evaluate plans to mitigate those risks for Phase II. Laboratory-scale demonstrations to verify the proposed insertion system should be completed. The Phase I Option, if exercised, will include the initial design specification and capabilities description to build a prototype solution in Phase II. Coordinate with Navy SBIR liaisons on key technical requirements data to be measured, size of the sensor, size of the insertion system, application method, power, and data storage/transmission needs.

PHASE II: Design and develop a prototype of the mechanical property sensor based on the concept(s) from Phase I. Ensure the design has the ability to collect data that can be used to measure, at a minimum, the data needed to calculate the initial modulus and the relaxation modulus. Ensure the design is sized such that it can pass through the throat of a solid rocket motor nozzle and fit within the bore of the motor. Ensure the design is capable of performing the measurements at multiple locations in a repeatable manner. Ensure the insertion system is capable of moving the sensor to the desired location. Complete testing of the sensor prototype to validate operation and feasibility. Design the testing to emulate the installation, sensing, data collecting/storage, and removal. Test material compatibility to ensure survivability and compatibility with solid rocket propellant during the inspection process.

PHASE III DUAL USE APPLICATIONS: Update the sensor based on Phase II efforts. Support the development of an instruction manual for use. Manufacture an updated prototype and demonstrate use on an identified asset that is considered representative. Provide the necessary support for certification and qualification of the system for deployment and use at fleet facilities and/or facilities where fleet assets are located.

This technology has the potential to be used commercially in any industry that has a need for mechanical property monitoring of elastic / elastic-plastic materials in areas of high hazards.

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KEYWORDS: Relaxometry; 1.1 Propellants; Non-Destructive Measurement; Mobile Sensor; High Elongation Propellants; Propellant Mechanical Properties

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VERSION 3

N222-122 TITLE: High Temperature Cable and Connector Development for Radio Frequency (RF) Applications in Harsh Environments

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

TECHNOLOGY AREA(S): Battlespace Environments; Materials / Processes; Weapons

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

OBJECTIVE: Develop High Temperature Radio Frequency (RF) cables and connectors that can perform in harsh environments and are reliable, cost effective, and manufacturable. Solutions are to be utilized in various applications in a high-speed missile system.

DESCRIPTION: A major technical challenge for high-speed weapon systems includes managing the extreme heating environments experienced at increased speeds. Temperature requirements for components can vary depending on the location/placement on the platform. Air friction can cause extreme heating of the leading edge. Most materials, including RF cables and connectors, cannot sustain these high temperatures.

The developed RF cables and connectors should have a minimum temperature rating of 1200° C and an objective of 1500° C. The RF cables will be used in different applications so a wide variety of impedance, frequency specifications, phase stability, attenuation specifications, power specifications, and physical dimensions should be considered. Some possible applications are:
• Aerospace industry for accurate communication equipment
• Military and space application
• Satellite communications

Commercial High Temperature cables are typically rated at 1000° C and High Temperature connectors are 600° C.

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

PHASE I: Propose a solution for developing a RF cable and connector prototype. The recommended solution shall demonstrate the ability to withstand an operational harsh aerospace military environment.

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Demonstrate a proof of concept for the subsystem design and analysis, addressing material and environmental requirements for the cable and connector. Specific requirements for material, performance characteristic, and measurement implementation for the prototype design must be understood. The proposed solution must demonstrate a concept that can improve the temperature rating of a RF cable and connecter system. Trade studies shall be completed if optimal materials are predicted to affect performance.

Cable diameter, flexibility, and weight should be considered when designing for increased temperature capabilities.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype that meets the government's design requirements based on the results of Phase I and the Phase II Statement of Work (SOW). The developed units must be suitable for proof of concept demonstration and ensure the cable and connector prototype meet the Government's requirements, which will be provided upon contract award. During this phase, access to classified design data is required to gain the actual system requirements for the technical specifications of the sensor, as well as the exact mechanical and electrical constraints that the prototype must adhere. The effort should also focus on procuring materials for test and evaluation. High fidelity analysis will be conducted. Testing will take place in contractor selected facilities to validate design.

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

PHASE III DUAL USE APPLICATIONS: Qualify the prototype to system testing. Support the Navy in transitioning the technology to Navy use. This may include modifications to meet all testing requirements. Develop and document assembly instructions and drawings provided to the government for manufacturing purposes. This technology can be transitioned to other Navy, DOD, and Government weapon systems for integration of next generation flight systems. In the commercial sector, space shuttles and any high-speed systems could utilize the developed cables and connectors.

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2. "Guild to RF Coaxial Connectors and Cables" rf/microwave Instrumentation https://www.arworld.us/resources/Guide-to-RF-Coaxial-Connectors-and-Cables.asp

KEYWORDS: High Temperature materials; Aerospace cables; RF harsh environment components; Military Communication; cables and connectors; material integration

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VERSION 3

N222-123 TITLE: Software Simulation of a Thermal Protection System for Hardware-in-the-Loop

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

TECHNOLOGY AREA(S): Battlespace Environments; Materials / Processes; Weapons

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

OBJECTIVE: Develop a software simulation of a Thermal Protection System (TPS) for a Hypersonic Weapon with intent to integrate the software into a system-level test architecture.

DESCRIPTION: A Thermal Protection System (TPS) on a vehicle protects vehicle components from heating effects brought on by the advanced aerodynamic environments of hypersonic flight. The Navy desires a high-fidelity software model of a TPS to show the effects of these advanced hypersonic aerodynamic environments on the TPS. The novel nature of this SBIR topic stems from two requirements on this high-fidelity software model; the software model is expected to be seeded with experimental data of a real TPS from provided material coupon and the software model is expected to interface with a Navy system-level test asset that runs on a real-time computational platform. The Navy is currently expanding its ability to do real-time system level test and evaluation of hypersonic weapons, and so requires continuous improvement to the subcomponent models that make up system-level test architecture. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Outline the following three concepts:
1. A framework for a software simulation of a TPS in a Hypersonic environment. Key inputs to this simulation should be derived from vehicle kinematics and TPS material properties, utilize publically available data for hypersonic boost-glide systems to define inputs. Key outputs to this simulation should indicate TPS performance and vehicle heat exchange information. The software simulation will be required to run in a real-time computational environment.
2. A test plan for advanced TPS materials outlining the process of experimentally determining relevant data parameters for the software simulation model.
3. A software architecture for integrating the software simulation model into the Navy's system level test architecture.
Relevant information for setting up the framework will be provided upon contract award.

PHASE II: Develop prototype software development is expected to happen in two sections based on the three concepts outlined in Phase I:
1. Software development of the TPS software simulation will begin, with the expectation that initial development will be complete by the end of Phase II with preparation to integrate into the Navy's system-level test equipment during Phase III. Interface with Navy engineers familiar with the system-level test equipment and be provided with specific details of the software interface definition. Navy engineers will also work with the awardee to provide details of the system-level test software for software integration to ensure smooth transition in Phase III. Certain details of the Navy's system-level test equipment will be Classified.
2. Execution of the test plan for the advanced TPS material will occur. The awardee will receive advanced TPS material coupons for experimental test in order to seed the TPS software simulation with TPS material data. TPS material coupons will be classified.
It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: The delivered product to the Navy is expected to be a software package to reside on system-level test hardware and interface with system-level test software. Provide installation guidance and support for the software. Provide a level of support for validation and debugging as the Navy team performs checkout activities on the software. These checkout activities will take the form of data packages created using the Navy's system-level test with the incorporated software package, to be compared to data packages of the system-level test without the software and also compared to data packages of experimental data. Experimental data will include the awardee's experimental data from Phase II. Experimental data may also include Navy generated data, which will not be distributed to the customer – in this case, the expectation is the Navy will generate internal reports that include this data and distill out of these reports a version sharable with the customer as it relates to the performance of the customer supplied software product. Transition activities will end when the company awardee and the Navy have agreed to successful integration of the software package into Navy system-level test equipment.

While specific data within the software package related to the TPS will remain classified, the software architecture and advanced TPS modeling tools developed by the awardee are expected to be usable by the awardee for non-military applications in the commercial hypersonic industry.

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3. Yang, Yz., Yang, Jl. & Fang, Dn. "Research progress on thermal protection materials and structures of hypersonic vehicles." Appl. Math. Mech.-Engl. 08 Oct 2007: Ed. 29, 51–60. https://doi.org/10.1007/s10483-008-0107-1

KEYWORDS: Hardware-in-the-loop; Thermal Protection System; Software; Modeling and Simulation; Hypersonics; System Level Test Architecture

TPOC-1: SSP SBIR POC
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VERSION 3

N222-124 TITLE: Secure Data Module for Leave-Behind Applications

OUSD (R&E) MODERNIZATION PRIORITY: Cybersecurity

TECHNOLOGY AREA(S): Electronics; Information Systems

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

OBJECTIVE: To generate a unique capability with appropriate National Security Agency (NSA) approvals at Technology Readiness Level Eight (TRL-8), leveraging existing component technologies at TRLs 3-9. The proposed device would provide a small form factor computer with integrated classified data storage and transmission, meant for integration into small unmanned platforms, and would be interoperable with other standard NSA Type 1 encryption technologies.

DESCRIPTION: Existing encryption solutions for Data at Rest (D@R) are bulky and require significant power availability to operate, making deployment on smaller platforms or in power-limited systems challenging. Much smaller Data in Transit (DiT) solutions are available but are designed for use over solid networking connections, making deployment in situations with limited bandwidth or intermittent connectivity difficult or impossible. The proposed device incorporates existing chips available from multiple vendors for implementation of cryptographic algorithms into a single box meant to optimize size, weight, and power (SWaP) for field implementations. SWaP objectives are a maximum of the following: 0.5 cubic feet volume, 20 lb, and 100 W. The device should be ruggedized, designed for leave behind operations with automated tamper detection and zeroization, and designed to meet NSA standards required for handling of TS/SCI.

As Navy systems are increasingly small, unmanned devices in remote locations, securing of data collected and generated by these systems becomes more complex. Current devices require each system to devise custom implementations for handling of DiT over low bandwidth or inconsistent communications links. The only alternative to the existing devices is to develop a fully custom implementation, which requires NSA approvals of each specific use case.

Enabling technologies are available, including OEM devices intended to host the level of encryption required, and small form factor data diodes which could be incorporated. Most chip-level encryption devices require NSA approval of the specific implementation, making implementation of these in each situation requiring encryption extremely cost prohibitive.

Innovative approaches will be required to optimize SWaP, and to implement appropriate tamper-safety mechanisms for leave behind operation. The ideal solution is easily powered from a battery bank, can operate without need for ventilation, and is smaller and lighter when compared with existing D@R solutions.

Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and

approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: In Phase I, a project plan and schedule will be developed. In these, the awardee should demonstrate a thorough understanding of the required processes and potential challenges of building an approved cryptography device and pursuing NSA approvals. Key enabling technologies should be identified and understood, including any necessary government support for procurement of approved crypto items. Basic data flow diagrams should be developed, showing interconnections and locations of all key components.

PHASE II: In Phase II, specific key components will be identified, purchased, and integrated into two benchtop prototype solutions. Ruggedness of the designed unit should be confirmed through mechanical modeling. Data handling, zeroization, and network management should be tested using the benchtop prototypes. Successful keying of devices, development and sustainment of the necessary security associations across intermittent communications paths, as well as appropriate fail-secure mechanisms should be demonstrated.

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

PHASE III DUAL USE APPLICATIONS: In Phase III, the device should be manufacturable at scale, with target uses in unmanned systems in a variety of environments. Validation testing should be performed by the awardee. Additional testing will be required for NSA authorization of the device; the awardee must accommodate testing and documentation requirements for NSA approvals.
This concept is for an enabling technology for a variety of systems serving a wide range of purposes. Certification to the NSA standard provides authorization for use to the Navy and other government organizations.

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1. Trinidad, J. M. Programmable encryption for wireless and network applications. MILCOM 2002 Proceedings, 2002, pp. 1374-1377 vol. 2.
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KEYWORDS: Encryption; Cryptography; Unmanned Systems; Leave Behind; Data at Rest; D@R; Data in Transit; DiT; Disadvantaged Communications

TPOC-1: SSP SBIR POC
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VERSION 3

N222-125 TITLE: Development of a Shore Based Information System (SBIS) Interface Software

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

TECHNOLOGY AREA(S): Air Platforms; Battlespace Environments; Weapons

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

OBJECTIVE: Develop the requirements, architecture, and a Model-based Systems Engineering (MBSE)-based interface profile/software that will perform data mining of Navy generated data (operational, logistics, maintenance, configuration, etc.), creating a specific portion of a Shore Based Information System (SBIS).

DESCRIPTION: This SBIR topic will provide an MBSE based profile and stereotypes to use in a shore based digital infrastructure (DI). Navy provided shipboard operational, logistics, maintenance, etc., data will be transferred off ship manually or through a cyber-connection to the SBIS and be ported through this developed MBSE profile/process and evaluate for product support impact, such as impact to Operational Availability (AO) and life cycle cost. Specific Navy data and requirements will be provided upon contract award, proposals should outline the framework before this data is provided. The architecture/profile will contain a shore based interface to other key navy maintenance and life cycle databases such as Open Architectural Retrieval System (OARS) to obtain other shipboard reported maintenance and manpower data that is not generated from the ship. This OARS interface may be manual but preferred as automated. This data can be used to assess effectiveness of product support. This profile/interface software will analyze tenets of AO and other data and provide near real time metrics of affordable readiness in the form of Business Intelligence DI dashboards. The SBIS will mirror the Shipboard Information System (SIS) with capability to all other Navy weapon system nodes to perform analysis that the Warfighter is currently unable to complete. Additional uses of a tool like this can aid in development of after action reports or post mission data collection. There is no known product support profile which can be applied to a DI in an MBSE format, which can use system generated data. This profile and capability can also be used in the “SSP of the Future” concept as it can be a key enabler for product support. As it can tie to a specific product support and other operational and configuration data sets, it can be applied to any program based on the same principles and that aligns to MBSE.

The SBIS, and specifically this SBIR effort, will help identify how all aspects of the weapon system tie together, inform decisions, and understand the weapon system at a functional level to verify how the upgrades will affect current functions and supportability of the system. The MBSE profile/interface software will be used to lessen the logistics footprint of the current system by reducing computing time on the ship. It may enable response product support in the form of Distance Support, spares allocation changes, training updates, etc. An MBSE profile tied to the program requirements and based on system generated data will aid in decision based product support.

The Phase I effort will not require access to classified information.

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

PHASE I: A proof of concept outlining the requirements and basic architectural concept of an MBSE Product Support Profile must be provided. The requirements generation must tie all aspects of operational, configuration, and product support (Logistics, maintenance, etc.) data into feasible concept. These can be in the form of Concept of Operations (CONOPS), white papers, PowerPoint concepts and if necessary, high level models showing the construct to use and evaluate data. Evaluation of the concept will be based on company generated CONOPS scenarios which are relevant to standard Navy product support and operations and how the concept can aid in rapid decision making based on the system generated data.

The new capability shall be data agnostic, meaning the government will not provide classified program data and any relative product support metric data may be used to represent availability, reliability, cost, etc., to show functionality. 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: Generate a requirements based MBSE profile/architecture for the SBIS based on the Phase I concept. Additionally, finalization of requirements complete with verification methods and traceability to Government requirements (to be provided upon contract award). The architecture/profile will be evaluated against a company provided product support scenario consistent with the product support analyses in SAE TA-STD-0017 and further defines in MIL-HDBK-502A. Show how the profile can accept data and propagate the data through the model, outputting to a DI Business Intelligence dashboard which will identify the program not meeting requirements, such as a low Availability. The architecture/profile functionality will decompose shipboard system and outside data such as OARS data to decompose the reason for the product support metric not meeting standards. For example, a low availability may be attributable to a lack of spare parts, or a high time to repair may be caused by admin delays, tech assist, bad training, etc., which when identified can help the Navy enhance product support. It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: The final product will be a profile/architecture that can be included in the program MBSE CAMEO model. Support transition of this integration to the Government DI and serve as a part of the programs SBIS. The program will be evaluated during CONOPS based scenarios tied to Product Support Manager (PSM) to be defined (TBD) test events related to affordable readiness, which will be part of Maintainability Demonstrations and comparison to existing reporting from Navy Operational Availability management activities. A goal would be to absolve the Navy of reliance on these outside activities for AO evaluation. There is a potential for these solutions to become a standard Navy profile tied to even the NAVSEA Model Based Product Support (MBPS) and future weapon systems, thereby decreasing reliance on many existing operational processes and enabling program offices to make rapid decisions based on specific weapon system data sets, vice waiting for a yearly or longer standard Navy analysis, at significant cost.

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1. James M. Acton (2015) Hypersonic Boost-Glide Weapons, Science & Global Security, 23:3, 191-219, DOI: 10.1080/08929882.2015.1087242. https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F08929882.2015.1087242
2. Guiping Hu, Bopaya Bidanda. "Modeling Sustainable Product Lifecycle Decision Support Systems." International Journal of Production Economics, Volume 122, Issue 1, Pages 366-375, ISSN 0925-5273, November 2009. https://www.sciencedirect.com/science/article/abs/pii/S092552730900200X

KEYWORDS: Shore-Based Information System; Product Support Analysis; life cycle support; Logistics Decision Support Systems; Operational Availability; Affordable Readiness

TPOC-1: SSP SBIR POC
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VERSION 3

N222-126 TITLE: Compact Boost Motor Propellant Stabilizer Sensor

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

TECHNOLOGY AREA(S): Materials / Processes; Sensors

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

OBJECTIVE: Develop a compact sensor(s) that will collect the data which is used to infer the stabilizer content as well as other energetic, low molecular weight, organic compounds from the propellant in a solid rocket motor assembly.

DESCRIPTION: Solid rocket motors used by the Navy have propellant formulations that contain highly energetic materials. The formulations contain inorganic and organic solids, plasticizers and an elastomeric polymer. Stabilizers are employed to protect the polymeric structure used in the propellant formulations. The stabilizer content changes with age and environmental exposure. The Navy has a need for a compact sensor or suite of sensors that can collect data that can be used to infer the stabilizer content of solid rocket motor propellant in a non-destructive manner. The sensor would be used to inspect a suitably prepared propellant surface or subsurface in a rapid fashion. Knowledge of the stabilizer content and some of the other energetic components allows for a better evaluation of the health of the propellant. In addition to the sensor(s), an insertion system that is capable of positioning the sensor at a variety of difficult to reach locations within the solid rocket motor assembly will need to be designed. The needed R&D effort is the miniaturization of the sensor head (on the order of inches) and the development of an insertion system capable of moving the sensor into hard to reach areas within the rocket motor.

A sensor or a sensor suite that can perform the required measurements will address the difficulty of non-destructively evaluating the stabilizer content of the propellant grain in areas that are difficult to access. This technology will avoid the need to extract samples, potentially rendering the asset unusable, or dissecting an asset which forces the need for a replacement. The technology will avoid the need to disassemble and reassemble the solid rocket motor and minimize or eliminate the need to attach the equipment to the solid rocket motor. The capability the technology provides will allow measurements to be taken on substantially more assets.

This SBIR topic is focused on a sensor or multiple sensors that have the ability to collect the data needed to determine the stabilizer content, concentration, of the two stabilizers present, as well as the concentration of the energetic, low molecular weight plasticizer. Current non-destructive approaches employ an Ultra-Violet – Visible (UV-Vis) light technique to determine stabilizer content. Laboratory methods typically employ high performance liquid chromatography techniques to determine stabilizer content. Future approaches may employ a miniature version of these techniques or leverage a completely different method. In the current approach, the operator manually places the sensor head into position. Fiber optics are used to expose the sample area to UV-Vis light. Some of the light is absorbed by the sample and the remainder is reflected off of the surface. The intensity of the reflected light is measured as a function of wavelength. Through calibration and data-processing, the stabilizer and plasticizer concentration is determined. The propellant surface is typically slightly oxidized or has a surface finish

and may need to be prepared before surface measurements can be made. The sensor should meet low power, low voltage and HERO (Hazards of Electromagnetic Radiation to Ordnance) requirements for on-shore use [Ref 4]. The sensor should be capable of being able to pass through the confined area of the nozzle and be used at locations in the interior of a solid rocket motor. The sensor must be capable of being calibrated prior to use. The insertion system must be capable of placing the sensor at multiple locations, up to several meters from the exterior of the solid rocket motor assembly or preferably a mobile system capable of moving to the correct location for measurement. The sensor and insertion assembly must be capable of intermittent usage for a period of ten years.

PHASE I: Develop a technical concept for a propellant stabilizer sensor. Proposed design concepts should be completed during Phase I. Laboratory-scale demonstrations to verify the proposed sensor concept(s) can meet size constraints while provide the correct data. The laboratory testing must be satisfactorily completed to transition from Phase I to Phase II. Identify risks to the technical approach and develop/evaluate plans to mitigate those risks for Phase II. Laboratory-scale demonstrations to verify the proposed insertion system should be completed. The Phase I Option, if exercised, will include the initial design specification and capabilities description to build a prototype solution in Phase II.

Coordinate with Navy SBIR liaisons on key technical requirements data to be measured, size of the sensor, size of the insertion system, application method, power, and data storage/transmission needs.

PHASE II: Design and develop a prototype of the propellant stabilizer sensor based on the concept(s) from Phase I. Ensure the design has the ability to collect the data that can be used to measure the concentration of the two stabilizers and the energetic plasticizer. Ensure the design is sized such that it can pass through the throat of a Third Stage solid rocket motor nozzle and fit within the confined spaces of the propellant grain geometry. Ensure the design is capable of performing the measurements at multiple locations. Ensure the insertion system is capable of moving the sensor to the desired location. Complete testing of the sensor prototype to validate operation and feasibility. Design the testing to emulate the installation, sensing, data collecting/storage, and removal. Test material compatibility to ensure survivability and compatibility with solid rocket propellant during the inspection process.

PHASE III DUAL USE APPLICATIONS: Update the sensor from Phase II efforts. Support the development of an instruction manual for use. Manufacture an updated prototype and demonstrate use on an identified asset that is considered representative. Provide the necessary support for certification and qualification of the system for deployment and use at fleet facilities and/or facilities where fleet assets are located. This technology has the potential to be used commercially in any industry that has a need for stabilizer monitoring of materials in areas of high hazards.

REFERENCES:

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VERSION 3

KEYWORDS: Stabilizer Measurement; 1.1 Propellants; Compact Ultra-Violet/Visible Light Spectrometer; UV-Vis; Low Molecular Weight Aromatic Compounds; Compact Multi-Spectral Spectrometer; Non-Destructive Measurement

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VERSION 3

N222-127 TITLE: Innovative Manufacturing/Materials in Hypersonic Thermal Protection Systems

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

TECHNOLOGY AREA(S): Battlespace Environments;Materials / Processes; Weapons

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

OBJECTIVE: Develop a weather-resistant, conductive Thermal Protection System (TPS) material, which can survive hypersonic flight environments and is manufactured by methods/processes with high uniformity/reproducibility.

DESCRIPTION: Current generation hypersonic vehicle Thermal Protection System (TPS) materials provide adequate thermal resistance but have limited structural capability in all-weather environments and a low level of manufacturing sophistication. This leads to high levels of variability and introduces program and performance risk. Hypersonic vehicles experience temperatures in excess of 3000°F and encounter elevated levels of shock and vibration. These vehicles must also be able to fly through all types of weather and withstand precipitation at high speeds. Developing and integrating conductive TPS materials capable of withstanding the harsh environments and weather experienced through flight is a priority for enhancing performance in hypersonic vehicles. Proposers should utilize publicly available data on hypersonic flight conditions when identifying material solutions, specific requirements will be provided in the Phase II. Material solutions that could yield agile configurations with tailored conductivity throughout the TPS would provide more versatile hypersonic vehicles. While proposed materials must meet thermal, dielectric, mechanical and conductive specifications, solutions must also maintain uniformity when manufactured in bulk and ensure ease of assembly.

Solutions proposed to this SBIR topic should apply some of the advanced aerospace composite materials and manufacturing technology developed over recent years; including but not limited to: fiber reinforcement, fiber orientation, ultra-high temperature ceramics, high-temperature dielectrics, and additive manufacturing to develop reliable, uniform, thermally conductive/high strength materials and near-net shape components in form-factors applicable to Navy hypersonic flight vehicles. Specific form factors and requirements are held at higher distribution levels and shall be provided upon contract award as applicable.

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

requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: Demonstrate a proof of concept for conductivity and structural capability of materials/manufacturing solutions at the desk top/lab scale level. Figures of merit for consideration and to be defined are dielectric properties, physical density, mechanical and compressive strength, and in-plane/through thickness thermal conductivity up to 3000°F. Address manufacturing approaches, uniform producibility concerns, and scale-up potential for production of aerospace grade hardware.
The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Produce prototype hardware to the requirements, materials, form factors and manufacturing approaches defined from Phase I. Further material, thermal and mechanical characterization data shall also be provided in order to assess replacement risk against current incumbent materials. At the end of Phase II, prototype hardware will be provided for government evaluation in a relative hypersonic environment.

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

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for Navy use. The final product shall be a prototype and design package outlining the material and manufacturing/assembly methods. A suitable material solution and assembly method is required for the future system to ensure reliability and performance throughout flight. This technology can be transitioned to Navy and Air Force hypersonic and ballistic re-entry weapon systems. Solution materials would have applicability in commercial access-to-space environment as well as commercial aerospace, and gas turbine engine applications.

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KEYWORDS: Weather-Resistant Materials; Thermal Protection System; Manufacturability; High Thermal Materials; Thermal Resistance; Reentry Vehicles; Hypersonic Vehicle Heat Loads; Conductive Materials.

TPOC-1: SSP SBIR POC
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VERSION 3

N222-128 TITLE: Development of Hypersonic Glide Body Deployable Antennas

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

TECHNOLOGY AREA(S): Air Platforms; Battlespace Environments; Weapons

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

OBJECTIVE: Develop aft-deployable antenna systems from the aft plate of hypersonic glide vehicles, with release or retraction mechanisms.

DESCRIPTION: Hypersonic vehicles have limited antenna mounting real-estate. The limited space on the available antenna real-estate limits the number of antennas and other mounted capabilities that can be employed. Fortunately, many systems do not require the use of their antenna all the time. Some only need a small period of time during the flight, some only need periodic access, and some only after glide body separation. Hence, deployable, retractable, and releasable antennas present an additional approach for managing the antennas. There is also interest in applications for relatively high gain antennas with patterns directed perpendicular to the vehicle axis. Deployable antennas are a potential solution for enabling perpendicular oriented antennas. CubeSats are analogous to hypersonic vehicles in that they are both volume constrained for antennas. Examples of CubeSat deployable antennas include helical antennas, parabolic reflectors, mesh reflectors, conical horns, and conical log spiral (CLS) [Ref 1].

This SBIR research is intended to explore innovative technical solutions that would enable the design of deployable, retractable, and releasable antennas for hypersonic vehicles. The proposed approaches must be demonstrated in analysis, simulation, or prototype. Size, Weight and Power (SWaP) requirements of the resultant system are critically important given volume limitations in the glide body. The research should be conducted with the goal of designing and demonstrating a prototype deployable antenna system. When framing the proposal, firms should utilize publicly available data on hypersonic boost-glide systems. Specific SWaP requirements will be provided upon contract award.

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

PHASE I: Provide a concept that will lead to the development of a deployable antenna system. Demonstrate the feasibility of that concept. All critical materials, components, and technologies must be identified and demonstrated in the lab or through clearly relevant references. Demonstrate the feasibility

of the approach to provide required antenna functionality, and the usefulness to hypersonic applications. Provide modeling, simulation, and preliminary prototype results to demonstrate feasibility for anticipated applications. Size and weight trades should also be addressed.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop a prototype with enough detail for development and demonstration of a deployable antenna system, as addressed in Phase I, for a to-be-identified exemplar experiment on a sounding rocket launch. The Phase II Statement of Work (SOW) should identify a work plan that provides proof of concept that the technology has the potential to meet the performance goals highlighted in Phase I. The Phase II effort will produce at least one prototype for laboratory characterization and demonstration, and two flight ready prototypes for the sounding rocket experiment.

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

PHASE III DUAL USE APPLICATIONS: If the demonstration in Phase II is deemed to be of high interest to the government, support transition of the deployable antenna technology for government use.

The transitioned products are expected to be able to support current and future hypersonic glide body systems. Commercial hypersonic applications should be considered for transition as well. The primary objective of this project is for transition to defense contractors. To meet these needs, maturation and packaging of the technology to meet practical size, weight, and power constraints will be required.

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