DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)
11.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

Introduction:

DARPA's mission is to prevent technological surprise for the United States and to create technological surprise for its adversaries. The DARPA SBIR and STTR Programs are designed to provide small, high-tech businesses and academic institutions the opportunity to propose radical, innovative, high-risk approaches to address existing and emerging national security threats; thereby supporting DARPA's overall strategy to bridge the gap between fundamental discoveries and the provision of new military capabilities.

The responsibility for implementing DARPA's Small Business Innovation Research (SBIR) Program rests with the Small Business Programs Office.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Attention: DIRO/SBPO
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 526-4170
Home Page http://www.darpa.mil/Opportunities/SBIR_STTR/SBIR_STTR.aspx

Offerors responding to the DARPA topics listed in Section 8.0 of the DoD 11.2 SBIR Solicitation must follow all the instructions provided in the DoD Program Solicitation I. Specific DARPA requirements in addition to or that deviate from the DoD Program Solicitation are provided below and reference the appropriate section of the DoD Solicitation. .

SPECIFIC DARPA REQUIREMENTS:
Please note – these requirements and guidelines are supplemental to the DoD 11.2 SBIR Program Solicitation. For additional information, please refer to the corresponding section number in the DoD solicitation (http://www.dodsbir.net/solicitation/sbir112/preface112.htm).

2.3 Foreign National
DARPA topics are unclassified; however, the subject matter may be considered to be a "critical technology" and therefore subject to ITAR restrictions. ALL offerors proposing to use foreign nationals MUST follow section 3.5, b, (7) of the DoD Program Solicitation and disclose this information regardless of whether the topic is subject to ITAR restrictions. See **Export Control** requirements below in Section 5.

3.5 Phase I Proposal Format

PHASE I OPTION

DARPA has implemented 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 companies selected for Phase II will be eligible to exercise the Phase I Option. The Phase I Option covers activities over a period of up to four months and should describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option counts toward the 25-page limit for the Phase I proposal.

A Phase I Cost Proposal ($150,000 maximum) must be submitted in detail online. Proposers that participate in this solicitation must complete the Phase I Cost Proposal, not to exceed the maximum dollar amount of $100,000, and a Phase I Option Cost Proposal, not to exceed the maximum dollar amount of $50,000. Phase I and Phase I Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 25-page limit for the Phase I proposal. Phase I awards and options are subject to the availability of funds.

3.7 Phase II Proposals

DARPA Program Managers may invite Phase I performers to submit a Phase II proposal based upon the success of the Phase I contract to meet the technical goals of the topic, as well as the overall merit based upon the criteria in section 4.3 of the DoD Program Solicitation. Phase II proposals will be evaluated in accordance with the evaluation criteria provided in section 4.3. Information regarding Phase II Proposal format will be included in the Phase II Invitation letter.

PHASE II OPTION

DARPA has implemented the use of a Phase II Option that may be exercised at the DARPA Program Manager's discretion to continue funding Phase II activities that will further mature the technology for insertion into a larger DARPA Program or DoD Acquisition Program. The Phase II Option covers activities over a period of up to 24 months and should describe Phase II activities that may lead to the successful demonstration of a product or technology. The Phase II Option counts toward the 40-page limit for the Phase II proposal.

A Phase II Cost Proposal ($1,000,000 maximum) must be submitted in detail online. Proposers that submit a Phase II proposal must complete the Phase II Cost Proposal, not to exceed the maximum dollar amount of $1,000,000, and a Phase II Option Cost Proposal, not to exceed the maximum dollar amount of $750,000. Phase II and Phase II Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 40-page limit for the Phase II proposal. Phase II awards and options are subject to the availability of funds.

If selected, the government may elect not to include the option in the negotiated contract.

4.0 Method of Selection and Evaluation Criteria

The offeror's attention is directed to the fact that non-Government advisors to the Government may review and provide support in proposal evaluations during source selection. Non-government advisors may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. These advisors will not establish final assessments of risk and will not rate or rank offeror's proposals. They are also expressly prohibited from competing for DARPA SBIR or STTR awards in the SBIR/STTR topics they review and/or provide comments on to the Government. All advisors are required to comply with procurement integrity laws and are required to sign Non-Disclosure and Rules of Conduct/Conflict of Interest statements. Non-Government technical consultants/experts will not have access to proposals that are labeled by their proposers as "Government Only."

Please note that qualified advocacy letters will count towards the proposal page limit and will be evaluated towards criterion C. Advocacy letters are not required for Phase I or Phase II. Consistent with Section 3-209 of DoD 5500.7-R, Joint Ethics Regulation, which as a general rule prohibits endorsement and preferential treatment of a non-federal entity, product, service or enterprise by DoD or DoD employees in their official capacities, letters from government personnel will NOT be considered during the evaluation process.

A qualified advocacy letter is from a relevant commercial procuring organization(s) working with a DoD or other Federal entity, articulating their pull for the technology (i.e., what need the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. If submitted, the letter should be included as the last page of your technical upload. Advocacy letters which are faxed or e-mailed separately will NOT be considered.

4.2 Evaluation Criteria

In Phase I, DARPA will select proposals for funding based on the evaluation criteria contained in Section 4.2 of the DoD Program Solicitation, including potential benefit to DARPA, in assessing and selecting for award those proposals offering the best value to the Government.

In Phase II, DARPA will select proposals for funding based on the evaluation criteria contained in Section 4.3 of the Program Solicitation, including potential benefit to DARPA and ability to transition the technology into an identified system, in assessing and selecting for award those proposals offering the best value to the Government.

As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be of superior quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the quality of the proposals is deemed superior and are highly relevant to the DARPA mission, or it may not fund any proposals in a topic area. Each proposal submitted to DARPA must have a topic number and must be responsive to only one topic.

4.4 Assessing Commercial Potential of Proposals

DARPA is particularly interested in the potential transition of SBIR project results to the U.S. military, and expects explicit discussion of a transition vision in the commercialization strategy part of the proposal. That vision should include identification of the problem, need, or requirement in the Department of Defense that the SBIR project results would address; a description of how wide-spread and significant the problem, need, or requirement is; identification of the potential end-users (Army, Navy, Air Force, SOCOM, etc.) who would likely use the technology; and the operational environments and potential application area(s).

Technology commercialization and transition from Research and Development activities to fielded systems within the DoD is challenging. Phase I is the time to plan for and begin transition specific activities. The small business must convey an understanding of the transition path or paths to be established during the Phase I and II projects. That plan should include the Technology Readiness Level (TRL) at the start and end of the Phase II. The plan should also include a description of targeted operational environments and priority application areas for initial Phase III transition; potential Phase III transition funding sources; anticipated business model and identified commercial and federal partners the SBIR company has identified to support transition activities. Also include key proposed milestones anticipated during Phase I, II or beyond Phase II that include, but are not limited to: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.

4.5 SBIR Fast Track

Small businesses that participate in the Fast Track program do not require an invitation to submit a proposal, but must submit an application. The complete Fast Track application must be received by DARPA no later than the last day of the fifth month of the Phase I effort. Once your application is submitted, the DARPA Program Manager will make a determination on whether or not a technical proposal will be accepted for the Phase II effort. If the DARPA Program Manager approves the Fast Track application, the small business will have 30 days to submit the technical proposal.

Any Fast Track applications not meeting these dates may be declined. All Fast Track applications and required information must have a complete electronic submission. The DoD proposal submission site will lead you through the process for submitting your technical proposal and all of the sections electronically.

Firms who wish to submit a Fast Track Application to DARPA must utilize the DARPA Fast Track application template. Failure to follow these instructions may result in automatic rejection of your application. Phase I interim funding is not guaranteed. If awarded, it is expected that interim funding will generally not exceed $50,000. Selection and award of a Fast Track proposal is not mandated and DARPA retains the discretion not to select or fund any Fast Track applicants. NOTE: Phase I firms whose proposals are not accepted for a Fast Track Phase II award are not eligible to receive a Phase II invitation from the agency.

- DARPA encourages Phase I performers to discuss its intention to pursue Fast Track with the DARPA Program Manager prior to submitting a Fast Track application or proposal.
- Fast Track awards are subject to the availability of funds.
- After coordination with the DARPA Program Manager, the performer and the investor should submit a Fast Track application through the DoD Submission Web site no later than the last day of the fifth month of the Phase I effort.
- The Fast Track Interim amount is not to exceed $50,000.
- Additional information regarding the DARPA Fast Track process and application template may be found at: http://www.darpa.mil/Opportunities/SBIR_STTR/SBIR.aspx

4.6 Phase II Enhancement Policy

To encourage transition of SBIR projects into DoD systems, DARPA's Phase II Enhancement Program provides a Phase II performer up to $200,000 of additional Phase II SBIR funding if the performer can match the additional SBIR funds with funds from a DoD acquisition program, a non-SBIR/non-STTR government program or private sector investments. The Phase II Enhancement Program allows for an existing Phase II SBIR to be extended for up to one year per Phase II Enhancement application, to perform additional research and development and further mature the technology. Phase II Transition matching funds will be provided on a one-for-one basis up to a maximum amount of $200,000 of SBIR or funds in accordance with DARPA Phase II Enhancement policy.

Phase II Enhancement funding can only be applied to an active DoD Phase II SBIR contract. The funds provided by the DoD acquisition program or a non-SBIR/non-STTR government program may be obligated on the Phase II contract as a modification prior to or concurrent with the modification adding DARPA SBIR funds, OR may be obligated under a separate contract. Private sector funds must be from an "outside investor" which may include such entities as another company, or an investor. It does not include the owners or family members, or affiliates of the small business (13 CFR 121.103).

4.7 Commercialization Pilot Program

DARPA has established a Transition Support Pilot Program with the objective to increase transition success for companies that have one or multiple active DARPA-funded SBIR and/or STTR Phase II projects. This is accomplished through the identification of viable Phase III funding sources, and potential government and commercial partners interested in collaborating with the companies to further mature the technology to ***Technology Readiness Level (TRL) 7: System prototype demonstration in an operational environment.*** Achievement of this milestone takes the technology beyond the initial demonstration phase, typically the maximum achieved in Phase II, and is a key step in a transition roadmap for the testing and fielding of new capabilities to the U.S. military and other federal agencies with similar requirements.

Approach
The Foundation for Enterprise Development (The Foundation), a U.S.-owned non-profit organization, is assisting the DARPA Program Director, Small Business Programs Office in implementing the Pilot.

- **Transition Assistance:** The Foundation will provide companies that have one or multiple active DARPA-funded SBIR and/or STTR Phase II projects that elect to participate in the Pilot with assistance in preparing a transition plan as well as provide targeted assistance in identifying potential Phase III funding sources, and potential government and commercial partners with requirements for the technology under development. The Foundation will also provide suggestions on the development of project materials and facilitate introductions to the potential funding sources and partners. DARPA Phase II SBIR and STTR projects in the Pilot program will be included in a transition/commercialization report prepared annually by DARPA.

- **Success Reports:** The Foundation will document company transition successes in a brochure or other printed material for distribution at outreach events. The DARPA Success Reports can be viewed at this link:
http://www.darpa.mil/Opportunities/SBIR_STTR/SBIR_STTR_Success_Reports.aspx

- **Outreach/Process Improvement:** The Foundation will capture lessons learned, best practices and help develop and implement process improvements to increase transition success for DARPA-funded SBIR and STTR companies. We welcome feedback from the participating companies and the DARPA program managers during the Pilot.

- **Company Participation Process:** Companies that elect to participate in the Pilot program will be asked to sign a technology transition support agreement (TTA) that specifies what activities will be performed by the Foundation and the SBIR or STTR company's obligations and other provisions. Once the agreement is signed, transition support will begin.

5.1.b. Type of Funding Agreement (Phase I)

- DARPA Phase I awards will be Firm Fixed Price contracts.
- Companies that choose to collaborate with a University must highlight the research that is being performed by the University and verify that the work is FUNDAMENTAL RESEARCH.
- Companies are strongly encouraged to pursue implementing a government acceptable cost accounting system during the Phase I project to avoid delay in receiving a Phase II award. Visit www.dcaa.mil and download the "Information for Contractors" guide for more information.

5.1.c. Average Dollar Value of Awards (Phase I)
DARPA Phase I proposals **shall not exceed $150,000,** and are generally 6 months in duration.

5.2.b. Type of Funding Agreement (Phase II)

- DARPA Phase II awards are typically Cost-Plus-Fixed-Fee contracts; however, DARPA may choose to award a Firm Fixed Price Phase II contract or an Other Transaction (OT) on a case-by-case basis. Visit http://www.darpa.mil/Opportunities/SBIR_STTR/Small_Business_OTs.aspx for more information on Other Transactions.
- Companies are advised to continue pursuit of implementation of a government acceptable cost accounting system in order to facilitate their eligibility for future government contracts.

- Companies that choose to collaborate with a university must highlight the research that is being performed by the university and verify that the work is FUNDAMENTAL RESEARCH.

5.2.c. Average Dollar Value of Awards (Phase II)
DARPA Phase II proposals should be structured as a 24 month effort in two equal increments of approximately $500,000 each. The entire Phase II base effort should generally not exceed $1,000,000.

5.3 Phase I Report
All DARPA Phase I and Phase II awardees are required to submit a final report, which is due within 60 days following completion of the technical period of performance and must be provided to the individuals identified in Exhibit A of the contract. Please contact your contracting officer immediately if your final report may be delayed.

5.11.r. Export Control
The following will apply to all projects with military or dual-use applications that develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.

(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

(4) The Contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

Please visit http://www.pmddtc.state.gov/regulations_laws/itar.html for more detailed information regarding ITAR requirements.

5.11.s. Publication Approval (Public Release)
NSDD 189 established the national policy for controlling the flow of scientific, technical, and engineering information produced in federally funded fundamental research at colleges, universities, and laboratories. The directive defines fundamental research as follows: "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."

It is DARPA's goal to eliminate pre-publication review and other restrictions on fundamental research except in those exceptional cases when it is in the best interest of national security. Please visit

http://www.darpa.mil/NewsEvents/Public_Release_Center/Public_Release_Center.aspx for additional information and applicable publication approval procedures. Visit http://dtsn.darpa.mil/fundamentalresearch/ to verify whether or not your award has a pre-publication review requirement.

5.14.h. Human and/or Animal Use

This solicitation may contain topics that have been identified by the program manager as research involving Human and/or Animal Use. In accordance with DoD policy, human and/or animal subjects in research conducted or supported by DARPA shall be protected. Although these protocols will most likely not be needed to carry out the Phase I, significant lead time is required to prepare the documentation and obtain approval in order to avoid delay of the Phase II award. Please visit http://www.darpa.mil/Opportunities/SBIR_STTR/SBIR.aspx to review the Human and Animal Use PowerPoint presentation(s) to understand what is required to comply with human and/or animal protocols.

- **Human Use:** All research involving human subjects, to include use of human biological specimens and human data, selected for funding must comply with the federal regulations for human subject protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, *Protection of Human Subjects* http://www.access.gpo.gov/nara/cfr/waisidx_07/32cfr219_07.html) and DoD Directive 3216.02, *Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research* (http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf).

  Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office of Human Research Protection Federal Wide Assurance (http://www.hhs.gov/ohrp). All institutions engaged in human subject research, to include subcontractors, must also have a valid Assurance. In addition, personnel involved in human subjects research must provide documentation of completing appropriate training for the protection of human subjects.

  For all proposed research that will involve human subjects in the first year or phase of the project, the institution must provide evidence of or a plan for review by an Institutional Review Board (IRB) upon final proposal submission to DARPA. The IRB conducting the review must be the IRB identified on the institution's Assurance. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection, and data analysis. Consult the designated IRB for guidance on writing the protocol. The informed consent document must comply with federal regulations (32 CFR 219.116). A valid Assurance along with evidence of appropriate training for all investigators should accompany the protocol for review by the IRB.

  In addition to a local IRB approval, a headquarters-level human subjects regulatory review and approval is required for all research conducted or supported by the DoD. The Army, Navy, or Air Force office responsible for managing the award can provide guidance and information about their component's headquarters-level review process. Note that confirmation of a current Assurance and appropriate human subjects protection training is required before headquarters-level approval can be issued.

  The amount of time required to complete the IRB review/approval process may vary depending on the complexity of the research and/or the level of risk to study participants.

Ample time should be allotted to complete the approval process. The IRB approval process can last between one to three months, followed by a DoD review that could last between three to six months. No DoD/DARPA funding can be used towards human subjects research until ALL approvals are granted.

- **Animal Use:** Any Recipient performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Laboratory Animal Welfare Act of 1966, as amended, (7 U.S.C. 2131-2159); (ii) the guidelines described in National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals"; (iii) DoD Directive 3216.01, "Use of Laboratory Animals in DoD Program."

  For submissions containing animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the PHS Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.

  All Recipients must receive approval by a DoD certified veterinarian, in addition to an IACUC approval. No animal studies may be conducted using DoD/DARPA funding until the USAMRMC Animal Care and Use Review Office (ACURO) or other appropriate DoD veterinary office(s) grant approval. As a part of this secondary review process, the Recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at https://mrmc-www.army.mil/index.cfm?pageid=Research_Protections.acuro&rn=1.

6.3 Notification of Proposal Receipt

After the solicitation closing date, DARPA will send an e-mail to the person listed as the "Corporate Official" on the Proposal Coversheet acknowledging receipt of proposal.

6.4 Information on Proposal Status

Once the source selection is complete, DARPA will send an email to the person listed as the the "Corporate Official" on the Proposal Coversheet with instructions for retrieving letters of selection or non-selection from the DARPA SBIR/STTR Information Portal..

6.5 Debriefing of Unsuccessful Offerors

DARPA will provide debriefings to offerors in accordance with FAR Subpart 15.5. The notification letter referenced above in paragraph 6.4 will provide instructions for requesting a proposal debriefing. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the proposal number and topic number referenced. All communication from the DARPA SBIR/STTR Program management will originate from the sbir@darpa.mil e-mail address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

DARPA SBIR 11.2 Topic Index

SB112-001	Pump for Vapor-Liquid Mixtures of Refrigerants
SB112-002	High Velocity Insensitive Launch Systems
SB112-003	Online Graphic Novel/Sequential Art Authoring Tools for Therapeutic Storytelling
SB112-004	SHIELD (Novel Techniques for the Synthesis of High Fidelity Social Network Data)
SB112-005	Improved Dried Biological Specimen Materials, Recovery and Processing for Diagnostics

DARPA SBIR 11.2 Topic Descriptions

SB112-001 TITLE: Pump for Vapor-Liquid Mixtures of Refrigerants

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Sensors, Electronics

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop and demonstrate a device capable of pumping a refrigerant mixture of liquid and vapor through a piping network with horizontal and vertical segments and substantial flow resistance.

DESCRIPTION: Thermal management is a key element in the development of many defense electronic systems and improvements in thermal management are needed to realize the full potential of emerging semiconductor materials and system architectures. Pumped liquid-vapor, phase-change cooling of electronic components, using common refrigerants and dielectric fluids, offers among the highest heat transfer rates and heat removal efficiencies for the configurations and environments of interest.

Current technology requires use of an all-liquid or all-vapor prime mover to impart the necessary pressure for circulating the fluid through the network. The absence of a pump that can circulate a liquid-vapor mixture, containing small or large vapor fractions, against a substantial flow resistance leads to system inefficiencies and is impeding the development and implementation of two-phase cooling.

The proposed SBIR effort targets the development of a device for pumping liquid-vapor mixtures through a piping network that includes an evaporator, a condenser, several valves, and a fluid reservoir, as well as several horizontal and vertical segments, in a configuration appropriate to an electronic equipment rack. It is desired to operate this two-phase pump at a variable location in the piping network, where the vapor may constitute a small or large fraction (thermodynamic quality) of the mass flow and where the operating pressure may be below or above the ambient condition

PHASE I: Design, build, and successfully demonstrate the operation of a laboratory prototype device pumping a liquid-vapor mixture of a common refrigerant through a refrigerant piping loop tube, while experiencing mass flow vapor fractions (qualities) of between 5% and 95% upstream of the pumping device. The flow loop should incorporate an evaporator, a condenser, and flow regulator(s) in a flow loop approximately 3m long, incorporating elevation variations of +/- 25cm and using standard diameter refrigeration tubes (~3-6mm).

Required Phase I deliverables will include the raw and processed experimental data for the operation of the laboratory pumping device, a description of the physical phenomena utilized in developing the two-phase pumping capability and anticipated performance limits, and a comparison of the measured performance against the anticipated limits.

PHASE II: Based on the performance achieved in the Phase I SBIR, design, build, and demonstrate two-phase, liquid-vapor, refrigerant pump(s) for a 20kW refrigeration system to be used in a standard electronic rack. The flow loop should incorporate multiple evaporators, flow regulators, and - at least – one condenser, and provide mass flow vapor fractions (qualities) of between 5% and 95% upstream of the pumping device(s). Conduct life-cycle and environmental testing, appropriate to a selected shipboard and/or equipment shelter DoD application, including 1000 hrs of continuous, failure-free operation with variable inlet qualities, ambient temperatures, and heat loads.

Required Phase II deliverables will include a working two-phase pump prototype (at the TRL6 level), a mathematical model that can be used to predict the pumping capability of the device for various refrigerants and operating conditions, raw and processed experimental data for the operation of the prototype, and a comparison, along with analysis, of the predicted and measured performance characteristics.

PHASE III: For DoD purposes, this technology would be developed into an actual equipment rack on a Navy ship or Army equipment shelter. The commercial/dual use application would include development of an actual data center rack. The commercial/dual use application would include development of an actual data center rack.

REFERENCES:
1. Woias, P., A. Ludwigs,G. K. Allee, 2005,"Micropumps—past, progress and future prospects," Sensors and Actuators, Vol B 105, pp 28–38.

2. Olivet,A., J. Gamboa, F. Kenyery, 2002, "Experimental Study of Two-Phase Pumping in a Progressive Cavity Pump Metal to Metal," Paper Number 77730-MS, SPE Annual Technical Conference and Exhibition, September 2002, San Antonio, Texas; DOI 10.2118/77730-MS.

3. Jiang, L et al, 2002, "Closed-Loop Electroosmotic Microchannel Cooling System for VLSI Circuits," IEEE Transactions on Components and Packaging Technologies, Vol. 25, No. 3, pp 347.

KEYWORDS: pump, refrigerant, two-phase, vapor, electronic cooling, rack cooling

SB112-002 TITLE: High Velocity Insensitive Launch Systems

TECHNOLOGY AREAS: Weapons

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Identify and develop innovative, near –term solutions for increasing muzzle velocity, and thus the lethality of cannon systems while moving away from conventional propellants.

DESCRIPTION: DARPA is interested in developing the technologies necessary for high velocity cannon systems that can be used for a number of mission critical applications. We are seeking to increase range, velocities and intercept rates that conventional powder guns cannot achieve. Acceleration of projectiles to velocities greater than 2 km/s is required to extend the capability of modern kinetic weapons to intercept high-velocity offensive weapons as well as provide long range fire support. Conventional, chemically driven cannons reach a (practical) fundamental limit at ~ 1 km/s to 1.5 km/s due to the adiabatic flame temperature (sound speed) of conventional explosives. Higher projectile velocities cannot be achieved without the use of auxiliary heating. Currently the Navy is pursuing an electro-magnetic gun concept. This SBIR is intended to investigate alternatives to EM launch more suitable to transportable fire basing systems.

In addition to providing increased range, safety and intercept these high velocity projectiles will be insensitive material (IM) compliant by using kinetic energy rather than high explosives. This will reduce the significant logistics requirements for resupply, storage and handling of hazardous materials when dealing with conventional powder guns.

While a major technical challenge, the achievement of higher projectile velocities would be a game-changing development for projectile systems, especially in the area of missile defense applications where offensive capabilities of our potential adversaries grow in speed, accuracy and quantity.

PHASE I: Conduct an analysis and feasibility study on one or more methods to increase projectile velocities for defensive and long range fire applications:
• Develop a basic system conceptual design
• Identify key sub-systems requiring development
• Identify major risks
• Develop a credible plan and cost estimate to accomplish the tasks

PHASE II: Mature the concept and demonstrate feasibility of the chosen method to increase projectile velocities:
• Develop materials and sub-systems identified in Phase I
• Design a proof-of-concept system that can fire realistic (scaled) mass projectiles
• Build the proof-of-concept system
• Conduct experiments on the proof-of-concept system to demonstrate performance
• Develop a credible plan, with risks identified, and cost estimates to mature the technology through Phase III

At the completion of Phase II the technology should be at a TRL 4 and all of the basic technological components should have been integrated with reasonably realistic supporting elements so the technology can be tested in a simulated environment.

PHASE III: Development of a pre-production transportable high speed launcher system capable of velocities in excess of 2 km/s and projectile masses over 10kg.

High speed, ground based technologies developed through this SBIR can enable a decrease in overall booster necessary for space access therefore reducing size and cost of space launch system. Additionally, responsive access can be achieved with less infrastructure necessary. Other possible commercial concepts that have been suggested are bio-degradable projectiles carrying fire retardants or potentially water for forest fire suppression.

REFERENCES:
1. http://nextbigfuture.com/2009/10/orbital-gun-launch-systems-light-gas.html

2. THEORETICAL LIGHT-GAS GUN PERFORMANCE, ARO Inc, Arnold AFS, TN (DTIC AD0256571)

3. Gourley, Scott R, "The Jules Verne Gun", Popular Mechanics, 1996 December.

4. "SHARP Gun Accelerates Scramjets to Mach 9", Aviation Week & Space Technology, 1996-09-09, p. 63.

KEYWORDS: High Velocity Gun/Cannon, Weapon, Insensitive Propellants, Projectile

SB112-003 TITLE: Online Graphic Novel/Sequential Art Authoring Tools for Therapeutic Storytelling

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop user-friendly authoring tools to help Service Members express combat-related experiences through personal narratives in a graphic novel/sequential art format that will enable them to process their memories and emotions through healthy, constructive activities.

DESCRIPTION: Art Therapy and narrative are both useful techniques for helping individuals traumatized by life experiences process memories and channel emotions through a healthy outlet. Narratives related to experiences do not necessarily have to be veridical representations of history. A good example of channeling emotion and memories related to combat experiences into storytelling is Joe Haldeman's, "Forever War" published in 1974 and winning both the Hugo and Nebula Awards in which Haldeman translates experiences and feelings related to the Vietnam War into a Science Fiction theme. Graphic novels/sequential art have rich traditions of high-quality artwork and rich storytelling related to combat experiences as exemplified in the 1951 series, "Frontline Combat" and the 1966 series, "Blazing Combat". Considered political in their day for their stark portrayals of war, both are now considered hallmarks of the genre both stylistically and in the emotionality of their content. Likewise the recent work of Garry Trudeau has chronicled the road to recovery following combat injuries with both humor and sensitivity. The current effort is aimed at providing authoring toolkits to allow Service members and Veterans to relate their own stories via a graphic novel/sequential art format of equally high quality.

The goal is to create web-based software with a simple interface that assists in both storytelling and graphical content creation that can relate experiences either directly or metaphorically. While providing simple-to-use authoring tools, the results should have the look and feel of a professional product and provide the flexibility of telling a wide range of stories. For example, content creation could relate to modern combat, historical combat, science fiction, or fantasy. But, the authoring tools MUST allow the user to draw from a library of artwork, icons, and other templates to assist them in telling a story related to combat experiences. The software tools must assist the user at every opportunity to tell a story and the end result should be a professional looking narrative comparable to the best graphic novels/sequential art. The tool should also include pre-prepared examples of full-stories that can be used for inspiration and guidance. Innovation is key to this program and software must be designed to inspire, encourage, and guide users in the development of their own storylines and to guide them to additional resources if they are interested in exploring and/or obtaining personalized support and services.

Proposals MUST reflect team expertise in developing professional narrative, especially web comics and/or graphic novels/sequential art. Preference will be given to teams who demonstrate expertise in content development, military expertise, and psychological health. One of the goals of this program is to determine the best way to use these narratives tools. Can they be a stand-alone resource? Can they be used as an aid to formal therapy? Is this approach safe and effective? Therefore, teams must be well-rounded.

Innovation in the program is seen in the areas of user-interface design, flexibility of tool to tell a wide-range of stories, and the quality of the artwork and storytelling produced by the tool. Metrics for success should be clearly specified and should take into account both usability and psychological health issues.

PHASE I: Develop a conceptual design and model key elements for art therapy and narrative authoring tools that will allow service members to tell their own stories related to deployment experiences in a simple, intuitive Web Browser based graphic novel/sequential art format. In preparation for Phase II, develop a robust methodology with clear metrics for assessing usability, user acceptance, and effectiveness of the web tool. It is important to note that there will be no human use testing in Phase I.

Test key hypotheses by developing, constructing, and testing prototype subsystems. Determine best methods for using the tool (online, integral part of therapy, or both). Phase I deliverables should include a Final Phase I report that includes: (1) a detailed design of the art therapy and storytelling therapy authoring tools with storyboards for user interface and design at a minimum, (2) experimental results from such toolsets, and (3) a Phase II plan.

PHASE II: Develop, demonstrate, and validate a proof of concept design of the web based art therapy and storytelling therapy authoring tools. Produce a prototype art therapy and storytelling therapy authoring tools on a standalone system with the expectations of integrating into a network deployable web based health care system to be identified at the Phase III timeframe. The required deliverable for Phase II will include: the prototype system, demonstration and testing of the prototype system, and a Final Report. The Final Report will include (1) a detailed design of the prototype art therapy and storytelling therapy authoring toolsets, (2) the experimental results from such toolsets, and (3) a plan for Phase III.

PHASE III: In Phase III, delivery of mature web based art therapy and storytelling therapy authoring tools that will allow service members to tell their own stories related to deployment experiences in a simple, intuitive Web Browser based graphic novel/sequential art format that would be delivered and integrated into a military medical health system would be expected.

Potential dual use of the toolset could be applied to the commercial medical health services for as useful techniques for helping “non-military” individuals traumatized by life experiences process memories and channel emotions through a healthy outlet. Tools can also be used to develop educational tools for children to include the development of language skills and narrative ability.

REFERENCES:

1. Andrews, D. H., T. d. Hull, et al. (2009). "Storytelling as an Instructional Method: Descriptions and Research Questions." The Interdisciplinary Journal of Problem-based Learning Vol. 3(No. 2): 18 pp.

2. Collie, K., A. Backos, et al. (2006). "Articles - Art Therapy for Combat-Related PTSD: Recommendations for Research and Practice." Art Therapy: Journal of the American Art Therapy Association 23(4): 8 pp.

3. Eisner, W. (1985). Comics & Sequential Art: Principles & Practice of the Worlds Most Popular Art Form, Expanded to include print and computer. Tamarac, FL, Poorhouse Press.

4. Eisner, W. (1996). Graphic Storytelling and Visual Narrative. Tamarac, FL, Poorhouse Press.

5. Goodman, A. (2010), Blazing Combat. Seattle, WA. Fantagraphics Books.

6. Haldeman, J. (1974). The Forever War, St. Martin's Press.

7. Haven, C. (2010). "Stanford Class Creates Graphic Novels, from Concept to Finished books." Stanford University News Retrieved 11-02-2010, 2010, from http://news.stanford.edu/news/2010/october/graphic-novel-project-102810.html.

8. Kurtzman, H. (2008). The EC Archives: Frontline Combat, York, PA. Gemstone Publishing.

9. McCloud, S. (1993). Understanding Comics: The Invisible Art. New York, HarperCollins Publishers, Inc..

10. Trudeau, G (2005), The Long Road Home, Andrews McMeel Publishing.

KEYWORDS: Graphic Novel, Sequential Art, Web, Therapy, Storytelling, Trauma, Life Experiences, Memories, Emotions, Combat Experiences, PTSD, psychological health, mental health

SB112-004 TITLE: SHIELD (Novel Techniques for the Synthesis of High Fidelity Social Network Data)

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: Develop scalable methods, tools and techniques to synthesize and validate high fidelity social network data. For the purpose of this topic, fidelity means degree of similarity between synthetic and real data. In particular, applications developed with high fidelity synthetic data must work on corresponding real data.

DESCRIPTION: In recent years, interest in social networks has dramatically increased. Massive amounts of social network data are being collected for military, government and commercial purposes. Much of this data is most naturally represented as rich graph structures, with many types of links connecting sets of entities in the graph where links and entities can have multiple attributes.

The availability of a wide range of social network data to the research community is essential for progress in the analysis of such data. Experience to date has shown that the development and evaluation of social applications can produce very different results depending on the social graphs used. However, in contrast to the need, there are only a small number of measurement-generated graphs available whose continued distribution and experimental use faces two significant challenges. First, owners of datasets are increasingly concerned about inadvertently revealing private information with their anonymized datasets. Recent work shows that malicious parties can recover information from anonymized graphs using various de-anonymization attacks. Given recent privacy compromises, these concerns act as a strong disincentive against sharing graph datasets. Second, the limited number of available graphs is insufficient to generate meaningful experimental results. Ideally, researchers would like to experiment with multiple real graphs with a wide variety of characteristics to produce statistically confident results.

While the use of synthetic data has its own challenges, it offers great opportunities. A user can flexibly control and rapidly and economically generate data sets with desired characteristics, size and quality (e.g., as measured by error characteristics). Such data can be published, and thus allows other researchers to repeat experiments and compare algorithms. Synthetic data can’t replace real data, but it can significantly lower the barriers to entry into research

requiring such data and provide the type of experimental control necessary to help establish a solid scientific foundation for such research.

DARPA is interested in "first principles" methods for generating high fidelity synthetic social networks that are based on integrating various real world data sets and using appropriate social and behavioral theories to infer the relational networks. These networks are labeled, dynamic and exhibit variability that reflects particular features of the entities and their relations being modeled. The key problem that proposals must address is that of creating a statistical/probabilistic description of a network which demonstrably captures its essential components relative to a given network analytical function. An additional complication concerning networks of interest to DARPA is that they are dynamic. Analytic functions of central importance rely on the ability to do and evaluate change detection. Network descriptions must, therefore, explicitly take temporal variation into account (e.g., using Markov Chains). Creating rigorous techniques for characterizing and validating the fidelity of the synthetic data is equally important.

PHASE I: Consider the following social network analytical functions:
1. Determine the number of users in specific subpopulations, e.g., in age ranges, locations, etc.
2. Determine the patterns of interaction and friendship, and which subpopulations are interacting? What is the amount and frequency of interaction? When is it occurring (time of day, day of week, month of year)?
3. Determine whether the graph of interactions can be partitioned with small cuts? E.g., are there few links between users from different departments in an organization? Can the graph structure be characterized into collections of sub-graph types and do the sub-graphs have identifiable properties?
4. Determine whether the interaction patterns change/grow over time? How is the distribution of interaction between subpopulations shifting over time?

• Task 1: For each of these functions, create a statistical/probabilistic time-varying description of a network which demonstrably captures its essential components relative to the function.
• Task 2: Use the results of Task 1 to design and implement algorithms for generating corresponding high fidelity synthetic graph data. Devise techniques to rigorously characterize and validate the fidelity of the data. Describe the real graph data sets that will be used for prototype development and testing. Note that the data sets used are the sole responsibility of the performers – the government will not supply any data.

PHASE II: Extend the work of Phase I to the following network analytical functions:
5. Determine what can be learnt about the use of applications (such as games) in the network? E.g., how does their popularity spread over time and is this correlated with friendship links?
6. Detect anomalies in the results from 1-5.

Develop and optimize, using analytic and computational techniques as appropriate, implementations of software prototypes developed for all analytical functions (1-6). Plan, design, construct, execute and evaluate verification and validation testing (evaluation methods and metrics) of developed software using real graph data that will supplied exclusively by the performer. Proposers should describe the types of data that they will provide and use to facilitate the development and evaluation of their proposed software. At the conclusion of Phase II algorithms and software should meet or exceed Transition Readiness Level 5 (System/subsystem/component validation in relevant environment).

PHASE III: In Phase III, delivery of mature software to targeted intelligence and military analysts is expected.

The techniques developed under this topic will also have direct applicability to a wide variety of commercial interests.

REFERENCES:
1. Barrett, C. L., Beckman, R. J., Khan, M., Kumar, V. S. A., Marathe, M. V., Stretz, P. E., Dutta, T., Lewis, B., "Generation and Analysis of Large Synthetic Social Contact Networks," Proceedings of the 2009 Winter Simulation Conference, Rossetti, M. D., Hill, R. R., Johansson, B., Dunkin, A., and Ingalls, R. G., eds.

2. Cormode, G., Srivastava, D., Bhagat, S., and Krishnamurthy, B., "Class-based Graph Anonymization for Social Network Data," VLDB '09, August 24-28, 2009, Lyon, France.

3. Musolesi, M., and Mascolo, C., "Designing Mobility Models based on Social Network Theory," ACM SIGMOBILE Mobile Computing and Communications Review, Vol. 11, Issue 3, July 2007.

4. Pudjijono, A. and Christen, P., "Accurate Synthetic Generation of Realistic Personal Information," in Advances in Knowledge Discovery and Data Mining, Lecture Notes in Computer Science, 2009, Volume 5476/2009, Springer.

5. Sala, A., Lili, L., Wilson, C., Zablit, R., Zheng, H., and Zhao, B. Y., "Measurement-calibrated Graph Models for Social Network Experiments," WWW 2010, April 26–30, 2010, Raleigh, North Carolina, USA.

KEYWORDS: Social network data, social network theory, synthetic graph data, privacy preserving graph data

SB112-005 TITLE: Improved Dried Biological Specimen Materials, Recovery and Processing for Diagnostics

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Military Health System, Defense Health Program, Defense Medical Research an

OBJECTIVE: To develop innovative methods, materials, and devices for improved collection, storage, material recovery and processing of dried biological specimens for diagnostics.

DESCRIPTION: Advances related to dried biological specimen analysis will enhance the utility of this method for point of need diagnostics and transport stability for further testing at higher complexity laboratories for clinical, population surveillance, or biomarker discovery and qualification research. Dried blood spot (DBS) samples are increasingly used in non-clinical drug development, newborn screening and therapeutic drug monitoring, and have demonstrated utility for blood sample transport from remote locations, simple stable storage and subsequent diagnostic analysis. Similarly, analyses have been demonstrated from other dried biological specimens, such as urine. Proposals are sought that will enhance the applicability of DBS samples and other dried biological specimen samples (e.g. urine, saliva, cerumen, feces) for DoD-relevant clinical analyses. Proposals may address all or one of the following aspects described below: 1) enhanced recovery of analytes, 2) improved materials for dried specimen cards, 3) automated processing of dried specimen samples—particularly if elements of integrated sample preparation are necessary to preserve the recovery of integrity of a given class of biomarker for later detection. Note that this research, especially the Phase I investigations, does not require use of patient-identified or disease-specific samples. Research could be performed using existing/exempt/synthetic samples, as appropriate for the proposed research and the performing institution. Proposers are encouraged to consider methods and technologies compatible with Clinical Laboratory Improvement Amendment (CLIA)-waived analysis, good laboratory practices (GLP), and good manufacturing practice (GMP) procedures.

1) Typically, blood is the biological sample of choice for diagnostics, collected invasively in milliliter volumes, and requiring temperature controlled storage conditions. DBS are a convenient method for blood microliter volume sample collection, shipping and environmentally permissive storage. Since a very small blood volume is collected, any loss of analyte during elution from the DBS card decreases probability of detection, decreasing the sensitivity of the analysis. Therefore, enhanced recovery methods would improve detection probabilities. In addition, other biological samples (urine, saliva, cerumen, feces) are available in larger volumes and/or may easier to collect. Clinical utility of such samples also depends on the analyte integrity and concentration available for detection. Therefore, proposals are sought that address enhanced recovery of clinically relevant analytes from dried specimens. Proposal may address one or more clinical specimen type. Proposals should address sample integrity and quantitative recovery of proteins, lipids, sugars, nucleic acids, and small molecules, and aim to minimize recovery volumes and processing steps. Elution methods that comply with GLP and could be incorporated in a CLIA-waived device or analyzed in a CLIA-certified laboratory are encouraged.

2) Improvements in dried biological specimen absorptive platform materials may also optimize performance. Advances such as new materials or modification of existing materials for improved performance may be proposed. Efforts should address quantifiable improvements to be demonstrated with the new materials, such as shortened

drying time, enhanced analyte stability/recovery (nucleic acids, proteins, lipids, sugars, and/or small molecules), or processing ease. Absolute dryness is not required; however, concentration of sample to a small volume that facilitates transport without cold storage or degradation is essential. Cost, shelf-life, and good manufacturing practice (GMP) procedures should be considered.

3) Dried biological specimen processing typically requires numerous manual sample preparation/processing steps. Technologies for automated processing of dried samples would reduce the level of operator skill required for analysis. Proposals should detail the methods to be used in the automated device and may address one or more biological specimen type. Quantitative recovery of proteins, lipids, sugars, nucleic acids, and small molecules is critical, and may be performed from separate dried specimen samples. Sample preparation methods must be compatible with standard post-processing analysis methods such as mass spectrometry, PCR assays, and immunoassays. Direct interface with analysis devices is encouraged. Device applicability to single patient and multi-patient sample processing should be described. Devices with potential for CLIA-waived or CLIA-moderate complexity compliance are encouraged.

PHASE I: 1) Initiate development of approaches for enhanced recovery of critical analytes from dried or preserved biological samples and demonstrate quantitative results using standard laboratory assays. The proposer should choose clinically relevant analytes that are currently challenging to recover due to low concentration in the specimen(s) (e.g., aM-pM) or degradation over time, and demonstrate an increased recovery of these analytes as compared to conventional methods. Proposers are also encouraged to demonstrate analyte recovery sufficient for analysis using partial dried specimen samples.

2) Initiate development of new materials. Demonstrate preliminary quantitative performance improvements using new materials for dried biological specimen absorptive platforms. Improvements may include decreased drying time, enhanced collection capability, enhanced analyte stability/recovery, or more facile processing of the dried or preserved sample.

3) Initiate development of automated sample processing technology of dried or preserved biological samples for purification of proteins, lipids, sugars nucleic acids, and/or small molecules. Consideration of integrated elements of sample preparation, if necessary to preserve integrity or stability, are encouraged. Analysis of processed samples should be demonstrated using standard analytical laboratory methods. Technology should be aimed at development of a CLIA-waived (preferred) or CLIA moderate complexity device, and a plan for interface with sample detection instrument(s) should be developed.

PHASE II: 1) Validate feasibility of the sample recovery method developed in Phase I with a practical protocol that can be used by minimally trained personnel. Provide a detailed plan for integrating the proposed method for processing and sample analysis post collection, with other requisite technologies for a point of need diagnostic device.

2) Demonstrate incorporation of the new material into dried or preserved biological specimen sample absorptive platforms. Evaluate performance including drying time, shelf-life and quantitative analyte recovery using standard detection methods. 6 months storage of blank cards and dried or preserved biological specimen samples on the new materials should be initiated within the two-year performance period and testing plans developed.

3) Demonstrate a complete sample preparation device for dried or preserved biological specimen samples and demonstrate equivalent or better clinical performance than achieved with manual preparation methods. Validation should quantify analyte recovery and purity using standard laboratory analyses. Technology interface with analysis methods should be described. Demonstration of direct interface is encouraged. Device potential for classification as a CLIA-waived (preferred) or CLIA moderate complexity device should be described.

PHASE III: The technology to be developed is applicable to deployable medical diagnostics. Transition customers include MHS DMRDP, MIDRP, DTRA, and JPEO-CBD.

There is a significant commercial market for medical diagnostics and analysis of samples from dried biological specimens. The developed technology would allow expansion of tests utilizing dried biological samples and any steps taken to achieve a CLIA-waiver would greatly facilitate transition to market.

REFERENCES:

1. CLIA: http://wwwn.cdc.gov/clia/regs/toc.aspx

KEYWORDS: Blood, dried blood spot, DBS, biological specimen, urine, feces, saliva, cerumen, point-of-care, diagnostics, CLIA-waived