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

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topics only:**
  - **N211-D01 to N211-D02**
- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **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 NOTES.**
- A DP2 Phase I Feasibility proposal template, unique to DP2 topics, will be available to assist small businesses to generate a Phase I Technical Volume (Volume 2). The template will be located on https://www.navysbir.com/links_forms.htm.
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- The Supporting Documents Volume (Volume 5) is available for the SBIR 21.1 BAA cycle. The Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation.

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For program and administrative questions, contact the Program Manager listed in Table 1; **do not** contact them for technical questions. For technical questions about a topic, contact the Topic Authors listed within the topic during the Pre-release period. During the Open period the DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) must be used for any technical inquiry. Review section 4.13 of the Department of Defense (DoD) SBIR/STTR Program Broad Agency Announcement (BAA) for further information related to Direct Contact with Topic Authors and the Topic Q&A platform. For general inquiries or problems with electronic submission, contact the DoD SBIR/STTR Help Desk at 1-703-214-1333 (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET) or via email at dodsbirsupport@reisystems.com.

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TABLE 1: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N211-D01	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	jeffrey.a.kent@usmc.mil
N211-D02	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	navair.sbir@navy.mil

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 pertaining to the DON's mission can be obtained from the DON website at www.navy.mil.

During government fiscal years (FY) 2012 through 2022, the Department of Defense (DoD) including the Department of the Navy (DON) may issue an award to a small business firm under Phase II of the SBIR program with respect to a project, without regard to whether the firm was provided an award under Phase I of an SBIR program with respect to such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the firm has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those firms that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

Each eligible topic requires documentation to determine that Phase I feasibility described in the Phase I section of the topic has been met.

The DON SBIR DP2 is a two-step process:

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

DON SBIR reserves the right to refuse to make any awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposers are to read the topic requirements carefully.

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The Government is not responsible for expenditures by the proposer prior to award of a contract. For 21.1 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following MUST BE MET or the proposal will be deemed noncompliant and shall be REJECTED.

- **Eligibility.** Each proposing firm must:
  - Have demonstrated feasibility of Phase I-type R&D work
  - Have submitted a Phase I Feasibility Proposal for evaluation
  - Meet Offeror Eligibility and Performance Requirements as defined in section 4.2 of the DoD SBIR/STTR Program BAA
  - During the Phase II award, primary employment of the principal investigator (PI) must be with the firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the firm
  - Register in the System for Award Management (SAM) as defined in section 4.14 of the DoD SBIR/STTR Program BAA. To register, visit https://beta.sam.gov

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
  - Content is responsive to evaluation criteria as specified in DoD SBIR/STTR Program BAA section 6.0
  - Not to exceed **30** 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*

  *For headers, footers, listed references, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that the text may be unreadable by evaluators.

  Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

  The Technical Volume (Volume 2) should include the following sections:

  - Phase I Proof of Feasibility (NTE 20 pages)
    1. Introductory Statement
    2. Phase I Proof of Feasibility
    3. Commercialization Potential/Transition Plan Summary

  - Snapshot of Proposed Phase II Effort (NTE 10 pages)
    1. Description of Proposed DP2 Technical Effort and Objectives
    2. DP2 Work Plan
    3. Key Personnel Resumes – should be submitted for the Principal Investigator and up to 4 additional individuals. Resumes are limited to one page per person, and should be limited to only information relevant to the work to be performed under the project

4. Subcontractors/Consultants
5. Order of Magnitude Cost Estimate Table (example provided below in the Cost Volume (Volume 3) section).

It is recommended that proposers follow the DP2 Phase I Feasibility Template as a guide for structuring the DP2 Phase I Feasibility proposal. The template is located on https://www.navysbir.com/links_forms.htm.

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 or any subsequent 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. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under "Other") in the Supporting Documents Volume (Volume 5).

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at https://www.dodsbirsttr.mil/submissions/), however, proposers DO NOT need to download and complete the separate cost volume template for the DON SBIR Phase I Feasibility Proposal. Proposers are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Technical Volume (Volume 2). Please refer to Table 2 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item – Details	**Estimated Base Amount**	**Estimated Option Amount**	**Total Estimated Amount Base + Option**
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			
Fee/Profit			
TABA (NTE $25K, included in total amount)			

Total Estimated Costs			

TABLE 2: COST & PERIOD OF PERFORMANCE

Topic Number	Base		Option One		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N211-D01	$1,000,000	24 mos.	$500,000	12 mos.	$1,500,000
N211-D02	$800,000	24 mos.	$300,000	12 mos.	$1,100,000

- **Company Commercialization Report (Volume 4)**. DoD requires Volume 4 for submission to the 21.1 DP2 BAA. Please refer to instructions provided in section 5.4.e of the DoD SBIR/STTR Program BAA.

- **Supporting Documents (Volume 5)**. Volume 5 is available for use when submitting Phase I and Phase II proposals.

  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 proposals must include as a part of their submission a written certification in response to the NDAA clauses (Federal Acquisition Regulation clauses 52.204-24, 52-204-25 and 52-204-26).** 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 instructions provided in section 5.4.g of the DoD SBIR/STTR Program BAA.

  A proposal that has an answer of "Yes" to any question regarding foreign investment disclosure in the Firm Certifications section of Volume 1 (Proposal Cover Sheet) must then include as part of their submission a Foreign Disclosure Addendum. The Foreign Disclosure Addendum can be found in Attachment 2 of the DoD SBIR/STTR Program BAA. The addendum, if required, must be completed by the authorized company representative and uploaded as a separate PDF file in Volume 5. Please refer to instructions provided in section 5.4.h of the DoD SBIR/STTR Program BAA.

  Volume 5 is available for small businesses to submit additional documentation to support the Technical Proposal (Volume 2) and the Cost Volume (Volume 3). A template is available on https://navysbir.com/links_forms.htm. DON will not be using any of the information in Volume 5 during the evaluation.

  - Letters of Support relevant to this project
  - Additional Cost Information
  - SBIR/STTR Funding Agreement Certification
  - Data Rights
  - 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
- Majority-Owned VCOC, HF, and PEF Certification, if applicable

NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

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 to the 21.1 DP2 BAA. Please refer to instructions provided in section 5.4.i of the DoD SBIR/STTR Program BAA.

DON SBIR PHASE I FEASIBILITY PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Enter this information in the "Explanatory Material" field in the online DoD Volume 3. 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. 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).

- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.

- **Discretionary Technical and Business Assistance (TABA).** If TABA is proposed, the information required to support TABA (as specified in the TABA section below) must be added in the "Explanatory Material" field of the online DoD Volume 3. If the supporting information exceeds the character limits of the Explanatory Material field of Volume 3, this information must be included in Volume 5 as "Additional Cost Information" as noted above. Failure to add the required information in the online DoD Volume 3 and, if necessary, Volume 5 will result in the denial of TABA. TABA may be proposed for a DP2 effort which will be included as part of the award amount and limited by the established award values for Phase II by the SYSCOM. The total value may not exceed $25,000 under this DP2 contract.

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 to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within

the $1,700,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee application by the SBIR/STTR awardee 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.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. A detailed request for TABA must include:

- 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
- 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 applicant
- Propose a TABA provider that is the SBIR applicant
- Propose a TABA provider that is an affiliate of the SBIR applicant
- Propose a TABA provider that is an investor of the SBIR applicant
- 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 must be included in the Cost Volume (Volume 3) as follows:

- Phase II: The value of the TABA request must be included in the Order of Magnitude Cost Estimate Table in the Snapshot of Proposal Phase II Effort section of the Technical Volume (Volume 2). The detailed request for TABA (as specified above) must be included as a note in the Order of Magnitude Cost Estimate Table and be specifically identified as "Discretionary Technical and Business Assistance".

Proposed values for TABA must NOT exceed:

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

NOTE: Section 9(b)(5) of the SBIR and STTR Policy Directive requires that a firm receiving technical or business assistance from a vendor during a fiscal year submit a report with a description of the technical or business assistance received and the benefits and results of the technical or business assistance provided. More information on the reporting requirements of awardees that receive TABA funding through the DON can be found on https://www.navysbir.com/links_forms.htm. Awardees that receive TABA funding through the DON will upload the report to https://www.navysbirprogram.com/navydeliverables/.

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 assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must attend a one-day DON STP meeting during the first or second year of the Phase II contract. This meeting is typically held in the spring/summer in the Washington, D.C. area. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

EVALUATION AND SELECTION

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The DON will evaluate and select Phase I Feasibility proposals and DP2 proposals using the evaluation criteria in Sections 6.0 and 7.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. As noted in the sections of the aforementioned Announcement on proposal submission requirements, proposals exceeding the total costs established for the Base and/or any Options as specified by the sponsoring DON SYSCOM will be rejected without evaluation or consideration for award. Due to limited funding, the DON reserves the right to limit awards under any topic.

Approximately one week after the DP2 BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Selected Phase I Feasibility proposers will be notified to submit Full DP2 Proposals. SYSCOM-specific Full DP2 Proposal guidance will be provided at the time of this notification.

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 of the Phase I Feasibility evaluations and DP2 selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed directly with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 1. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 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 section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

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

AWARD AND FUNDING LIMITATIONS

Awards. The DON typically awards a Cost Plus Fixed Fee contract for DP2; but, may consider other types of agreement vehicles, such as an Other Transaction Agreement (OTA) or a Basic Ordering Agreement (BOA) 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 II awards. DP2 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).

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

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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. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

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.

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 concerns must register with the SBA Company Registry Database.
b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. The SBIR VC Certification must be included in the Supporting Documents Volume (Volume 5). A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm.
c. Should a proposer become a member of this ownership class after submitting its application 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.

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

System for Award Management (SAM). It is strongly encouraged that proposers register in SAM, https://beta.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.

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).

Support Contract Personnel for Administrative Functions. 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.

PHASE III GUIDELINES

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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, which includes assigning SBIR/STTR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or 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.

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NAVY 21.1 SBIR Direct to Phase II Topic Index

N211-D01	DIRECT TO PHASE II Size/Weight Optimized Compact-Prime Power Generator (CPPG) Technologies
N211-D02	DIRECT TO PHASE II – Cartridge Actuated Devices/Propellant Actuated Devices Digital Twin

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N211-D01 TITLE: DIRECT TO PHASE II Size/Weight Optimized Compact-Prime Power Generator (CPPG) Technologies

RT&L FOCUS AREA(S): Directed energy;General Warfighting Requirements

TECHNOLOGY AREA(S): Air Platforms;Ground / Sea Vehicles;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 section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop high power density, small heavy fuel prime power generator technology for next generation directed energy weapons. The technology should be highly optimized for size and weight, and should be scalable to enable development of a family of small generators, with designs including power ratings ranging from 5kW to 25kW in 5kW increments, and capable of supporting 100% of duty cycle requirements.

DESCRIPTION: Currently available prime power sources that power directed energy weapon systems are very large and heavy and preclude integration on small tactical vehicles and unmanned systems. These power systems today are primarily composed of hybrid power systems of very large/heavy (100's of pounds) high voltage batteries and/or large 1000 pound+ high voltage gas-diesel generators. Payload volumes and weight margins on most small tactical vehicles/platforms simply cannot accommodate or support these large payload volumes nor the extra weight. An example of this would be the current Light Marine Air Defense Integrated System (LMADIS) which employs a 5 kilowatts (kW) diesel generator weighing 300 lbs. that results in the vehicle weighing 15 lbs. over the maximum gross vehicle weight (GVW) of the current ULTV. Future mission growth to add additional communications equipment to LMADIS is expected to increase the power demands to 10 kW. Currently available diesel generators that meet the higher power requirements weigh close to 500 pounds (lbs) and would result in the vehicle weighing 100 to 150 lbs. over maximum GVW. Compact and lightweight power generation systems are needed to power these directed energy weapon, surveillance, and C2 systems and keep the vehicle safely within its allowable GVW. The system requirements are:

Scalable prime power generator designs are to include 5kW, 10kW, 15 kW and 20kW designs and support 100% duty cycle requirements and range in size and weight from (for the 5kW generator design).

- Size and Weight (exclusive of fuel tank and mounting frames):
    - o For a 5kW genset, Volume Threshold of 1,300 cu in. and Objective of 1,000 cu in.; Weight Threshold of 40 lbs (8 lb/kW) and 30 lbs (6 lb/kW) Objective
    - o For a 25kW genset, Volume Threshold of 3,500 cu in. and Objective of 3,000 cu in.; Weight Threshold of 175 lbs (7 lb/kW) and 150 lbs (6 lb/kW) Objective
- Fuel Efficiency: For all ratings, Threshold fuel consumption rate of 275 g/kWh and Objective of 240 g/kWh
- Fuel: JP-8
- Electrical Output: 28VDC, less than 1% ripple
- Noise: Less than 70 dbA at 30 feet, at full (rated) power
- Duty cycle: Eight (8) hours of operation at rated (100%) power

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Generators designs are based on optimized overall system size and weight and with overall system efficiency to achieve very high fuel efficiency such as < 250 gm/kW-h;
o Composed of lightweight materials such as Aluminum, be air-cooled, run on JP-8 (heavy fuels)
o Be extremely quiet (< 70 dbA at 30 feet at full power)
o Have a compact form-fit of less than 500 cu inches (with fuel tank) o Run 100% power for an 8 hour mission
o Run close to diesel engine efficiencies but with much less mass than a standard diesel generator – weight/power goal of < 0.5 lbs/hp o Run with realistic prop speeds of less than 1000rpm
o Run with low exhaust noise o Have a long lifetime with a mean time between failures (MTBF) of > 3000 hours;
o Be compatible with 24-VDC tactical electrical systems and 12-VDC vehicle electrical systems;
o Incorporate electrical component and connections with an ingress protection rating of Ingress Protection(IP67) or higher in accordance with (IAW) American National Standards Institute (ANSI) / International Electrotechnical Commission (IEC) 60529-2004;
o Have a modular design that can be inspected, serviced, and repaired in the field

The program requires the development at least one small heavy fuel generator set (genset) in the required power range, which shall be scalable (up and or down in power rating) in order to enable the development of the small generator family described above, through the entire power range of 5kW to 25kW. The design shall be optimized for weight and size, utilizing light weight, durable materials, and shall be designed to have a mean time between failure (MTBF) of at least 3,000 hours. A complete, fully operational prototype genset shall be constructed and tested to demonstrate compliance with the technical requirements, including, size, weight, and performance.

Currently only diesel powered generators within the desired power range can achieve fuel consumption at the required rates; however, their large size and weight make them unsuitable for the intended application. A compact, lightweight, efficient, JP-8 fuel capable, reliable, and very quiet system is necessary to meet the mobility and compatibility requirements of potential platforms for the directed energy weapon systems. For higher power ratings, advanced gas turbine engine driven, high speed generators now under development can achieve near diesel efficiency; however, as the power rating and size decrease below about 40kW, their efficiency falls substantially, hence the need to develop new technologies for the high power density, small generators as described in these requirements.

Note: The current active Phase II USMC SBIR N132-086 to develop a Compact Prime Power Generator (CPPG) for Non-Lethal Directed Energy Weapons supports the development of a 40 kW to 1.6MW recuperated gas-turbine generator design. The generator design supports higher power directed energy weapon requirements. Its size and weight is optimized over this 40kW to 1.6MW power region. The Phase II SBIR prototype will produce 300 kW, support a 100% duty cycle, consume the same fuel as a standard gas-diesel generator (19.3gph) – same fuel burn rate as the MEP-809 at rated power, weigh only 480 lbs., and have a compact form-fit of < 20 cu ft. This SBIR topic requests an optimized scalable minimum size and weight lower power prime power source (generator) for the following NL DEW power requirements: 5kW, 10kW, 15 kW, and 20 kW. The current USMC Phase II SBIR design which employs a scalable recuperator gas-turbine generator design does not provide the smallest and lightest design at these lower power levels. A different more optimized generator design is required to fully optimize size and weight at these lower power requirements.

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 and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security

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Clearances, in order to perform on advanced phases of this project as set forth by DCSA and MCSC 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: For this Direct to Phase II (DP2) topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. It must have developed a concept for a workable prototype or design to address at a minimum the basic requirements of the stated objective above and it must have already developed a commensurate prototype in hardware, i.e., developed a large number of the components necessary to achieve the required Power Output per pounds and per cubic feet of form-fit.

Documentation showing a prime power gas-diesel power generation system is feasible and that the system requirements discussed in the Description are in the realm of possible. The small business should have produced a model to evaluate different approaches to optimize powering directed energy weapons on a small tactical vehicle/platform. The small business should show they have identified higher power density electrical efficiencies with lightweight materials and long MTBF to meet this SBIR DP2 topic's scalable output power goals of 5kW, 10 kW, 15 kW, and 20 KW and weight ~50 lbs; and a compact form-fit of < 100 lbs and 1500 cu inches (e.g., the size of a small Honda 1 kW generator).

FEASIBILITY DOCUMENTATION: Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.1 Direct to Phase II Broad Area Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this BAA.

PHASE II: Based on the Phase I equivalent effort and the Phase II plan, develop and use analytical modeling to assist in design and integration of high power density, small heavy fuel prime power generator technology for next generation directed energy weapons. Build scalable prime power generator prototypes for both fitment and functionality of power generation to support directed energy weapon systems. Support evaluation of prototypes to determine if the performance goals defined in the Phase II development plan and the requirements outlined in MIL-STD-1275E and MIL-STD-810H have been met. Demonstrate system performance through modeling and generator testing under full electrical load conditions. Refine the design based on the results of testing/modeling to facilitate integration on small tactical vehicles (such as the JLTV) and or other DoD Platforms as well as facilitate integration on small unmanned systems. Support full power tests of these directed energy weapon systems on DoD platforms. Prepare a Phase III plan to transition the technology to the Marine Corps and the commercial marketplace.

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: Provide support to the Marine Corps in transitioning the technology for Marine Corps use. Refine a prime power generation system for evaluation to 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 Department of Homeland Security and civilian law enforcement missions. The need for the use of directed energy weapon systems on small tactical vehicle/platforms is high for many government agencies – beyond just the DoD.

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KEYWORDS: Compact/Lightweight Prime Power Systems; Directed Energy Weapons Systems Prime Power; Tactical Vehicle Power Generation; Prime Power Weight Reduction; Prime Power Size Reduction; Mobile Expeditionary Power; Small Heavy Fuel Generators

VERSION 2

N211-D02 TITLE: DIRECT TO PHASE II – Cartridge Actuated Devices/Propellant Actuated Devices Digital Twin

RT&L FOCUS AREA(S): General Warfighting Requirements;Machine Learning/AI

TECHNOLOGY AREA(S): Air Platforms;Information Systems;Weapons

OBJECTIVE: Develop, validate, and migrate to the cloud a digital twin of Cartridge Actuated Devices/Propellant Actuated Devices (CAD/PAD) that use double-base propellants while providing real-time health monitoring of deployed devices based on the environmental exposure.

DESCRIPTION: The Navy requires digital twin technologies, which allow the digital footprint of any product to permeate throughout the CAD/PAD devices' entire service life from design inception, through development, sustainment, and finally to disposal. Digital twin technology is viable and allows access to the digital image of the asset in real time, leading to secure actionable information that will improve a process, product, or service of any organization [Ref 1]. The concept has been around for a while, as shown during the disaster of the Apollo 13 mission. NASA demonstrated the technology with a mirrored system on the ground, which rescued the flight, and is further illustrated in [Ref 2]. Digital twin technology involves creating a virtual representation of a physical product. Digital twins are powered by machine learning algorithms and are continuously learning systems. The products are connected in a cloud-based environment that receives the data from the sensors or other available data sources. The input data is analyzed and compared to the CAD/PAD device baseline data to identify actionable information.

The goal for the CAD/PAD digital twin technology is to design, test, and develop a product in a virtual environment and to monitor product health to identify potential degradation. This will allow real-time monitoring and replacement of the product utilizing its maximum safe life, which will reduce product's life cycle costs. In the future, the goal is to have a digital twin model for selected CAD/PAD devices hosted in the cloud and updated with historical deck plate data to make the model more robust. The frequency of the digital twin updates will coincide with approved for release historical deck plate and sensor data.

Because of the large variety of CAD/PAD devices and the numerous failure modes associated with these devices, this topic seeks to pursue a digital twin model for CAD/PAD items that employ double-based propellants. Double-based propellants will deplete its stabilizer at a faster rate when exposed to high temperature. A comparative study of the thermal decomposition of naturally- and artificially-aged double-based propellants has been carried out at five different heating rates and the results show that there is only one decomposition peak on differential scanning calorimetry (DSC) curves, and this decomposition has been accelerated by ageing. The influence of the heating rate on the DSC behavior of the propellants was verified. The kinetic parameters such as activation energy and frequency factor and the thermodynamic parameters were obtained from DSC data [Ref 3]. The aging of CAD/PAD items containing double-based propellants are dependent on the environmental conditions, such as temperatures, to which they are subjected. The digital twin being developed will take these environmental conditions and determine the stabilizer content of the CAD/PAD items. The environmental conditions are dependent upon the operational location and duration of the aircraft at the location.

In order to determine the environmental exposure of the CAD/PAD items, the developed digital twin should all be able to use both collected sensor data and a combination of deck plate data and available weather data, such as National Oceanic and Atmospheric Administration (NOAA) or local installation data, in order to determine stabilizer content. The developed digital twin predicted stabilizer content should be validated against measured stabilizer content of fleet return assets with known environmental exposure.

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Upon successful demonstration, the contractor should assist in obtaining the necessary approvals for use of the developed digital twin and migration into a cloud-based environment compliant with all applicable Navy Marine Corp Internet (NMCI) and applicable Operations Security (OPSEC) requirements.

Digital twin technology is not widespread due to the requirements of prohibitive computing power needs, accessibility, bandwidth, and storage issues. Lack of robust data analytics aided by artificial intelligence, machine learning techniques, and visualization tools is impeding technology development. Digital twin technology has the potential to improve supply chain integrity, flight safety, in-flight service, Condition Based Maintenance (CBM), foreign object detection, and predictive maintenance. For example, developing any predictive maintenance algorithm requires sensor data, which can be utilized to train a classification algorithm for fault detection. This algorithm is used for verification and is installed as a code to the control unit of the product. It is nearly impossible to create the fault conditions necessary for training a predictive maintenance algorithm on the actual product. A solution to this challenge is to create a digital twin of the product (a model), and apply simulation and analysis of sensor data for various fault conditions. A neural network detects abnormal patterns of the sensor data, reflects the trends in predictive models, which are then used to predict failures, and allows tests for all fault conditions with severity. The entire procedure should be automated, thereby allowing tests of "what-if" scenarios on the digital twin model. Predictive maintenance helps to determine when an aircraft product needs maintenance or replacement. It reduces downtime and prevents product failure by enabling maintenance or replacement of the CAD/PAD device to be scheduled based on the actual need rather than at predetermined intervals. It can be used to calculate maintenance-related parameters (i.e., MTBR – Mean Time Between Replacement), forecast the behavior of the product under different circumstances, and simulate different maintenance scenarios. Thus, predictive maintenance capability helps to extend the product life and reduce total ownership costs. Collectively, it will contribute significantly to improving the Navy's mission readiness and sustainment. It is envisioned that the CAD/PAD program will be able to develop a virtual integrated, model-based representation of a physical product, allow the simulation of the product in a real setting in a dynamic fashion, and demonstrate closed loops between the virtual and physical space.

Challenges for this effort include developing an accurate model that precisely reflects the physical twin's properties. For predicting failures, detailed blueprints of a product's failure modes are required. Since the digital twin is a replica of the physical product itself, the requirements, qualification, and certification necessary to determine the flight worthiness of the product are the same for the virtual model as well. The expected outcomes of the effort are real-time monitoring and health status of the deployed CAD/PAD items. This will enable prolonged product life to deliver capabilities continually. For the proof of concept, the Parachute Deployment Rocket Motor (PDRM) [DODIC MT29], the Under Seat Rocket Motor (USRM) [DODIC MD68], and the Catapult Primary Cartridge [DODIC WB15] will be used for the demonstration of the digital twin model.

The developed digital twin model should be capable of predicting remaining stabilizer content within 20% of measured values. The developed digital twin should be migrated into a cloud-based environment and be capable of meeting all NMCI and OPSEC regulations and requirements. The developed digital twin should be capable of utilizing both historical aircraft location/weather data and sensor data.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. Have developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

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Designed and developed a digital twin capable of predicting stabilizer content based on environmental exposure of deployed devices.

Determined and demonstrated the model's prediction of the cockpit temperature gradient based on aircraft location and available weather data.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but from non-SBIR funding sources) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Build, refine, enhance, and validate (against measured stabilizer content of fleet returned assets (MT29 and WB15) with known environmental exposure) a prototype product (a high-fidelity model) by integrating the physical asset to the digital twin and demonstrate the closed loop between physical - virtual - physical space. Demonstrate the applicability of readiness and sustainment influencing factors such as CBM, predictive maintenance, and flight safety with quantifiable metrics. Quantify the cost benefits, such as reduction in the operation cost and total lifecycle cost, as applicable. Demonstrate the applicability of Navy provided "what-if" scenarios tested against factors such as product performance management, Navy-unique harsh environmental operating conditions, and future operating environments. Assist in obtaining approvals for the developed digital twin's use and migrate the digital twin into a cloud-based environment. Demonstrate compliance with NMCI requirements and end user access.

PHASE III DUAL USE APPLICATIONS: Develop robust architecture, showing the linkage between connectivity and services. Demonstrate the integration of the product into naval aircraft and perform final testing. Successfully transition, implement, and insert the technology for warfighter benefits. Develop mobile application solutions as applicable. Aerospace industry employs cartridges that use double-based propellants and will benefit from the digital twin technology. The successful demonstration of the digital twin of the product that is operationalized will enable the applicability of the approach to any product/process/service industry to achieve cost benefits.

The private sector (e.g., commercial aerospace industry and private military fleets) use similar cartridges as the ones used in military aircrafts. Some of these cartridges employ double-based propellants as their energy source and experience similar propellant-stabilizer depletion issues. The digital twin model developed under this SBIR topic will provide those industries a mean of tracking the health of the installed devices and assist them in making replacement decisions based on the environmental exposure of the devices. The digital twin model will enable the private sector to utilize maximum safe life of the devices and enhance the safety of their operations.

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KEYWORDS: Digital Twin; Stabilizer depletion; Navy Marine Corp Internet; NMCI; DODIC WB15; DODIC MT29; National Oceanic and Atmospheric Administration; NOAA; Parachute Deployment Rocket Motor; PDRM; Under Seat Rocket Motor; USRM; DODIC MD68; Catapult Primary Cartri