ARMY INSTRUCTIONS
13.3 Small Business Innovation Research (SBIR)

INTRODUCTION

The US Army Research, Development, and Engineering Command (RDECOM) is responsible for execution of the Army SBIR Program. Information on the Army SBIR Program can be found at the following Web site: https://www.armysbir.army.mil.

Solicitation, topic, and general questions regarding the SBIR Program should be addressed according to the DoD Program Solicitation. For technical questions about a topic during the pre-release period, contact the Topic Authors listed for each topic in the Solicitation. To obtain answers to technical questions during the formal Solicitation period, visit http://www.dodsbir.net/sitis. Specific questions pertaining to the Army SBIR Program should be submitted to:

John Smith
Program Manager, Army SBIR
army.sbir@us.army.mil
US Army Research, Development and Engineering Command (RDECOM)

ATTN: AMSRD-PEB
3071 Aberdeen Blvd.
Aberdeen Proving Ground, MD 21005-5201
TEL: (703) 399-2049
FAX: (703) 997-6589

The Army participates in three DoD SBIR Solicitations each year. Proposals not conforming to the terms of this Solicitation will not be considered. Only Government personnel will evaluate proposals.

PHASE I PROPOSAL SUBMISSION

SBIR Phase I proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20 page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 20-page limit. The CCR is generated by the proposal submission website, based on information provided by you through the Company Commercialization Report tool.

Army Phase I proposals submitted containing a Technical Volume over 20 pages will be deemed NON-COMPLIANT and will not be evaluated.

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

Phase I proposals will be reviewed for overall merit based upon the criteria in Section 6.0 of the DoD Program Solicitation.

13.3 Phase I Key Dates

Solicitation closes, proposals due	25 September 2013
Phase I Evaluations	September – late November 2013
Phase I Selections	December 2013
Phase I Award Goal	January 2013*

**Subject to the Congressional Budget process*

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implements the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which **must** be included as part of the Phase I proposal, should cover activities over a period of up to four months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal.

PHASE I COST VOLUME

A firm fixed price or cost plus fixed fee Phase I Cost Volume ($150,000 maximum) must be submitted in detail online. Proposers that participate in this solicitation must complete Phase I Cost Volume not to exceed a maximum dollar amount of $100,000 and six months and a Phase I Option Cost Volume not to exceed a maximum dollar amount of $50,000 and four months. The Phase I and Phase I Option costs must be shown separately but may be presented side-by-side in a single Cost Volume. The Cost Volume DOES NOT count toward the 20-page Phase I proposal limitation. When submitting the Cost Volume, complete the Cost Volume form on the DoD Submission site, versus submitting within the body of the uploaded proposal.

PHASE II PROPOSAL SUBMISSION

Commencing with Phase II's resulting from a 13.1 Phase I, invitations are no longer required. Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (http://www.dodsbir.net/submission/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8:00 a.m. to 5:00 p.m. ET).

Phase II proposals can be submitted by Phase I awardees only within one of four submission cycles shown below and must be submitted between 5 to 17 months after the Phase I contract award date. Any proposals that are not submitted within these four submission cycles and before 5 months or after 17 months from the contract award will not be evaluated.

SUBMISSION CYCLES	TIMEFRAME
Cycle One	30 calendar days starting on or about 15 October*
Cycle Two	30 calendar days starting on or about 1 March*
Cycle Three	30 calendar days starting on or about 15 June*
Cycle Four	30 calendar days starting on or about 1 August*

*Submission cycles will open on the date listed unless it falls on a weekend or a Federal Holiday. In those cases, it will open on the next available business day.

Army SBIR Phase II Proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 38-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 38 page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 38-page limit. The CCR is generated by the proposal submission website, based on information provided by you through the Company Commercialization Report tool.

Army Phase II Proposals submitted containing a Technical Volume over 38 pages will be deemed NON-COMPLIANT and will not be evaluated.

Army Phase II Cost Volumes must contain a budget for the entire 24 month Phase II period not to exceed the maximum dollar amount of $1,000,000. During contract negotiation, the contracting officer may require a Cost Volume for a base year and an option year. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year.

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

DoD is not obligated to make any awards under Phase I, II, or III. For specifics regarding the evaluation and award of Phase I or II contracts, please read the DoD Program Solicitation very carefully. Phase II proposals will be reviewed for overall merit based upon the criteria in Section 8.0 of the solicitation.

BIO HAZARD MATERIAL AND RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Volume whether the contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access to government resources of any kind. Animal or human research must be based on formal protocols that are reviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

FOREIGN NATIONALS

If the offeror proposes to use a foreign national(s) [any person who is NOT a citizen or national of the United States, a lawful permanent resident, or a protected individual as defined by 8 U.S.C. 1324b (a) (3) – refer to Section 3.4 of this solicitation for definitions of "lawful permanent resident" and "protected individual"] as key personnel, they must be clearly identified. **For foreign nationals, you must provide country of origin, the type of visa or work permit under which they are performing and an**

<u>explanation of their anticipated level of involvement on this project. Please ensure no Privacy Act information is included in this submittal.</u>

<u>OZONE CHEMICALS</u>

Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances are prohibited and will not be allowed for use in this procurement without prior Government approval.

<u>CONTRACTOR MANPOWER REPORTING APPLICATION (CMRA)</u>

The Contractor Manpower Reporting Application (CMRA) is a Department of Defense Business Initiative Council (BIC) sponsored program to obtain better visibility of the contractor service workforce. This reporting requirement applies to all Army SBIR contracts.

Offerors are instructed to include an estimate for the cost of complying with CMRA as part of the Cost Volume for Phase I ($100,000 maximum), Phase I Option ($50,000 maximum), and Phase II ($1,000,000 maximum), under "CMRA Compliance" in Other Direct Costs. This is an estimated total cost (if any) that would be incurred to comply with the CMRA requirement. Only proposals that receive an award will be required to deliver CMRA reporting, i.e. if the proposal is selected and an award is made, the contract will include a deliverable for CMRA.

To date, there has been a wide range of estimated costs for CMRA. While most final negotiated costs have been minimal, there appears to be some higher cost estimates that can often be attributed to misunderstanding the requirement. The SBIR Program desires for the Government to pay a fair and reasonable price. This technical analysis is intended to help determine this fair and reasonable price for CMRA as it applies to SBIR contracts.

- The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains the secure CMRA System. The CMRA Web site is located here: https://cmra.army.mil/.

- The CMRA requirement consists of the following items, which are located within the contract document, the contractor's existing cost accounting system (i.e. estimated direct labor hours, estimated direct labor dollars), or obtained from the contracting officer representative:

  (1) Contract number, including task and delivery order number;
  (2) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
  (3) Estimated direct labor hours (including sub-contractors);
  (4) Estimated direct labor dollars paid this reporting period (including sub-contractors);
  (5) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
  (6) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (The Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
  (7) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on Web site);

- The reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 31 October of each calendar year.

- According to the required CMRA contract language, the contractor may use a direct XML data transfer to the Contractor Manpower Reporting System database server or fill in the fields on the Government Web site. The CMRA Web site also has a no-cost CMRA XML Converter Tool.

Given the small size of our SBIR contracts and companies, it is our opinion that the modification of contractor payroll systems for automatic XML data transfer is not in the best interest of the Government. CMRA is an annual reporting requirement that can be achieved through multiple means to include manual entry, MS Excel spreadsheet development, or use of the free Government XML converter tool. The annual reporting should take less than a few hours annually by an administrative level employee.

Depending on labor rates, we would expect the total annual cost for SBIR companies to not exceed $500.00 annually, or to be included in overhead rates.

DISCRETIONARY TECHNICAL ASSISTANCE

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientists and engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has stationed Technical Assistance Advocates (TAAs) across the Army to provide technical assistance to small businesses that have Phase I and Phase II projects with the participating organizations within their regions.

For more information go to: https://www.armysbir.army.mil/sbir/TechnicalAssistance.aspx.

COMMERCIALIZATION READINESS PROGRAM (CRP)

The objective of the CRP effort is to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The CRP: 1) assesses and identifies SBIR projects and companies with high transition potential that meet high priority requirements; 2) matches SBIR companies to customers and facilitates collaboration; 3) facilitates detailed technology transition plans and agreements; 4) makes recommendations for additional funding for select SBIR projects that meet the criteria identified above; and 5) tracks metrics and measures results for the SBIR projects within the CRP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army utilizes a CRP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. The CRP investment fund must be expended according to all applicable SBIR policy on existing Phase II contracts. The size and timing of these enhancements is dictated by the specific research requirements, availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a non-proprietary summary report at the end of their Phase I project and any subsequent Phase II project. The summary report is unclassified, non-sensitive and non-proprietary and should include:

- A summation of Phase I results
- A description of the technology being developed

- The anticipated DoD and/or non-DoD customer
- The plan to transition the SBIR developed technology to the customer
- The anticipated applications/benefits for government and/or private sector use
- An image depicting the developed technology

The non-proprietary summary report should not exceed 700 words, and is intended for public viewing on the Army SBIR/STTR Small Business area. This summary report is in addition to the required final technical report and should require minimal work because most of this information is required in the final technical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at https://portal.armysbir.army.mil/SmallBusinessPortal/Default.aspx and is due within 30 days of the contract end date.

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

A final technical report is required for each project. Per DFARS clause 252.235-7011 (http://www.acq.osd.mil/dpap/dars/dfars/html/current/252235.htm#252.235-7011), each contractor shall (a) submit two copies of the approved scientific or technical report delivered under the contract to the Defense Technical Information Center, Attn: DTIC-O, 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218; (b) Include a completed Standard Form 298, Report Documentation Page, with each copy of the report; and (c) For submission of reports in other than paper copy, contact the Defense Technical Information Center or follow the instructions at http://www.dtic.mil.

ARMY SBIR PROGRAM COORDINATORS (PC)

Participating Organizations	PC	Phone
JPEO CBD	**Larry Pollack**	**(703) 767-3307**

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DoD requirements specified in the solicitation. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$100,000** with up to a six-month duration) AND (if applicable) an optional effort (up to **$50,000** for an up to four-month period to provide interim Phase II funding).

2. The proposal is limited to only **ONE** Army Solicitation topic.

3. The technical content of the proposal, including the Option, includes the items identified in Section 5.4 of the Solicitation.

4. SBIR Phase I Proposals have 4 sections: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 20-page limit including, but not limited to: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents [e.g., statements of work and resumes] and all attachments). However, offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in others sections of the proposal submission as THESE WILL COUNT AGAINST THE 20 PAGE LIMIT. ONLY the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 20-page limit. As instructed in Section 5.4.e of the DoD Program Solicitation, the CCR is generated by the submission website, based on information provided by you through the “Company Commercialization Report” tool. Army Phase I proposals submitted over 20-pages will be deemed NON-COMPLIANT and will not be evaluated.

5. The Cost Volume has been completed and submitted for both **the Phase I and Phase I Option** and the costs are shown separately. The Army prefers that small businesses complete the Cost Volume form on the DoD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the cover pages.

6. Requirement for Army Accounting for Contract Services, otherwise known as CMRA reporting is included in the Cost Volume (offerors are instructed to include an estimate for the cost of complying with CMRA).

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

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

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

Army SBIR 13.3 Topic Index

Army SBIR 13.3 Topic Descriptions

A13-097 TITLE: Nanofluidic Sequencing of Polypeptides

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: JPEO CBD

OBJECTIVE: Design, fabrication, and demonstration of an electrophoretic capillary nanofluidic integrated sensor platform effective for sequencing polypeptides. The goal is to rapidly determine the amino acid sequence of a large polypeptide in a non-destructive manner.

DESCRIPTION: Standard methods of proteomics, such as mass spectrometry and SDS-PAGE, involve an extensive amount of sample preparation that is usually performed in a well-equipped laboratory. Such methods are very difficult to move to field environments. Also, standard methods of proteomics involve fragmenting a protein into small peptides before analysis. Following analysis of the smaller peptides, the researcher is required to reassemble the data to determine the amino acid sequence of the original large protein. There is a need in the DoD for rapid non-destructive methods of protein analysis that have the potential for use in the field. Nanofluidic analysis has emerged as a method to address this important problem.

Recently, methods have been developed to rapidly separate long-strand polymers according to length. The separation mechanism utilizes confinement-induced forces to separate the polymers into different size fractions. Researchers have examined interfaces between regions of vastly different configuration entropy, where small fragments can become trapped in favorable regions, but the larger fragments cannot completely enter due to the large size. Researchers have also examined mechanical and/or field-induced dielectrophoretic trapping due to the surface roughness within nanopores and selective binding of proteins and nucleic acids to silica particles.

Nanofluidics holds the promise for rapid, inexpensive, non-destructive analysis of biopolymers. In particular, nanofluidics may address rapid, non-destructive determination of the amino acid sequence of a large polypeptide. A better understanding of the transport behavior of long and short biopolymer strands in nanochannels is required. Better reporter mechanisms are also needed.

PHASE I: Examine the transport behavior of large polypeptide strands in fused silica nanochannels with the application of electrical fields of different strengths. Examine mechanical and/or field-induced dielectrophoretic trapping due to the surface roughness within the nanochannels. Examine areas within the nanofluidic channels with induced interfaces between regions of vastly different configuration entropy. Examine methods for utilizing polypeptide transport in nanochannels as a method for the non-destructive determination of the amino acid sequence. Examine methods of amino acid reporting, including optical and electrical methods.

PHASE II: During Phase II, the offeror should build and test a functioning nanofluidic proteomics platform. The research and development work should include an assessment of the prototype's ability to analyze large polypeptides and report the amino acid sequence. The nanofluidic proteomics system should allow for stand-alone operation with fluidic and electrophoretic control that is self-sustained to facilitate a transparent operation by the user, with the ultimate goal of developing a system that can be used in a field environment. The ultimate goal of the effort is to develop a system that is the size of a smart-phone that can operate on available battery power. Analysis time will depend on the size of the polypeptide strand under analysis. Target analysis time should be approximately 30 minutes.

PHASE III: Further research and development during Phase III efforts will be directed towards refining a final deployable design, incorporating design modifications based on results from tests conducted during Phase II, and improving engineering/form-factors, equipment hardening, and manufacturability designs to meet U.S. Army CONOPS and end-user requirements to include the Joint Chemical and Biological Defense Program (CBDP).

Specifically improved nanofluidic analysis will have relevance to scientific studies on biological materials and structures, to the detection and identification of biological threats, to medical diagnostics of biological induced diseases, to the monitoring of commercial consumables for biological contamination, just to name a few possibilities.

REFERENCES:
1. Liming Ying, “Single molecule biology: Coming of age”, Molecular BioSystems, volume 3, pages 377-380, 2007.

2. Jongin Hong, Joshua B. Edel, and Andrew J. Demello, “Micro- and nanofluidic systems for high-throughput biological screening”, Drug Discovery Today, volume 14, numbers 3-4, pages 134-146, 2009.

3. Alice C Fan, Debabrita Deb-Basu, Mathias W Orban, Jason R Gotlib, Yasodha Natkunam, Roger O'Neill, Rose-Ann Padua, Liwen Xu, Daryl Taketa, Amy E Shirer, Shelly Beer, Ada X Yee, David W Voehringer, and Dean W Felsher, “Nanofluidic proteomic assay for serial analysis of oncoprotein activation in clinical specimens”, Nature Medicine, volume15, issue 5, pages 566-571, 2009.

4. Patrick Abgrall and Nam Trung Nguyen, “Nanofluidic Devices and Their Applications”, Analytical Chemistry, volume 80, number 7, pages 2326-2341, 2008.

5. Mario Cabodi, Stephen W. P. Turner, and Harold G. Craighead, “Entropic Recoil Separation of Long DNA Molecules”, Analytical Chemistry, volume 74, number 20, pages 5169–5174, 2002.

6. Stephen L. Levy, John T. Mannion, Ji Cheng, Christian H. Reccius, and Harold G. Craighead, “Entropic Unfolding of DNA Molecules in Nanofluidic Channels”, Nano Letters, volume 8, number 11, pages 3839-3844, 2008.

7. M. J. O'Brien, P. Bisong, L. K. Ista, E. M. Rabinovitch, A. L. Garcia, S. S. Sibbett, G. P. Lopez and S. R. J. Brueck, “Fabrication of an Integrated Nanofluidic Chip using Interferometric Lithography”, Journal of Vacuum Science and Technology B, volume 21, pages 2941-2945, 2003.

KEYWORDS: proteomics, nanofluidics, sequencing, polypeptides, nanofluidic channels

A13-098 TITLE: Thermal Infrared Detection of Aerosolized Bacterial Spores

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes, Sensors

ACQUISITION PROGRAM: JPEO CBD

OBJECTIVE: Develop a software package designed for detecting and tracking biological aerosols using a thermal infrared camera.

DESCRIPTION: In outdoor environments, biological aerosols exhibit a Mie scattering component within the infrared signature of the aerosol. The Mie scattering component is primarily due to the reflectance of the cold sky by the aerosol particles. The Mie scatter component is broadband extending into both the long-wave and mid-wave infrared regions. To a thermal infrared camera, the presence of the aerosol appears as an area of the thermal scene that appears slightly colder than surrounding areas. Aerosol plumes can also be identified and tracked due to the motion of the plumes. The goal of this effort is to develop software that can be used with existing thermal infrared cameras for the detection and tracking of biological aerosols. This system will be used to provide early warning to the soldier-in-the-field of an attack by a biological warfare agent in an aerosolized form.

Uncooled long-wave-infrared cameras offer advantages in battlefield environments. Uncooled IR sensors operating from 8 to 12 microns can easily operate in bright sunlight or total darkness. They use the naturally radiated IR scene energy to create high resolution images and are not dependent on artificial light sources. Their long wave-length of operation also provides good weather penetration. Enemy vehicles and soldiers can easily camouflage themselves in the visible, but have difficultly hiding their thermal emissions from an IR imager. As thermal infrared cameras become readily available on the battlefield, there is a desire to provide them with additional operational capabilities.

PHASE I: Examine the feasibility of detecting and tracking biological aerosols using a thermal infrared camera. Aerosol plume detection using thermal infrared cameras is possible due to an atmospheric effect called Mie scattering. Down-welling radiation from the atmosphere is scattered off aerosol particles, causing an aerosol plume to appear as a cold object against the surrounding background. A thermal camera with the appropriate software should be able detect and track biological aerosol clouds from a standoff distance of up to 5 km or better. Detection sensitivity should be 50,000 ACPLA or better for a plume size of 200 meters or larger with a probability of detection of at least 80%. A preliminary design of a software package that can detect biological aerosols from the scene of an infrared camera should be developed. A performance model of the system should be developed to predict the utility of the proposed system. Data acquisition and signal processing of the proposed system should be examined and modeled.

PHASE II: Develop a software package that can be used with existing thermal infrared cameras for the detection and tracking of biological aerosols. Advance the system design (with software package) and build/optimize for field usage. The final system should be able detect and track biological aerosol clouds from a standoff distance of up to 5 km. The system should function autonomously and be capable of real-time detection and tracking of aerosol clouds. The software package should be implemented, tested, and demonstrated using a thermal infrared camera platform.

PHASE III: Further research and development during Phase III efforts will be directed toward refining and implementing the new design software to meet U.S. Army CONOPS and end-user requirements to include the Joint Chemical and Biological Defense Program (CBDP). The software package should be implemented and tested on a variety of thermal infrared platforms that are of interest to the DoD. The offeror should also consider the system design to include aerosolized chemical agent detection, thus expanding its overall standoff detection capabilities.

The new design software will have broad impact across several avenues of defense applications. The fundamental mathematical and computational methods developed in this program will also have an impact. There are environmental applications for a robust standoff biological aerosol sensor. A thermal infrared camera that can be used for detecting biological aerosols will significantly reduce the logistics burden on the Joint Services by reducing the number of sensors in the field. Also, first responders such as Civil Support Teams and Fire Departments have a critical need for a rugged, inexpensive sensor that can be transported to the field to test for possible contamination by CBW agents.

REFERENCES:
1. Ryan Fauth, Christopher Powell, Thomas Gruber, and Dan Clapp, “Automated recognition and tracking of aerosol threat plumes with an IR camera pod”, Proceedings of the SPIE, volume 8358, Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XIII, paper 835806, 2012.

2. Jean-Marc Theriault, Eldon Puckrin, and James O. Jensen, “Passive Standoff Detection of Bacillus Subtilis Aerosol by Fourier-transform Infrared Radiometry”, Applied Optics, volume 42, number 33, pages 6696-6703, 2003.

3. C. M. Gittins, L. G. Piper, W. T. Rawlins, W. J. Marinelli , J. O. Jensen, and A. N. Akinyemi, “Passive and active standoff infrared detection of bio-aerosols”, Field Analytical Chemistry & Technology, volume 3, issue 4-5, pages 274-282, 1999.

4. Avishai Ben-David, Janon F. Embury, and Charles E. Davidson, “Radiative transfer model for aerosols in infrared wavelengths for passive remote sensing applications”, Applied Optics, Volume 45, Issue 26, pages 6860-6875, 2006.

5. Avishai Ben-David, Stephen Holland, Gabriel Laufer, and Jason Baker, “Measurements of atmospheric brightness temperature fluctuations and their implications on passive remote sensing”, Optics Express, Volume 13, Issue 22, pages 8781-8800 , 2005.

6. Agustin Ifarraguerri, Avishai Ben-David, and Richard G. Vanderbeek, “Estimating the limit of bio-aerosol detection with passive infrared spectroscopy”, International Journal of High Speed Electronics and Systems, Volume 18, Issue 3, pages 701-711, 2008

7. Ruth, Signorell, and Jonathan P. Reid, eds., “Fundamentals and applications in aerosol spectroscopy”, CRC Press, 2011.

8. Earl J. McCartney, “Optics of the Atmosphere: Scattering by molecules and particles”, John Wiley and Sons, Inc., New York, 1976.

KEYWORDS: biological detection, aerosols, infrared spectrum, Mie scattering, cold sky

A13-099 TITLE: Secondary Processing Development and Prototyping of Cast Single-Piece Vehicle Underbody Structure

TECHNOLOGY AREAS: Ground/Sea Vehicles

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.3 of the solicitation.

OBJECTIVE: Develop and prototype highly scalable processes to fabricate single-piece underbody structures to achieve a combination of high strength and high toughness.

DESCRIPTION: The Army is interested in the production of large single-piece underbody structures for combat vehicles. The structure must possess an outstanding combination of strength and toughness for it to survive battlefield threats. In general single-piece structures are produced by casting and followed by subsequent secondary processing to achieve the desired mechanical properties in the structure. It has been demonstrated that a cast steel material after appropriate post-cast secondary processing exhibits a combination of strength and toughness as high as 180 ksi tensile yield strength, 230 ksi ultimate tensile strength, 12% tensile elongation, and 30 ft-lb Charpy V Notch (CVN) toughness at -40°F[1,2]. Unfortunately such remarkable mechanical properties are achievable only in relatively small cast structures. Suitable scalable secondary processing techniques are not currently available which could be applied to large single-piece cast structures to achieve the aforementioned mechanical properties. The challenge here is to establish scalable secondary processes for very large single-piece structure to achieve the required combination of strength and toughness. Additional challenge is to achieve uniformity of the properties throughout the entire large single-piece structure including through thicknesses.

Army is inviting proposals to develop and prototype highly scalable processes to fabricate large single-piece underbody structures with a combination of high strength and high toughness throughout the entire structure and thickness. The process must be scalable and be able to integrate relatively smoothly to very large scale fabrication or production under the standard manufacturing practices without needing nonconventional manufacturing equipments or processes beyond what are currently used. Army is seeking proposals that address novel processing techniques, such as innovative casting, robust post-cast processing, or other equally innovative and robust processes, that can be easily integrated with the existing manufacturing bases to enable smooth transition to large scale processing of large single-piece structure.

PHASE I: Design processes to produce plates having nominal dimension of 4 ft wide x 4 ft long x 3 in thick. Demonstrate that the designed structure is able to achieve the Phase I threshold properties of 180 ksi tensile yield strength, 230 ksi ultimate tensile strength, 12% tensile elongation, and 30 ft-lb Charpy V Notch (CVN) toughness at -40°F. Two (2) 4 ft width x 4 ft length x 3 in thickness plates meeting the aforementioned threshold properties shall be produced. Verification and validation of the uniformity of the properties throughout the entire structure is critical and one (1) of the two (2) identically processed plates shall be destructively evaluated accordingly following the ASTM standards [3-5]. Uniformity of the properties throughout the entire plate including the thickness must be evaluated. For example, it may be evaluated in x, y, and z reference orientations within every 1 ft x 1 ft spacing in the x and y reference orientation at two positions in the z-direction: one at the mid-point of the plate and the other half-way between the mid-point and the surface. The plate not destructively tested shall be delivered to U.S. Army Research Laboratory for blast tests. The secondary process design preferably be suitable not only for processing simple structures but also for processing complex shape large structures. Additionally, the secondary process design must be sufficiently adaptable such that it can be directly integrated into the existing conventional manufacturing infrastructures or foundry processes without needing nonconventional manufacturing equipments or processes beyond what are currently available and used commercially. Numerical methodologies in process model and simulation are highly desirable in demonstrating the Phase I secondary process predictability.

PHASE II: The Phase II program will be to scale up and optimize the process to produce larger plates and subsequently to an entire single-piece vehicle underbody tub (i.e., lower hull and underbelly). Two (2) plates having nominal dimension of 6 ft wide x 10 ft long x 3 in thick shall be fabricated and achieved the same threshold properties of the Phase I. Verification and validation of the uniformity of the properties throughout the entire structure and through the thickness is critical and one (1) of the two (2) identically processed plates shall be destructively evaluated accordingly following the ASTM standards [3-5]. Uniformity of the properties throughout the entire plate and thickness must be evaluated. For example, it may be sampled at every 2 ft in the x-y plane. The plate not destructively tested shall be delivered to U.S. Army Research Laboratory for blast tests. Following successful validation of the plate properties, one (1) full single-piece vehicle tub (i.e., lower hull and underbelly) having nominal dimension of 12 ft wide x 30 ft long x 5 ft high and thickness between 2 in and 3 in shall be fabricated and delivered to U.S. Army Research Laboratory for blast tests.

The process shall be validated to be sufficiently predictable, adaptable, flexible, and robust such that it can be directly integrated into the existing conventional manufacturing infrastructures or foundry processes without needing nonconventional manufacturing equipments or processes beyond what are currently available and used commercially. Numerical methodologies of Phase II processes shall be developed and the model and simulation shall be demonstrated to be highly predictable.

PHASE III: The manufacturing technology shall be transitioned to civil and military sector applications. . Successful Phase II validation facilitates immediate single-piece vehicle hull and cap fabrication, and integration of demonstrated technology. The manufacturing technology and force protection capability information will be transitioned to both Tank Automotive Research and Development (TARDEC) and Tank Automotive Command (TACOM) for immediate implementation and integration into existing and future platform design and engineering efforts. Deliverables and technical data packages (TDPs) resulting from this SBIR will support a variety of Army PEOs and PMs in Army major acquisition programs. The manufacturing technology to civilian application enable very-large-scale complex-shape cast structural part in ship hulls, transportation vessels, and energy infrastructures where unnecessary joining are critical design requirements.

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KEYWORDS: single-piece, underbody, high strength, high toughness, innovative processing, scalable processing, casting, post-cast processing, tensile test, Charpy V-notch test, fracture toughness