NAVY
STTR 10.B PROPOSAL SUBMISSION

INTRODUCTION:

The responsibility for the implementation, administration and management of the Navy STTR program for this solicitation is with the Naval Air Systems Command (NAVAIR). The NAVAIR STTR Program Manager is Mrs. June Chan. If you have questions of a general nature regarding the Navy's STTR Program, contact Mrs. Chan (navair.sbir@navy.mil). For inquiries or problems with electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8AM to 5PM EST). For technical questions about a topic, contact the Topic Authors listed under each topic before **17 August 2010**. Beginning **17 August**, for technical questions you must use the SITIS system **www.dodsbir.net/sitis** or go to the DoD website at **http://www.acq.osd.mil/osbp/sbir/** for more information.

The Navy's STTR program is a mission-oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential, but primarily address the needs of the Navy. Companies are encouraged to address the manufacturing needs of the Defense Sector in their proposals. Information on the Navy STTR program can be found on the Navy STTR website at **http://www.onr.navy.mil/sbir.** Additional information pertaining to the Department of the Navy's mission can be obtained by viewing the website at **http://www.navy.mil.**

PHASE I PROPOSAL SUBMISSION:

Read the DoD front section of this solicitation for detailed instructions on proposal format, submission instructions and program requirements. When you prepare your proposal, keep in mind that Phase I should address the feasibility of a solution to the topic. The Navy only accepts Phase I proposals with a base effort not exceeding $70,000 and with the option not exceeding $30,000. The technical period of performance for the Phase I base should be 7 months. The Phase I option should be 3 months and address the transition into the Phase II effort. Phase I options are typically only funded after the decision to fund the Phase II has been made. Phase I technical proposals, including the option, have a 25-page limit (see section 3.4). The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. The Navy typically provides a firm fixed price contract or awards a small purchase agreement as a Phase I award.

All proposal submissions to the Navy STTR Program must be submitted electronically. It is mandatory that the **entire** technical proposal, DoD Proposal Cover Sheet, Cost Proposal, and the Company Commercialization Report are submitted electronically through the DoD SBIR/STTR Submission website at **http://www.dodsbir.net/submission**. This site will lead you through the process for submitting your technical proposal and all of the sections electronically. Each of these documents is submitted separately through the website. To verify that your technical proposal has been received, click on the "Check Upload" icon to view your uploaded technical proposal. If you have any questions or problems with the electronic submission contact the DoD SBIR Helpdesk at 1-866-724-7457 (8AM to 5PM EST). Your proposal **must** be submitted via the submission site before **6:00 a.m. EST, Wednesday, 15 September 2010**. An electronic signature is not required when you submit your proposal over the Internet.

Within one week of the Solicitation closing, you will receive notification via e-mail that your proposal has been received and processed for evaluation by the Navy. Please make sure that your e-mail address is entered correctly on your proposal coversheet or you will not receive a notification.

PHASE I ELECTRONIC SUMMARY REPORT:

In addition to the final report required in the funding agreement, all awardees must electronically submit a non-proprietary summary of that report through the Navy SBIR/STTR website. It must not exceed 700 words and should include potential applications and benefits. Submit the summary at **http://www.onr.navy.mil/sbir**, click on "Submission", and then click on "Submit a Phase I or II Summary Report". This summary will be publicly accessible via the Navy's Search Database.

PHASE II PROPOSAL SUBMISSION:

Phase II proposal submission is by invitation only. Only those Phase I awardees who achieved success in Phase I, measuring the results achieved against the criteria contained in section 4.3, will be invited to submit a Phase II proposal. If you have been invited to participate, follow the instructions provided in the invitation. The Navy will evaluate and select Phase II proposals using the evaluation criteria in the DoD solicitation. All Phase II proposals must be submitted electronically through the DoD SBIR/STTR Submission website.

Under the new OSD (AT&L) directed Commercialization Pilot Program (CPP), the Navy SBIR/STTR program will be structuring more of our Phase II contracts in a way that allows for increased funding levels based on the projects transition potential. This will be done through either multiple options that may range from $250K to $1M each, substantial expansions to the existing contract, or a second phase II award. For currently existing phase II contracts, the goals of the CPP will primarily be attained through contract expansions, some of which may significantly exceed the $750K recommended limits for Phase II awards not identified as a CPP project. All projects in the CPP will include notice of such status in their Phase II contract modifications.

All awardees, during the second year of the Phase II, must attend a one-day Transition Assistance Program (TAP) meeting. This meeting is typically held during the summer in the Washington, D.C. area. Information can be obtained at **http://www.dawnbreaker.com/navytap**. Awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

As with the Phase I award, Phase II award winners must electronically submit a Phase II summary through the Navy SBIR/STTR website at the end of their Phase II.

PHASE II ENHANCEMENT:

The Navy has adopted a New Phase II Enhancement Plan to encourage transition of Navy STTR funded technology to the Fleet. Since the Law (PL102-564) permits Phase III awards during Phase II work, the Navy may provide a one-to-four match of Phase II to Phase III funds that the company obtains from an acquisition program. Up to $250,000 in additional STTR funds for $1,000,000 match of acquisition program funding can be provided, as long as the Phase III is awarded and funded during the Phase II.

ADDITIONAL NOTES:

1. The Naval Academy, the Naval Postgraduate School and other military academies are government organizations and therefore do not qualify as partnering research institutions or subcontractors. In the special case of an otherwise qualifying proposal, if there is a compelling need for participation by such an institution, a request for a waiver of this regulation will be sent to the Small Business Administration (SBA); and the contract award will be contingent on the receipt of this waiver.

2. The Navy will allow firms to include with their proposals, success stories that have been submitted through the Navy SBIR website at **http://www.onr.navy.mil/sbir**. A Navy success story is any follow-on funding that a firm has received based on technology developed from a Navy SBIR or STTR Phase II award. The success stories should be included as appendices to the proposal. These pages **will not** be counted towards the 25-page limit. The success story information will be used as part of the evaluation of the third criteria, Commercial Potential (listed in Section 4.2 of this solicitation) which includes the Company's Commercialization Report and the strategy described to commercialize the technology discussed in the proposal. The Navy is very interested in companies that transition SBIR/STTR efforts directly into Navy and DoD programs and/or weapon systems. If a firm has never received a Navy SBIR/STTR Phase II it will not count against them.

3. Any contractor proposing research that requires human, animal and recombinant DNA use is advised to view requirements at website **http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections.aspx**. This website provides guidance and notes approvals that may be required before contract work may begin.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria must be met or your proposal will be REJECTED.

____1. Make sure you have added a header with company name, proposal number and topic number to each page of your technical proposal.

____2. Your complete STTR Phase I proposal (coversheet, technical proposal, cost proposal, and DoD Company Commercialization Report) has been submitted electronically through the DoD submission site by 6:00 a.m. EST, Wednesday, 15 September 2010.

____3. After uploading your file and it is saved on the DoD submission site as a PDF file, review it to ensure that it appears correctly.

____4. The Phase I proposed cost for the base effort does not exceed $70,000. The Phase I Option proposed cost does not exceed $30,000. The costs for the base and option are clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.

NAVY STTR 10.B Topic Index

NAVY STTR 10.B Topic Descriptions

N10B-T046 TITLE: Bioengineering of Organisms for the Selective Production of High Density Hydrocarbon Fuel Precursors

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

OBJECTIVE: Develop a bioengineering route for the selective formation and isolation of high density fuel precursors.

DESCRIPTION: Liquid, high density tactical fuels (e.g. JP-10, RJ-5) are composed of multicyclic, or cagelike molecules that allow for high density mixtures while maintaining good cold flow properties. Although a considerable amount of research is currently devoted to the development of renewable fuels as gasoline, diesel, or JP-8 replacements, virtually no research is being conducted on the development of high density fuels for missile propulsion, or as components of other renewable fuel mixtures to improve key performance characteristics. Bioengineering provides an elegant route for the isolation of high density fuel precursors as it has the potential to convert low value feedstocks such as cellulose into complex, high value molecules with specific properties.

The proposed approach must utilize bioengineered microorganisms to efficiently produce dense liquid hydrocarbons from cellulose or cellulose hydrolysis products. The hydrocarbons should have a density greater than 0.94 g/mL when fully saturated or must have the potential to be chemically converted to molecules with this density. Examples of promising targets for fuel precursors are molecules such as a- and ß-pinene, and cyclooctatetraene, but any molecule that can be directly converted into a liquid, high density fuel will be considered. Final fuel mixtures must contain only carbon and hydrogen, have net heats of combustion >142,000 btu/gal, and have freezing/pour points < -30 °C. The approach should be scalable, require modest energy inputs, and have the ability to be run in a continuous or semi-continuous fashion with concomitant separation of the product stream. The isolated product must be relatively pure (>90%) and require minimal processing prior to conversion to a fuel mixture.

PHASE I: Demonstrate the feasibility of a biological route to produce high density hydrocarbons from cellulose or cellulose surrogates. Characterize overall efficiency of the biomass conversion process with an emphasis on energy balance. Provide samples (ca. 1 mL) for the Navy to confirm that the product stream is suitable for conversion to a high density fuel mixture.

PHASE II: Optimize the process and extend feedstock to waste biomass. Scale-up the laboratory approach to pilot plant scale (20-100 gal). Provide samples to the Navy for evaluation.

PHASE III: Develop a commercial process for the conversion of waste biomass to high density fuel.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to its military market, high density fuel precursors would have applications in the fine chemical, perfume, and pharmaceutical industries.

REFERENCES:
1. Harvey, B. G., Wright, M. E., Quintana, R. L. (2010). High Density Renewable Fuels Based on the Selective Dimerization of Pinenes. Energy Fuels, 24(1), 267-273.

2. Stinson, M., Ezra, D., Hess, W. M., Sears, J., Strobel, G. (2003, October). An Endophytic Gliocladium sp. of Eucryphia Cordifolia Producing Selective Volatile Antimicrobial Compounds. Plant Science, 165(4), 913-922.

3. Burdette, G. W., Lander, H. R., McCoy, J. R. (1978). High-Energy Fuels for Cruise Missiles. Energy, 2, 289.

KEYWORDS: High Density Fuel; Bioengineering; Pinenes; Cyclooctatetraene; Bioreactor; Renewable Fuel

N10B-T047 TITLE: Innovative Methods for the Conversion of Biomass to Short Chain Alkenes for the Production of Renewable Jet Fuels

TECHNOLOGY AREAS: Air Platform, Information Systems, Materials/Processes

OBJECTIVE: Develop an efficient process for the conversion of biomass to short chain alkenes.

DESCRIPTION: A variety of approaches are currently under investigation for the conversion of biomass to fuels. The two most commonly explored methods are based on hydrolysis/fermentation, and pyrolysis. In the first method, acid hydrolysis followed by fermentation can directly produce alcohols such as ethanol and butanol. However, the conversion of cellulose to sugars suitable for fermentation is complex and expensive, and the product alcohols are unsuitable for applications as jet fuels due to their low net heats of combustion and high volatilities. The second method employs pyrolysis of biomass which typically produces complex oxygenated mixtures that require energy intensive post processing to remove oxygen, decrease acidity, and allow for their use in conventional engines. Biomass can also be pyrolyzed to produce synthesis gas, followed by Fischer-Tropsch catalysis to produce saturated hydrocarbon fuels, but this process typically produces a broad distribution, is energy intensive, and can require significant reforming to produce military relevant fuels.

Innovative methods are sought for the production of short chain olefins directly from biomass. Successful approaches will allow for the use of abundant renewable feedstocks for the production of saturated branched chain hydrocarbon mixtures that can be tailored to military specifications. Anticipated technical challenges include overcoming the recalcitrance of cellulose to hydrolysis, the difficulty in bioengineering microorganisms to produce specific short chain olefins, and the challenge of producing an efficient, continuous, and high throughput system.

The proposed approach should utilize a low energy, bioconversion route (microorganisms or yeast) to efficiently produce a specific short chain olefin or mixture of olefins (e.g. ethylene, propylene, butylenes, pentenes) from cellulosic or lignocellulosic feedstocks. Other approaches such as catalyzed pyrolysis or multistage catalytic processes will also be considered. The distribution of olefins can vary over a wide range, however, propylene and butylenes are the preferred products. Particular attention should be paid to the efficiency of the process, taking into account energy inputs and biomass treatment steps. The product stream should primarily consist of short chain olefins, although significant amounts of saturated hydrocarbons can be tolerated. Product streams with considerable amounts of oxygenated compounds (alcohols, carboxylic acids, ethers, etc.) are unsuitable for further applications.

PHASE I: Demonstrate the feasibility of an efficient process for the conversion of waste biomass or biomass surrogates to a short chain alkene or mixture of alkenes. Provide samples (ca. 1 g) for the Navy to confirm that the product stream is suitable for conversion to jet fuel.

PHASE II: Scale-up laboratory process to pilot plant scale (50-250 kg) and extend the approach to conventional waste biomass. Tailor the process to produce a preferred distribution of alkenes. In collaboration with the Navy, produce sample fuels from the product stream and confirm that these fuels meet specifications for JP-5.

PHASE III: Develop a commercial process for the conversion of waste biomass to a JP-5 equivalent fuel.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: In addition to its military market, there is an enormous commercial market for short chain olefins as precursors to fuels, polymers, commodity chemicals, and pharmaceuticals.

REFERENCES:
1. Wright, M. E., Harvey, B. G., & Quintana, R. L. (2008). “Highly Efficient Zirconium-Catalyzed Batch Conversion of 1-Butene: A New Route to Jet Fuels." Energy Fuels 22 (5) 3299-3302.

2. Sardesai, A., Lee, S. (2005, March 6). "Alternative Sources of Propylene." Energy Sources. 27(6), 489-500.

3. Mentzel, U. V., Shunmugavel, S., Hruby, S. L., Christensen, C. H., & Holm, M. S. (2009). "High Yield of Liquid Range Olefins Obtained by Converting i-Propanol over Zeolite H-ZSM-5." J. Am. Chem. Soc. 131(46) 17009-17013.

KEYWORDS: Alternative Fuels; Renewable Fuels; Biomass Conversion; Catalysis; Olefin Production; Alkene Production

N10B-T048 TITLE: High Voltage, Lightweight, Conformal, Integrated, Photovoltaic Modules for Unmanned Aerial Vehicles (UAVs)

TECHNOLOGY AREAS: Air Platform, Materials/Processes

OBJECTIVE: Develop and demonstrate an integrated photovoltaic (PV) module for Unmanned Aerial Vehicle applications

DESCRIPTION: Unmanned Aerial Vehicles (UAV) are primarily used for military applications which include both reconnaissance and attack missions. A major problem for electrically powered UAVs is limited mission longevity caused by re-chargeable battery systems. Most UAVs that are currently in use are electrically powered and typically use a collection of lithium-based batteries. Advantages of Li-ion batteries are high energy storage densities (in the range 140-160 W A hr/kg), high performance, and ready availability. Intrinsic limitations such as having to dismount the battery unit for charging via an external source, and battery weight and weight distribution are factors that reduce mission longevity.

The purpose of this STTR effort is to develop an integrated thin-film photovoltaic module that is conformal, lightweight and provides an electric power source for small UAVs such as the Raven. If successful, these PV modules should extend mission longevity by providing an energy source, possibly reduce the weight of air platforms (i.e. UAVs), and reduce battery charging constraints.

Proposed systems should be highly conformal (i.e.10-20% stretchable and flexible to a radius of curvature <8 mm) and provide sufficient energy output to replace current lithium ion polymer battery (~ 4 ampere hours capacity, 25 VDC and 100Whr power output). Thin-film solar cells composed of Silicon, Gallium Arsenide, Organic are likely candidates, but others would be considered provided that the resulting system can be conformally wrapped around curvilinear and non-curvilinear surfaces (i.e., ellipsoid surfaces), and are lightweight (<0.25 lbs). Ideally, the resulting system would be of such light weight that it would substantially reduce the weight and improve weight distribution (i.e. aerodynamics) of current UAV designs. In addition, proposed photovoltaic modules should be thin (<80 microns thick), be able to cover a large area (~0.2 m2) and show > 10% solar efficiency. A successful outcome at the end of this project is to develop and demonstrate a conformal integrated photovoltaic module charging system for powering small UAVs.

PHASE I: Demonstrate a thin-film photovoltaic module with 10% solar efficiency, >10 % mechanical stretchability, high voltage output (> 25V) over an area of 1 cm x 1 cm. Identify a plan for and possible routes for achieving the desired performance metrics for replacing Li-ion polymer batteries.

PHASE II: Scale up fabrication of high quality photovoltaic modules to one square meter and demonstrate electrical performance under ideal (Air Mass 1.5 illumination) and non-ideal conditions. Integrate cells with UAV and provide high quality photovoltaic modules for testing.

PHASE III: Conduct field testing to demonstrate and validate the conformal photovoltaic module. Transition and integrate the system for small UAV applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The development of conformal, lightweight PV modules is not limited to only military applications/market. Commercial applications could include portable power for wearable electronics, cell phones, sun umbrellas and vehicles.

REFERENCES:

1. Kim J. Y., et al. (2007, July 13). Efficient Tandem Polymer Solar Cells Fabricated by All-Solution Processing. Science, 317(5835), 222-225.

2. Kim, D.H., Ahn, J.H., et al. (2008, April 25). Stretchable and Foldable Silicon Integrated Circuits. Science. 320(5875), 507-511.

3. Baca, A.J., et al. (2009). Compact Monocrystalline Silicon Solar Modules with High Voltage Outputs and Mechanically Flexible Designs. Energy Environ, 3, 208-211. DOI: 10.1039/b920862c.

KEYWORDS: Photovoltaics; Flexible Photovoltaics; Unmanned Aerial Vehicles; Portable Power Sources; Organic Solar Cells; Wearable Electronics

N10B-T049 TITLE: Expanding Helicopter Pilots Field of View with Spherical Sensing

TECHNOLOGY AREAS: Air Platform, Human Systems

OBJECTIVE: Reduced visual hardware requirements on aircraft and simulators, while significantly enhancing pilot situation awareness.

DESCRIPTION: The restricted fields of view (FOV) that are provided by night vision devices (NVDs) are an increasingly important performance limitation for rotary wing aviation. The normal human FOV spans roughly 200° laterally and 135° vertically [1]. However, current NVDs typically provide a much smaller FOV. For example, the AN/AVS-9 provides a 40° spherical FOV. This FOV restriction limits pilot situation awareness (SA) and has been identified as a causal factor in numerous aviation mishaps [2]. Expanding the FOV provided by aviation NVDs should improve both safety and mission effectiveness.

Hardware limitations of current image-intensifier tubes are one major reason for the small FOV of current NVDs. Because of rectilinear optics, each tube itself has a limited FOV. Solutions attempting to create NVD systems with larger FOVs by combining multiple tubes have resulted in substantial increases in the weight, bulk, and price. Wide angle lenses, which provide spherical views, can increase the FOV provided to a single sensor and potentially do so without the drawbacks of multiple tube systems. However, the images provided by such systems are distorted, especially toward the periphery. Consequently, although lenses that provide FOVs of 180° or more are common for static applications such as security cameras, their use as visual aids in dynamic settings has been quite limited to date.

An innovative spherical sensing system for use by helicopter pilots that provides a spherical FOV of at least 200° is sought. The spherical sensor should affix to an existing Night Vision Goggle (NVG) in order to increase the FOV of the NVG. Materials should be selected to reduce the overall weight of the spherical sensor.

PHASE I: Design a concept for a spherical view NVG with a FOV of at least 200°. Develop a test plan that outlines how the proposed system will be demonstrated to be safe and effective for use by helicopter pilots under operational conditions. The test plan should contain provisions for documentation of the training necessary for pilots to adapt to any unusual visual features of the display and the duration and severity of after effects of using the system.

PHASE II: Build a demonstration prototype NVD system and conduct controlled, ground-based experiments to investigate its safety and utility in dynamic environments.

PHASE III: Build a flight-worthy NVD system and demonstrate its safety and effectiveness in rotary wing flight.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would have non-military applications as well. For example, the enhanced situation awareness that would be provided by the increase in FOV could potentially aid navigation systems as well as endoscopic cameras for invasive surgical applications.

REFERENCES:
1. Spalton, D.J., Hitchings, R.A., & Hunter, P.A. (1994). Atlas of Clinical Ophthalmology (2nd Ed.). London: Harcourt.

2. Braithwaite, M. G., Douglass, P. K., Durnford, S. J., and Lucas, G. (1998). The hazard of spatial disorientation during helicopter flight using night vision devices. Aviation, Space, and Environmental Medicine, 69, 1038-44.

KEYWORDS: Night Vision Devices; Night Vision Goggles; Field-of-View; Wide Field-of-View; Situation Awareness; Safety

N10B-T050 TITLE: <u>Innovative Concepts for Lightweight Composite Sandwich Systems for Complex Shapes</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes

OBJECTIVE: Develop innovative concepts for a lightweight composite sandwich for complex shapes.

DESCRIPTION: Lightweight, structurally efficient construction is integral to reducing weight in a military aircraft. Current designs rely heavily on metallic and non-metallic honeycomb sandwiches due to their high stiffness and strength to weight ratio. However, honeycomb sandwiches are difficult to fabricate over complex contours such as doubly curved surfaces and saddle shapes. In addition honeycomb structures are prone to water ingress resulting in performance degradation. An alternate material, which would be as lightweight as a honeycomb yet can be used to fabricate contoured surfaces, is greatly needed.

Innovative concepts for composite sandwiches material systems are sought. Proposed approaches should be more structurally efficient, conformable, durable, repairable, damage tolerant, and environmentally insensitive compared to a Kevlar honeycomb core. In addition, resulting sandwiches should be light-weight, affordable to manufacture and fabricate, and easy to maintain.

PHASE I: Develop an innovative concept for the described sandwich material system. Identify an aircraft component that can be manufactured using the new material. Define the design parameters and establish feasibility.

PHASE II: Fully develop the concept identified into a prototype sandwich system. Develop design optimization rules, generate material allowables, and manufacturing guidelines to design and fabricate the previously identified aircraft component using the new material.

PHASE III: Develop a plan and implement the transition of the SBIR technology to both military and civilian sectors.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Light weight sandwich system can be directly inserted as honeycomb replacement in civilian rotorcraft and fixed wing aircraft.

REFERENCES:
1. Thomsen et. al. editors, (2005). Proceedings from the 7th International Conference on Sandwich Structures: Sandwich Structures 7 :Advancing with Sandwich Structures and Materials. Aalborg University, Aalborg, Denmark, 29-31.

2. Gardiner, G. (2006). Engineered to Innovate: Core materials — and the ways they are used — evolve to meet new challenges. High Performance Composites: http://www.compositesworld.com/articles/engineered-to-innovate.

KEYWORDS: Sandwich; Conformable; Complex Shape; Honeycomb Replacement; Composite Design; Composite Manufacture