OSD DEPUTY DIRECTOR OF DEFENSE RESEARCH & ENGINEERING SMALL BUSINESS INNOVATION RESEARCH PROGRAM

PROGRAM DESCRIPTION

Introduction

The United States Special Operations Command (USSOCOM), the Army Medical Command and the Naval Sea Systems Command, hereafter referred to as a DoD Component acting on behalf of the Office of Technology Transition in the Office of the Director, Defense Research and Engineering, invites small business firms to submit proposals under this program solicitation entitled "Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in this section and with the ability to commercial the results are encouraged to participate. Subject to availability of funds, DoD Components will support high quality research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector.

Objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research and development results.

The DoD Program presented in this solicitation strives to encourage technology transfer with a focus on advanced development projects with a high probability of commercialization success, both in the government and private sector. The guidelines presented in the solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

Three Phase Program

Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR Program and will typically be one half-person year effort over a period not to exceed six months. Proposals should concentrate on that research and development which will significantly contribute to proving the scientific and technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. The measure of Phase I success includes evaluations of the extent to which Phase II results would have the potential to yield a product or process of continuing importance to DoD and the private sector. Proposers are encouraged to consider whether the research and development they are proposing to DoD Components also has private sector potential, either for the proposed application or as a base for other applications. If it appears to have such potential, proposers are encouraged, on an optional basis, to obtain a contingent commitment for private follow-on funding to pursue further development of the commercial potential after the government funded research and development phases.

Subsequent Phase II awards will be made to firms on the basis of results from the Phase I effort and the scientific and technical merit of the Phase II proposal. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research and development effort and is expected to produce a well defined deliverable product or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, the small business is expected to use non-federal capital to pursue private sector applications of the research development. Also, under Phase III, federal agencies may award non-SBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies. This solicitation is designed,

in part, to encourage the conversion of federally sponsored research and development innovation into private sector applications. The federal research and development can serve as both a technical and pre-venture capital base for ideas which may have commercial potential.

This solicitation is for Phase I proposals only. Any proposal submitted under prior SBIR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior SBIR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in this section.

For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts, and have successfully completed their Phase I efforts, will be considered. DoD is not obligated to make any awards under either Phase I, II, or III. DoD is not responsible for any money expended by the proposer before award of any contract.

The Fast Track provisions in section 4.0 of this solicitation apply as follows. Under the Fast Track policy, SBIR projects that attract matching cash from an outside investor for their Phase II effort have an opportunity to receive interim funding between Phases I and II, to be evaluated for Phase II under an expedited process, and to be selected for Phase II award provided they meet or exceed a threshold of "technically sufficient" and have met their Phase I technical goals, as discussed Section 4.5. Under the Fast Track Program, a company submits a Fast Track application, including statement of work and cost estimate, within 120 to 180 days of the award of a Phase I contract. Also submitted at this time is a commitment of third party funding for Phase II. Subsequently, the company must submit its Phase I Final Report and its Phase II proposal no later than 210 days after the effective date of Phase I, and must certify, within 45 days of being selected for Phase II award, that all matching funds have been transferred to the company. On average, the company will receive phase II contract awarded within an average of five months from the end of Phase I.

Follow-On Funding

In addition to supporting scientific and engineering research and development, another important goal of the program is conversion of DoD-supported research and development into commercial products. Proposers are encouraged to obtain a contingent commitment for private follow-on funding prior to Phase II where it is felt that the research and development has commercial potential in the private sector. Proposers who feel that their research and development have the potential to meet private sector market needs, in addition to meeting DoD objectives, are encouraged to obtain non-federal follow-on funding for Phase III to pursue private sector development. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent upon the DoD supported development meeting some specific technical objectives in Phase II which if met, would justify non-federal funding to pursue further development for commercial purposes in Phase III. Note that when several Phase II proposals receive evaluations being of approximately equal merit, proposals that demonstrate such a commitment for follow-on funding will receive extra consideration during the evaluation process. The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies stated elsewhere in this solicitation.

Contact with DoD

General informational questions pertaining to proposal instructions contained in this solicitation should be directed to the point of contact identified in the topic description section. Proposals should be mailed to the address identified for this purpose in the topic description section. Oral communications with DoD personnel regarding the technical content of this solicitation during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness.

Proposal Submission

Proposals shall be submitted in response to a specific topic identified in the following topic description sections. The topics listed are the only topics for which proposals will be accepted. Scientific and technical information assistance may be requested by using the DTIC SBIR Interactive Technical Information System (SITIS).

OSD DEPUTY DIRECTOR OF DEFENSE RESEARCH & ENGINEERING

FY 1998 Topic Descriptions

United States Special Operations Command (USSOCOM) Topics

Technology Focus Areas: Special Operations Biomedical; Sensors & Information Technology; and Materials Technology.

SOCOM has identified the following 8 technical topics:

Biomedical Technology:	OSD98-025	Casualty Retrieval Device
Sensors & Information Technology :	OSD98-026	Electronically Scanned Phased Array Antenna
	OSD98-027	Stand-Off Tag Emplacement
	OSD98-028	Database Conversion Software
	OSD98-029	Examination of Emerging Haptic Tactor Technology
	OSD98-030	Small Craft Vision Enhancement/Situation Awareness
	OSD98-031	Affordable Millimeter Wave Electronic Technology
Materials Technology:	OSD98-032	Lightweight, Portable, Blast-Resistant Barriers

The topics were initiated by the United States Special Operations Command's (USSOCOM's) technical offices that manage the research and development in their areas. Scientific and technical information assistance may be requested by using the DTIC SBIR Interactive Technical Information System (SITIS).

Send all proposals (original plus 3 copies) for topics OSD98-025 through 032 directly to the following address:

United States Special Operations Command
Attn: SOAL-KB/SBIR Program, Topic Nr. OSD 98-0___
2408 Florida Keys Avenue, 2nd Floor
MacDill Air Force Base, Florida 33621-5316

Proposals will be distributed to the appropriate technical office(s) for evaluation.

Inquires of a general nature or questions concerning the administration of the SBIR Program should be addressed to :

United States Special Operations Command
Attn: SOSB/Ms. Karen L. Pera
7701 Tampa Point Blvd.
MacDill Air Force Base, Florida 33621-5316
(813)828-9491

General technical questions should be addressed to Dave Saren (813)828-9363.
USSOCOM offers information on the Internet about its SBIR program on the SOAC Home Page at http://www.soac.hqsocom.mil.

TECHNOLOGY FOCUS AREA: Biomedical

OSD 98-025 TITLE: Casualty Retrieval Device

TECHNOLOGY: Biomedical

OBJECTIVE: Develop a casualty retrieval device for safer retrieval and extraction of battlefield casualties.

DESCRIPTION: Casualty retrieval is a high-risk operation, and will be even more so in the future characterized by increased operations in urban terrain. Studies show that 10% of battlefield injuries are received while attempting to render aid to other casualties. The purpose of this effort is to develop a casualty retrieval device for ground forces. The item would allow casualty retrieval from a safe location and distance. One concept could be a munition deployed net. The item should have the following objective characteristics:

a. Single or multiple use (i.e., reusable).
b. Lightweight - Less than 1kg for a single use device. Less than 2 kg for a multi-use device.
c. Capable of engaging and retrieving a casualty and his/her load bearing equipment weighing less than or equal to 120 Kg over a distance of 25 meters. It would be desirable for this device to also work when the casualty is in the water, and for this device to be capable of lifting the entire weight of the casualty (with gear) vertically (i.e. up walls, ravines, etc.)
d. Reliability, durability, and affordability will be additional considerations.

PHASE I: Develop alternative design and employment concepts. Consideration should be given to currently available equipment that might be utilized in concert with or to facilitate the operation of this item. Technologies of interest include those supporting non-lethal munitions, mine/countermine equipment, and unmanned platforms. In addition, present combat casualty retrieval and care procedures should be considered.
PHASE II: Fabricate and test selected design(s). Prepare for and support limited special operations forces (SOF) field evaluations, and incorporate resulting design modifications.

PHASE III DUAL USE APPLICATIONS: This device could be employed during disaster relief, police, and rescue operations. It could also be used by government and industry to retrieve high-value items from hazardous environments.

REFERENCES:
1) Fire in the Streets. The Battle for Hue, Tet 1968 by Eric Hammel
2) "Blackhawk Down" by Mark Bowden, in the Philadelphia Enquirer available at http://www3.phillynews.com.3

TECHNOLOGY FOCUS AREA: Sensors & Information Technology

OSD 98-026 TITLE: Electronically Scanned Phased Array Antenna (ESA)

TECHNOLOGY: Sensors

OBJECTIVE: Develop a low cost and lightweight ESA for rotary wing and tilt-rotor aircraft.

DESCRIPTION: It would be highly desirable for military aircraft to utilize low-power radar when operating in all-weather conditions and low altitudes. The problem with this class of radar is that it requires a large antenna to receive an acceptable return to conduct operations. While such an antenna is acceptable for fixed wing aircraft, it is not for rotary and tilt-rotor aircraft because of on-board size and weight constraints. An antenna that is both small enough to fit aboard rotary and tilt-rotor aircraft, and large enough to facilitate the necessary return is not currently available. Electronically scanning antenna (ESA) technology could provide the solution to this requirement. The intent of this project is to develop a lightweight, low cost ESA that will allow incorporation of low-power coherent type radar systems on-board rotary and tilt-rotor aircraft, and at the same time significantly decrease the support cost for radar systems on-board rotary aircraft.
PHASE I: Identify and assess processes to develop a low ESA that can address the small size and weight requirements of helicopters and tilt-rotor aircraft. Develop a brassboard system and conduct a laboratory demonstration.
PHASE II: Demonstrate the capability to conduct all-weather and low-altitude flight with the prototype antenna aboard a military rotary wing aircraft.

PHASE III COMMERCIAL POTENTIAL: A small lightweight low cost ESA would allow use of coherent radar on many small platforms. This could eliminate the modification of the airframe for some aircraft, and increase the reliability of the radar system simultaneously. Specifically, this program could be applied to both large commercial airlines, resulting in reduced

weight and increased reliability of the antenna thereby reducing cost, and providing a navigation capability for smaller aircraft that currently is not available.

REFERENCES:
1) "Rotman Lens Offers Inexpensive, Electronically Scanned Antenna", by John Toon, available at http://www.gtri.gatech.edu/rh-sf96/rotman.htm
2) "Phased Array Antenna Technology", author unknown, available at http://www.achq.dnd.ca/cfsas/parray.htm

OSD 98-027 TITLE: Stand-Off Tag Emplacement

TECHNOLOGY: Sensors & Information Technology

OBJECTIVE: Develop the ability to place tracking devices on objects and individuals remotely.

DESCRIPTION: While tagging and tracking technologies are progressing for both military and commercial purposes, the ability to affix or emplace tags remotely has not been addressed. There is a need for the capability to emplace tagging/tracking devices remotely and clandestinely, which would be useful in secure, hazardous, or denied environments. The purpose of this SBIR effort would be to develop tag emplacement concepts and associated equipment. The optimum emplacement concept will probably limit and might define the tagging/tracking technologies that can be utilized, so a systems level approach to development and testing must be used. A system is desired that can be employed (i.e., emplaced and monitored) to track high value assets inside buildings and outdoors, and in all types of weather and terrain, while allowing operators to remain safe distances away.

PHASE I: Survey ongoing tagging/tracking initiatives in industry and government and develop employment concepts that are consistent with SOF operating procedures. This includes conceptualizing equipment/procedures for emplacing tags, as well as the tags and monitoring equipment itself. Consideration must be given to keeping all aspects of the tagging/tracking procedures from detection. Phase I will culminate in a recommendation of optimal concepts for prototyping and testing in Phase II.

PHASE II: Will include prototype development and laboratory and limited field testing, and culminate in delivery of a system-level design.

PHASE III DUAL USE APPLICATIONS: This system would have wide application throughout government and industry for the tracking and protection of high-value assets.

REFERENCES:
1) Hunter-Warrior Warfighting Experiment presentation, available at http://208.198.29.7/cwl-main/html/sld001.htm
2) Unattended Ground Sensors Advanced Concept Technology Demonstration program description, available at http://www.acq.osd.mil/at/ugs.htm

TECHNOLOGY FOCUS AREA: Computing and Software

OSD 98-028 TITLE: Database Conversion Software

TECHNOLOGY: Computing and Software

OBJECTIVE: Develop a process which converts native format databases to other formats with little or no loss of resolution.

DESCRIPTION: Special Operations Forces use a variety of mission planning and mission rehearsal tools which depend on imagery based or partially imagery based terrain databases to provide a 3D visualization of the environment in which the mission is to be carried out. There are several database generation facilities that provide products. Some facilities are USSOCOM activities. However, there are other facilities that are not controlled by USSOCOM, which provide products in different formats. The conversion of databases from one format to another currently requires separate converters for each format. Our requirement is that industry provide a process, mechanism or other approach, which enables multiple 'run time" data basis to be developed for a unique platform from a single original source data base and that this process be accomplished rapidly with minimal manual interaction and without loss of geo-spatial fidelity. This will significantly expand the utility of current rehearsal devices. Further, it will enhance the ability to rehearse the time sensitive missions by expanding the terrain available on short notice.

PHASE I: Investigate technologies and demonstrate the ability to import and export databases between at least two formats commonly used by USSOCOM mission rehearsal devices.

PHASE II: Expand the prototype to address the other formats used by the primary database generation facilities used by USSOCOM.

PHASE III DUAL USE APPLICATIONS: Dual use applications abound for extracting and processing information from non-native databases. Government applications within and external to DOD include exchange of programmatic and technical information. In particular, this would be an extremely useful adjunctive capability for web crawling and sentinel programs that extract information from internet-accessed databases without human intervention. Presently, this type of information is extracted in many different formats and stored, or only processed to a rudimentary level, before human intervention is required. This limits the efficiency and utility of these programs.

TECHNOLOGY FOCUS AREA: Sensors

OSD 98-029 TITLE: Examination of Emerging Haptic Tactor Technology

TECHNOLOGY: Sensors

OBJECTIVE: This effort is directed at emerging technologies that are adaptable to providing haptic cues to military personnel operating in various environmental conditions. The objective is to produce tactors with improved characteristics in the following areas: (1) miniaturization, (2) variable tactile sensor strength (frequency and amplitude modulation), (3) robustness (shock and vibration), (4) waterproofing, (5) reliability, (6) produceability, and (7) magnetic signature. A successful development program will include the achievement of the following technical objectives:

a. Demonstration of tactors that provide adequate haptic cues that are at a minimum twice as small as existing tactors, exhibit no (goal) electromagnetic signature, are waterproof and operational to depths of 66 fsw and altitudes to 35,000 ft., and at ambient temperatures ranging from 0^{o} C. to 33^{o}C.

b. Demonstrate reliability and durability greater than present day tactors.

DESCRIPTION: Tactor research is a one element of a larger program referred to as the Tactile Situation Awareness System (TSAS). The initial objective of the TSAS program was to decrease spatial disorientation accidents in the aviation community. Several studies concluded that human-factors problems accounted for the bulk of aircraft mishaps, and that spatial disorientation was the most significant human-factors problem both in terms of material and personnel losses as well as mission degradation. The 1990 Naval Research Advisory Committee Panel on Aviator Physical Stress concluded that "current displays are not adequate to prevent spatial disorientation mishaps. It is imperative that research and development be focused to ensure introduction of improved displays, controls and decision aids to reduce pilot workload." Subsequent research demonstrated that tactile displays can be an effective method of reducing or eliminating spatial disorientation, as well as providing an alternative method of receiving information from typical visual or auditory displays. This technology is now being applied to enhance navigation, communication, and warning controls and indicators for air, surface, and subsurface Special Operations missions. Another application that is under investigation is the use of tactile technology to stimulate motion sensations in non-motion based training simulators.

The principle of TSAS technology is relatively simple. Inputs provided from a source such as navigation equipment (GPS, Loran, inertial navigation systems, etc.,), gyroscopes, altimeters, accelerometers, communication devices, pressure gauges, alarms, indicators, etc., are processed by a small computer and converted into outputs that control the activation of tactors placed against the skin of an operator. The tactors provide electrical or mechanical stimulus (vibration) that is sensed by the operator. These sensations are cues for operator action. As an example, a diver receives a vibration on the left side of his/her body indicating that they are off-track of a predetermined navigation course. The diver swims in the direction of the vibration (to the left) until the vibration stops indicating they are back on course. The need for a visual display for the diver navigation has been eliminated resulting in less visual and mental workload for the diver.

A TSAS laboratory system has been developed in a collaborative effort between the Naval Aerospace Medical Research Laboratory (NAMRL), Pensacola, FL and the Coastal Systems Station (CSS), Panama City, FL. One of the many purposes of this laboratory system is to develop computer generated graphical simulations so that the feasibility of applying tactile technology to SOF/DoD operational areas can be evaluated. Simulations of high speed surface craft navigation, underwater mine search, aircraft navigation and maneuvering, and space shuttle docking have been developed and demonstrated. Selected technologies have then been transferred from the laboratory system to operational equipment. In FY 97 TSAS technology was successfully demonstrated by hovering a UH-60 Blackhawk helicopter using tactile cues. During the same year, an underwater navigation device used by Explosive Ordnance Division divers was interfaced with a TSAS to successfully demonstrate enhanced underwater navigation using only tactile cues.

The proposed evaluation of emerging haptic tactor technology is intended to provide an avenue for industry to present innovative ideas, concepts, and techniques to solving issues associated with tactors and tactor technology. The tactors in use today are too large, do not provide a wide enough range of sensation intensities, are not durable enough for the SOF operating environment, and exhibit unacceptable magnetic characteristics. Tactor connectors, wires, and/or supply lines must meet the same environmental criteria as the tactor. Consideration into electrical, electronic, pneumatic, hydraulic, or related advanced tactor technologies is desired. Human factors must consider the integration of the tactor with operator worn clothing and equipment such as flight suits, wet and dry suits, cold weather clothing, backpacks, dive gear, survival suits, etc. The ability to combine tactor technologies in solving related issues such as operator thermal protection, survivability, etc., will also be considered.

PHASE I: Phase I of the program will analyze tactor concepts to prove that meeting the above identified criteria is achievable. The prioritized list of tactor characteristics is: (1) no/low magnetic signature, (2) tactor sensation variability, (3) size, (4) environmental robustness, (5) all other criteria. The deliverable from this first phase will be an investigative engineering report to include as appropriate functional and/or physical characteristics, drawings, illustrations, computer models, allocated and/or predicted performance data, etc. Non-operational candidate tactors, prototypes, etc., that may be available to more clearly depict the proposed design is desired but not required.

PHASE II: Phase II of the program will consist of development of 2 prototype tactors to be tested. These tactors will be interfaced by the government with existing SOF equipment for operational demonstrations and assessments. A final technical report shall be provided with delivery of the tactors, to include any contractor testing that may have been conducted as part of the development process.

PHASE III DUAL USE APPLICATIONS: There is a high potential for duel commercial use of tactor technologies. Apnea and related biomedical monitoring devices, as aids to the hearing and visually challenged, commercial airline applications, and automobile applications are just a few of the potential markets in the commercial sector.

REFERENCES: Publications that may be applicable to the Examination of Emerging Haptic Tactor Technology:

1. Swimmer Inshore Navigation System (SINS)/Tactile Situation Awareness System (TSAS) Test Report, 2 Aug97
2. Tactile Situation Awareness System (TSAS) Very Slender Vessel (VSV) and High Speed Assault Craft (HSAC) Test Report, 2 August 1997.
3. Which Way is Down, Naval Aviation News, Mar-Apr 1997, pp 16-17.
4. Technical Articles, www.accel.namrl.navy.mil/
5. Technical Articles, www.ncsc.navy.mil/css/projects/uti.htm

OSD 98-030 TITLE: Small Craft Vision Enhancement/Situation Awareness System

TECHNOLOGY: Sensors

OBJECTIVE: Develop an all-weather vision enhancement system, or new components for existing systems, to support navigation of small military maritime craft (<36ft) operating in littoral areas and extreme environments.

DESCRIPTION: Small military maritime craft (<36ft) are used in low to medium threat. To facilitate all weather operations there is a need for vision enhancement systems to supplement existing navigational aids. The system(s) should integrate and fuse sensors, and processing and display elements to provide situational awareness in all types of weather, daylight, and hours of darkness. Nominal objectives are to detect a 100 ft craft at 3 miles, a 25 ft craft at 1 mile, and a navigation buoy at 1500 ft, regardless of sea-state, weather, and daylight conditions; and without increasing the craft's organic signature. Key limitations are size (less than 12 inches wide by 12 inches by 8 inches total net package size) and weight (less than 20 lbs total net package weight). Challenges include sensor mounting and operation in extreme environments, which include exposure to high g-loads and sustained vibrations, temperature and humidity extremes, and saltwater intrusion. Mounting consideration must be given to utilizing existing attachment points to include weapon mounts and display consoles. Technologies applicable to this effort include sensor fusion and image processing algorithms, high-performance and lightweight FLIR/low-light level camera systems, high performance and low power/signature displays, and stabilizing/shock mitigation packaging and mounting systems.

PHASE I: Investigate and obtain technologies and devices suitable for use in an all-weather vision enhancement system for small military maritime craft. Consideration must be given to operating environment and mounting possibilities. A laboratory scale prototype comprised of commercially available elements should be demonstrated by the end of Phase I to provide insight into potential capabilities, limitations, and opportunities for Phase II development.

PHASE II: Based on the results of Phase I, develop an operational prototype that can be tested on representative craft in typical operating environments/mission profiles. Support operational testing and incorporate required modifications.

PHASE III DUAL USE APPLICATIONS: Applications include navigation in commercial and recreational boating and aviation, and detection in smuggling interdiction and security operations by police and military forces protecting borders and sea lanes.

REFERENCES:
1) "Nightsight Camera Takes Night Vision to New Lengths," Raytheon Press Release 2/19/97 available at http://www.ratheon.com/rtis/docs/thermal/
2) Gollwitzer, R. M. and Peterson, R. S. Repeated Water Entry Shocks of Naval Special Warfare High Speed Planing Boats, Coastal Systems Station Report CSS/TR-94/44, Dec 94.

OSD 98-031 TITLE: Affordable Millimeter Wave Electronic Technology

TECHNOLOGY: Sensors

OBJECTIVE: The military has an inherent need to develop enabling passive as well as active sensor technology that is both affordable and flexible, with growth potential to address new requirements. Passive millimeter wave sensors are an emerging technology whose development is being facilitated by recent advances in low-noise millimeter wave components. The advantages of such sensors are that they enjoy all weather performance and are not readily detectable. PMMW sensors would inherently low signature characteristics in an auxiliary sensor mode, and provide threat information while in an active mode. Combined with the low cost potential of evolving components, this technology offers great promise for application on aviation platforms. PMMW is envisioned as a multi-role sensor that could provide affordable all-weather navigation and reconnaissance capability and possibly communications capabilities with minimal demand for weight, space and power. The purpose of this effort would be to demonstrate through measurement, simulation and testing, the applicability of new PMMW millimeter wave sensor technology to diversified military aviation mission requirements, with a primary focus on affordability.

DESCRIPTION: Millimeter wave antenna or passive sensor module to support the various military aviation missions. These missions require a multi-role sensor that provides all weather navigation, and reconnaissance capability.

PHASE I: This effort should study the emerging or novel passive millimeter wave technologies that can support operational military aviation missions, emphasizing technology tradeoffs with respect to affordability and flexible architectures. There should be considerable examination of one technology over another. This effort should identify risk associated with the chosen approach. The effort should simulate and develop a preliminary design and describe the flexible features and the upgrade path for this module. There should also be a cost breakdown for prototyping a two-dimensional aperture array with a suitable number of elements to demonstrate that the chosen approach will meet the above objectives.

PHASE II: Simulate, design, build, test, and report on the chosen design from the Phase I effort.

PHASE III DUAL APPLICATIONS: Modules that are both affordable and flexible, and are associated with supporting passive millimeter wave technology, may have vast commercial opportunities (i.e. all weather collision avoidance in the commercial air, sea and land transportation industry).

REFERENCES:
1) Blume, B.T., et al, "Passive Millimeter Wave Imaging Model Application and Validation," Proceedings of SPIE Millimeter-Wave Imaging Technology, AeroSense 97, Orlando, FL, April 1997.
2) Smith, R.M., Trott, K.D., Sundstrom, B.M., Ewen, D., "The Passive MM-Wave Scenario", Microsoft Journal, April 1996
3) Ulaby, F.T., et al, Microwave Remote Sensing: Active and Passive, Vol I, Microwave Remote Sensing Fundamentals and Radiometry, Artech House, 1986.

TECHNOLOGY FOCUS AREA: Materials, Processes, and Structures

OSD 98-032 TITLE: Lightweight, Portable, Blast-Resistant Barriers

TECHNOLOGY: Materials, Processes, and Structures

OBJECTIVE: Develop a barrier system, which is light, easily deployable, but made of material rugged enough to thwart a conventional blast sufficiently to protect structures.

DESCRIPTION: Current semi-permanent barrier systems are typically constructed of concrete or stone. These tend to be difficult to move or redeploy. Sandbags, large earth and stone mounds can be used as temporary barriers, but they provide limited protection and are time-consuming and difficult to erect. SOF is in need of easily deployable deflection-type barriers, which can stop and/or deflect the effects of a blast away from troops in garrison, buildings, and other structures. An "ideal"

solution would be a barrier that deflects effects back to the point of origin; i.e., a car bomb explodes and the barrier sends all the debris back toward the blast or straight up in the air, away from the targeted structure. Design consideration must be given to preclude the barrier from being used to aid the explosion. The system should be employable with minimal support and material handling equipment.

PHASE I: Investigate materials (e.g., fabrics, ceramics) and structures (e.g., air/water beams, interlocking panels), which could be used to develop the above described barrier, and test prototype concepts. Inherent in this phase is characterization of the threat environment and proposal of protection levels.

PHASE II: Based on Government selection of the protection level, prototype design, and employment concept, finalize design concept, fabricate multiple samples and support limited special operations forces (SOF) field evaluations, and incorporate resulting design modifications.

PHASE III DUAL USE APPLICATIONS: Lucrative military, other government, and commercial markets for these items would include temporary protection of high-valued assets.

REFERENCES:

1) "Report of Investigation, The Khobar Towers Bombing" , 25 Jun 96, Air Force Link, available at http://www.af.mil/current/Khobar/

OSD DEPUTY DIRECTOR OF DEFENSE RESEARCH & ENGINEERING

FY 1998 Topic Descriptions

U.S. Army Medical Research Acquisition Activity Topics

Technology Focus Area: Biomedical Research

The U.S. Army Medical Research Acquisition Activity has identified the following seven biomedical research topics:

OSD98-033	Decontamination of Nerve Agent Exposed Personnel: Preparation of Towelettes Consisting of Immobilized Enzymes that Destroy Toxins.
OSD98-034	Development of in vitro model system for screening the effects of botulinum neurotoxin.
OSD98-035	Blood Processor for Hydroxy Ethyl Starch
OSD98-036	Development of Temperature and Humidity Insensitive Dental Materials
OSD98-037	Head motion tracking and performance measurement of helicopter pilots during simulated flights over digitized terrain.
OSD98-038	Development of a Catalytically Reactive Topical Skin Protectant (rTSP) Against Chemical Warfare
OSD98-039	Detection of Persons With Mild, Intermittent Asthma.

The topics were initiated by the technical offices that manage the research and development in their areas. Scientific and technical information assistance may be requested by using the DTIC SBIR Interactive Technical Information System (SITIS).

Send all proposals (original plus 3 copies) for topics OSD98-033 through 039 directly to the following address:

U.S. Army Medical Research Acquisition Activity
ATTN: MMR-AAU (Mr. Herman Willis/Ms Nancy Smith)
820 Chandler Street
Fort Detrick, MD 21702-5014
(301)619-2471

OSD98-033 TITLE: Decontamination of Nerve Agent Exposed Personnel: Preparation of Towelettes Consisting of Immobilized Enzymes that Destroy Toxins.

TECHNOLOGY: Biomedical

OBJECTIVE: Develop a personal decontamination kit to remove and inactivate organophosphorous compounds from skin, wounds, or other sensitive surfaces of exposed soldiers. Such decontamination devices will also protect field medical personnel from cross-contamination and secondary contamination while attending the chemical casualties.

DESCRIPTION: A kit consisting of disposable towelettes similar to 2x4, 4x4, or 4x6 inch surgical pads consisting of a mixture of immobilized enzymes to destroy organophosphorous compounds is needed for personnel protection. The combination of enzymes would be cholinesterases (acetylcholinesterase/butyrylcholinesterase) and organophosphorous hydrolases from bacterial or animal origins which metabolize organophosphates (e.g. paraoxon hydrolase, phosphotriesterase, or squid diisopropylfluorophosphate hydrolase). Enzymes would be covalently linked to a matrix like polyurethane to form the correct texture, poracity, and consistency to function as towelettes or sponges. By crosslinking the enzymes to an immobilized support, the towelette would resist leaching of the enzyme to the skin, be stable at a wide range of temperatures, and retain enzymatic activity for a long period of storage. To increase the efficacy of such a device, an oxime would be added in the solution in which the towelette is packaged. This will ensure that the catalytic activity of organophosphate inhibited cholinesterases will be rapidly and continuously regenerated, and that the organophosphate on the skin will be detoxified.

PHASE I: Design a cocktail of enzymes which are shown to detoxify organophosphates and covalently link them to a solid support (towelette). Develop and evaluate the towelette for a) packaging with oximes to continuously reactivate the enzymes, b) multiple enzyme stability, immobilization efficiency, temperature resistance, and extended storage shelf-life, c) suitable consistency and material strength of the towelette solid support, and d) overall capability to detoxify organophosphates.

PHASE II: Test towelettes for efficacy in the decontamination of animals exposed to organophosphates (e.g. paraoxon, sarin, soman, VX, Tabun, pesticides).

PHASE III DUAL-USE COMMERCIALIZATION: The public, farmers, crop dusters, and particularly migrant farm workers face health risks associated with organophosphates during the use of commercially available pesticides. More than 23,000 emergency room visits per year in the United States can be accounted for by pesticide poisoning. The technology developed for decontamination of organophosphate exposed soldiers would have direct applicability to the decontamination of the public exposed to pesticides as described above and the public exposed to nerve agent in the 1995 Tokyo subway incident.

REFERENCES: Lois Ember, Detoxifying Nerve Agents, Chemical and Engineering News, pgs 26-29, September 15, 1997.

KEY WORDS: Personal Decontamination Kit; Organophasphorous; Decontamination; Towlette; Cholinesterases; Acelylcholinesterase; Butyrylcholinesterase; Hydrolases; Paraoixon Hydrolase; Phosphotriesterase; Diisopropylfluorophosphate; Hydrolase; Covalently; Oxime

OSD98-034 TITLE: Development Of In Vitro Model System For Screening The Effects Of Botulinum Neurotoxin.

TECHNOLOGY: Biomedical

OBJECTIVE: The objective is to replace the current mouse botulinum toxin neutralization assay, in whole or in part, with in vitro assay systems for determining toxin activity, antibody titers and evaluating candidate medical countermeasures.

DESCRIPTION: The toxin neutralization test in mice used to determine the activity of botulinum neurotoxins and neutralizing antibody in sera is cumbersome, requires a large number of laboratory animals, and a well trained technical staff. Reproducibility between laboratories has also been problematic. There have been a number of alternative in vivo assays proposed (1). Although these may provide enhanced reproducibility and sensitivity in a given laboratory they still suffer from the same technical constraints of the standard in vivo protocol. Although relatively sensitive Enzyme-linked immunosorbent assays (ELISA) for detection of Clostridium botulinum neurotoxins and solution-phase complexes (antibody) have been developed (2) there is a lack of definitive correlation between ELISA and biological activity of the toxin or neutralizing antibody (3). Ideally a motoneuron based biological system would be developed that is capable of releasing acetylcholine (Ach). This could be used as an in vitro model system for screening the effects of botulinum neurotoxins, toxin activity, toxin neutralization and candidate medical countermeasures. Similar systems have been developed to evaluate Clostridial neurotoxins and substrate proteolysis in intact neurons (4). These primary cell cultures do not survive for long and cannot be utilized in the screening assays. To be practical the cell line would have to be stable for several months in culture, be well characterized and provide reproducible responses.

PHASE I: Develop cell cultures of motoneurons that are capable of releasing acetylcholine (Ach), are well characterized and provide reproducible responses. Provide assay formats that can function on a routine basis.

PHASE II: Employ in vitro systems for screening the effects of botulinum neurotoxins, toxin activity, toxin neutralization and candidate medical countermeasures. Correlate inhibition of in vitro biological activity with in vivo biological activity.

PHASE III DUAL-USE APPLICATIONS: As botulism is encountered world-wide such an assay has an extensive commercial application in both the diagnostic field and the determination of neutralizing titers. It also has a direct application to determining biological activity of the botulinum neurotoxins used in the treatment of a number of clinical indications to include blepharospasm, dysphonia, and spasmodic torticollis.

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1. Pearce, L. B., G. E. Borodic, E. A. Johnson, E. R. First, and R. MacCallum. 1995. The median paralysis unit: A more pharmacologically relevant unit of biologic activity for botulinum toxin. Toxicon. 33:217-227.
2. Doellgast, G. J., G. A. Beard, J. D. Bottoms, T. Cheng, B. H. Roh, M. G. Roman, P. A. Hall, and M. X. Triscott. 1994. Enzyme-linked immunosorbent assay and enzyme-linked coagulation assay for detection of Clostridium botulinum neurotoxins A, B, and E and solution-phase complexes with dual-label antibodies. J Clin Microbiol. 32:105-111.
3. Siegel, L. S. 1988. Human immune response to botulinum pentavalent (ABCDE) toxoid determined by a neuitralization test and by an Enzyme-Linked Immunosorbent Assay. J of Clinical Microbiology. 26:2351-2356.
4. Williamson, L. C., J. L. Halpern, C. Montecucco, J. E. Brown, and E. A. Neale. 1996. Clostridial neurotoxins and substrate proteolysis in intact neurons botulinum neurotoxin C acts onsynaptosomal-associated protein of 25 kDa. J Biol Chem. 271
(13):7694-7699.

KEY WORDS: In Vitro; Spasmodic Torticollis; Botulinum Neurotoxin; Immunosorbent; Motoneuron; Acetylcholine; Clostridial Neurotoxins; Blepharospasm; Dysphonia

OSD98-035 TITLE: Blood Processor for Hydroxy Ethyl Starch

TECHNOLOGY: Biomedical

OBJECTIVE: To develop a medical device to process the frozen/thawed blood cryoprotectant hydroxy ethyl starch.

DESCRIPTION: Research and design a closed sterile filtration device to automatically thaw and wash out the frozen/thawed blood cryprotectant hydroxy ethyl starch; and add blood preservatives to attain 8 week post thaw storage. The suggested design concept is for a microprocessor-driven tabletop device with heated plates for thawing; and a peristaltic pump and valve system for processing. It should weigh less than 100 pounds, have a foot print less than 2 square feet, and a height less than 3 feet. Other design goals include: processing time less than 10 minutes; direct infusion after 8-week post thaw storage without further processing; maximum 1 liter of a single wash solution; and disposable costs less than $50. Input power should include the following multiple options: 110/220 volts AC 60 Hz; 220 volts 50 Hz (European power); commercial or generator driven tactical sources. The device should be universal and flexible so that it can be adapted for other blood processing procedures.

PHASE I: Investigate feasibility of filter washing the hydroxy ethyl starch and the necessary design parameters to initiate prototype fabrication. Develop an experimental prototype device to demonstrate feasibility.

PHASE II: Continue to develop the device through a series of improved prototypes until a pre-production model is finalized. Test the pre-production model and submit for Food and Drug Administration approval.

PHASE III DUAL-USE APPLICATIONS: The existing frozen blood system utilizes glycerol as a cryoprotectant; which is, complicated & time consuming to remove prior to infusion, and logistically burdensome. The starch system has the potential to simplify processing of thawed blood in the following ways: reducing processing time from the current 60 minutes to 10 minutes including thaw time and operator set up; reducing wash solutions from the current 3 types (12%, isotonic, storage) or a total of over 2 liters to a single wash/storage solution less than 1 liter in quantity; replace current water-bath thaw system with controlled heated plates built into the processing device; replace the existing complicated expensive device with a smaller, simpler less expensive model. The advantages of the starch system would render the current glycerol system obsolete in both the military and civilian markets. The military currently stockpiles tens of thousands of frozen units and the US. civilian market processes over 20,000 frozen units per year.

KEY WORDS: Medical device; Frozen/thawed blood; Cryoprotectant hydroxy ethyl starch; Microprocessor driven; Heated plates; Peristaltic pump

OSD98-036 TITLE: Development of Temperature and Humidity Insensitive Dental Materials

TECHOLOGY: Biomedical

OBJECTIVE: To develop, test, and deploy polymeric based dental materials that are temperature and humidity insensitive for use under deployed conditions.

DESCRIPTION: Current polymeric dental materials, both those used as a portion of a composite restorative system and those used as impression materials, are prone to unpredictable physical properties when used outside controlled environmental conditions. Extremes in temperature and high humidity cause deterioration of most desirable properties. Storage histories of these materials also adversely effect physical properties. Development of temperature and humidity insensitive dental materials would allow much more predictable results in deployed situations. It would also permit relaxed handling and storage of these materials.

PHASE I: Feasibility determination and development of temperature and humidity insensitive polymeric systems, including silicone, polymethylmethacrylate, and/or novel types. Development of an esthetic composite resin restorative system using this polymer matrix.

PHASE II: Testing of systems under deployed conditions.

PHASE III DUAL-USE APPLICATIONS: Commercialization of these products would be dramatic. Storage and handling costs add significantly to the cost of polymeric dental materials. Elimination of the need for special handling would be a very well received concept.

KEY WORDS: Temperature; Dental Materials; Deterioration; Humidity; Polymeric; Silicone; Insensitive; Composite Restoration Polymethylmethacrylate

OSD98-037 TITLE: Head Motion Tracking And Performance Measurement Of Helicopter Pilots During Simulated Flights Over Digitized Terrain.

TECHNOLOGY: Biomedical Human Systems Research

OBJECTIVE: Develop and build a PC-based virtual reality projection software and hardware system which can be easily programmed, maintained and operated by the user. The system will be used in various laboratory settings, including the study of the effects of head-supported devices on the performance of helicopters pilots during simulated terrain fly-over and while exposed to whole-body vibration.

DESCRIPTION: An important function of helmets worn by helicopter pilots is its use as a platform to mount an array of devices that enhance the pilot's performance. The weights of these helmet-mounted devices (HMD) have increased as they became more complex and as new capabilities are introduced. The effects of the added weight on pilot fatigue and performance is evaluated in laboratory setting prior to final fielding. Because of whole-body vibration and the HMD added weight, the accuracy of tracking a moving target is likely to degrade. With recent proliferation of virtual reality (VR) software and hardware, the accuracy of target tracking can be measured using inexpensive computer platforms and drawing upon public domain terrain data, open architecture graphic software and lightweight tracking hardware. Many components of the desired system have been demonstrated to work in commercial, shareware and freeware video game and research products on inexpensive personal computer platform, i.e., they do not require expensive graphic workstation hardware and software. These include: 3-D motion tracking devices that monitor the head motion; terrain simulation based on published terrain elevation satellite data; interactive terrain fly-over that simulates the view from the cockpit as the pilot maneuvers the helicopter; real-time display of instruments and symbols to reflect pilot's actions; the ability to control and pre-program the mission profile; and monitoring and scoring of pilot's tracking actions. Since the system will be used for evaluation of HMDs, VR goggles and similar head-worn devices cannot be used. Instead, VR imagery must be projected on one or multiple screens as necessary. The desired system is not intended as a training platform but as an inexpensive research tool that can be easily modified and maintained as new technologies or research requirements emerge.

PHASE I: Develop a plan to integrate various components into an operational system and describe the functional requirements of various sub-systems that can feasibly and inexpensively be integrated. Identify existing public domain software and data as well as commercially available hardware and software components that are most likely to satisfy the requirements of the different sub-systems. Demonstrate the feasibility of concept by building a prototype that incorporates the following functions: simulation of 3-D terrain fly-over controlled by a joystick, moving target tracking that shows an acquisition

grid controlled by head motion, and a simplified instrument display controlled by keyboard and mouse input. The prototype may be limited to a single-screen projection, to one instrument display, and to a crosshair as the tracking grid. However, it must demonstrate the cost-effectiveness, and the ease of setup, modification and operation.

PHASE II: Expand the capabilities of the system to multiple screens to provide a wide view. Increase the range of flights by splicing multi-regions terrain data. Incorporate software for multi-task performance measurement. Increase the number and complexity of available moving targets. Improve the realism of tracking display. Improve the programmability and ease of use of the software. Adapt the software to ground vehicle ride simulations and other operations where HMD may be used.

PHASE III DUAL-USE APPLICATION: Because the system will be capable of fly-over or drive-over simulations, the performance and fatigue of truck driver or a commercial pilot may be evaluated with or without head-supported devices. The cost-effectiveness of this simulation system makes it an ideal research tool for graduate students at academic institutions and small private companies that are engaged in VR simulations and human performance studies. Given the popularity of flight simulator software for windows, the commercial success of this multi-input and multi-display system based on its entertainment value cannot be ignored.

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1. Proceedings of the Virtual Reality Annual International Symposium, Albuquerque, NM 1-5 March 1997.
2. Terrain elevation data, National Geophysical Data Center, Boulder, CO
3. Comstock, JR and Arnegard, RJ (1991). The multi-attribute task battery (MATB) for human operator workload and strategic behavior research. NASA TM-104174.
4. Microsoft Flight Simulator, version 5.0

KEY WORDS: PC-based; Software; Hardware; Simplified instrument; Controlled by keyboard/mouse input; Lab setting; Simulated terrain; Flyover head-motion; Head supported device; Helicopter-pilots; Vibration; Joystick; Tracking; Moving targeted

OSD98-038 TITLE: Development of a Catalytically Reactive Topical Skin Protectant (rTSP) Against Chemical Warfare Agents

TECHNOLOGY: Biomedical

OBJECTIVE: The identification and synthesis of catalytically reactive materials capable of neutralizing chemical warfare agents (CWAs, vesicants and/or nerve agents) when incorporated into a cream of perfluorinated polyether oil thickened with polytetrafluoroethylene, that can be applied to the skin as a protectant from cutaneous exposure to CWAs.

DESCRIPTION: There is a requirement to develop catalytic materials capable of neutralizing CWAs that contact the skin. These materials must prevent the toxic effects of skin contact with CWAs when the catalyst is incorporated into a cream of perfluorinated polyether oil thickened with polytetrafluoroethylene. This cream has already been demonstrated to provide a physical barrier against CWAs. The incorporated catalysts must enhance the barrier effect of the cream by chemically neutralizing the CWAs, so that in case of barrier breakdown the agent is no longer toxic. The material should have reasonable cost, be safe and nonirritating, chemically stable, and demonstrate rapid kinetics. Successful proposals must possess a viable concept, an evaluation plan demonstrating a logical sequence of steps to identify, synthesize and test the catalytic materials for preparation of the final product

PHASE I: Production of catalytic materials capable of neutralizing CWAs when the catalysts are incorporated into a cream of perfluorinated polyether oil thickened with polytetrafluoroethylene. Reactivity, stability, cost, and skin toxicity must be considered.

PHASE II: Establish in vitro efficacy of the proposed catalytic rTSP against CWAs using procedures already established by the U. S. Army.

POTENTIAL COMMERCIAL MARKET: There are industries where workers are exposed to toxic materials, e.g. pesticides, herbicides, other chemicals that represent health hazards, poison ivy and cs. Use of a rTSP would provide these workers with protection against these noxious agents.

KEY WORDS: Catalysts, Chemical Warfare Agents, topical skin protectants, barrier creams

OSD98-039 TITLE: Detection of Persons With Mild, Intermittent Asthma.

TECHNOLOGY: Biomedical

OBJECTIVE: Develop a rapid, inexpensive method to screen all military recruit applicants for asthma, particularly those with mild or moderate disease. Results should be standardized and easily interpretable by physicians without specialty training in pulmonary medicine. The screening test should be sensitive, specific, and without significant health risk to persons tested.

DESCRIPTION: Asthma is common and the prevalence and mortality in the United States are increasing.
Asthma is of vital importance to the military as active duty persons are exposed to a variety of factors that exacerbate asthma such as exercise, cold, dust, stress, smoke, fumes, and pyridostigmine. The risk factors for adult problems after childhood asthma are difficult to quantify. A British study predicted that of people enlisted in the Army with a history of childhood asthma and remission in their teens, 40% would succeed, but 25% would require down-grading of their duties and 35% would be discharged because of asthma. In 1995, 72.8% of the 1,014 individuals prematurely discharged from the military for asthma existing prior to service concealed their condition at the accession medical examination. Asking about a history of asthma is clearly not a sensitive screening tool. The current Department of Defense Directive pertaining to accession into the military disqualifies a person for asthma reliably diagnosed at any age. This undoubtedly prohibits some from entry who may have had asthma in early childhood who do not currently and would not have respiratory problems as a young adult. Using the history of asthma at any age, if revealed, lacks the desired specificity as a screening tool. When an individual is disqualified for entry into the military because of asthma, they may be granted a waiver. Authorities granting waivers use imperfect aids such as the methacholine or exercise challenge tests in decision making, neither of which would be practical for use in the entire applicant pool. A simple test to use on large numbers of individuals to detect current asthma is necessary to prevent the massive monetary and manpower losses to the military from premature attrition due to undisclosed or undetected asthma.

PHASE I: Find new respiratory, serologic, or other markers for current asthma.

PHASE II: Evaluate the markers in a population of active young adults for the ability to predict current and future asthma related symptoms. Determine sensitivity, specificity, positive predictive value, and ease of correct performance of the test.

PHASE III DUAL-USE APPLICATIONS: Asthma is a growing health problem in the civilian population as well as in the military, despite advances in therapy. A test such as this could be quite valuable in the commercial clinical setting in differentiating asthma from other disease entities such as vocal cord dysplasia, hyperventilation, chronic bronchitis, and interstitial lung disease that require different treatment. A simple test to diagnose children that do not wheeze at the time of the visit with the health care provider or those that wheeze but do not have asthma would assist in making accurate treatment decisions. The markers could also possibly be used to assess objectively the severity of asthma and the response to therapy or specific exposures.

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1. Connolly JP, Baez SA: Asthma in the Navy and Marine Corps. Milit Med 156:461-465, 1991.
2. Dickinson JG: Asthma in the Army: A Retrospective Study and Review of the Natural History of Asthma and its Implications for Recruitment. J R Army Med Corps 134:65-73, 1988.
3. Department of Defense. Physical Standards for Appointment, Enlistment, and Induction. Washington, DC; 1994. Directive 6130.0

KEY WORDS: Recruit; Asthma; Pulmonary Medicine; Respiratory; Serologic; Methacholine; Pyridostigmine

OSD DEPUTY DIRECTOR OF DEFENSE RESEARCH & ENGINEERING

FY 1998 Topic Descriptions

Naval Sea Systems Command Topics

Technology Focus Area: Materials Process Technology Area

The Naval Sea Systems Command has identified the following five topics:

OSD98-040	Fire Resistant Organic Composite Material
OSD98-041	Superelastic Shape Memory Alloy (SMA) for Seal Applications
OSD98-042	Development of a Self-Cleaning Filter System for Navy Shipboard Reverse Osmosis
OSD98-043	High Temperature Multifunctional Core Material for Lightweight Composite Structures
OSD98-044	Lightning Protection for Ship Topsides Fabricated of Composite Materials

The topics listed are the only topics for which proposals will be accepted. The topics were initiated by the Naval Sea Systems Command's technical offices and are applicable to future Navy surface ships. Materials/processes technologies are critical to meeting DoD platform, infrastructure, and logistical needs. Continued progress in material/processes is essential to ensure increased affordability, performance, and longevity in DoD systems.

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OSD 98-040 TITLE: Fire Resistant Organic Composite Material

TECHNOLOGY: Composite Materials

OBJECTIVE: Develop a low cost organic composite resin material which meets the fire and toxicity requirements of MIL-STD 2031, possesses mechanical properties similar to standard vinylester and polyester resins, and can be processed using a vacuum-assisted resin transfer molding (VARTM) process and low-temperature cure.

DESCRIPTION: To develop, demonstrate and document a low cost organic composite resin material (<$10/lb) which is resistant to structural degradation and toxic off-gassing when subjected to a severe fire insult. This resin system must have a viscosity suitable for VARTM fabrication, a cure temperature less than 160□F, and maintain mechanical properties at operating temperatures of 200□F.

PHASE I: Develop detailed material criteria and survey the state of the art to identify candidates which have the potential to be modified to meet one or more essential criteria. Establish possible methods to modify candidates to improve their fire characteristics.

PHASE II: Demonstrate the fire resistance of the new resin system in a large composite structure representative for naval ship applications.

DUAL-USE COMERCIALIZATION: A low cost organic composite resin material (<$10/lb) which has mechanical properties and improved fire resistance over currently available resin systems would be utilized in a wide variety of applications in the marine, automotive and aerospace communities. Specific examples of current commercial projects that could utilize this new product are passenger ferries for both transportation and industrial uses, low-cost bus and train bodies, and blast resistant aircraft luggage compartments.

REFERENCES:

1. "Fire Resistance of Composite Structures", Composite Materials in Maritime Structures, Volume 2: Practical Considerations, Editors: R.A. Shenoi and J.F. Wellicome, Section 11.4, pg. 211-225, 1993.
2. Morchat,R.M., Allison,D.M., Marchand,A.J., "Large-Scale Fire Performance Testing of Composite Structures", Advances in Marine Structures –2, Editors: C.S. Smith and R.S. Dow, 1991.
3. Pering, G.A., Farrell, P.V. Springer, G.S., "Degradation of Tensile and Shear Properties of Composites Exposed to Fire or High Temperatures", Journal of Composite Materials, Vol 14 (1), pp 54-68, 1980.

OSD 98-041 TITLE: Superelastic Shape Memory Alloy (SMA) for Seal Applications

TECHNOLOGY: Shape Memory Alloy

OBJECTIVE: Develop robust, corrosion free and long life sealing technology utilizing superelastic shape memory alloy made by either plasma spraying or other near net shape processes.

DESCRIPTION: Recent advances in the plasma spraying of conventional SMA have indicated that this process could be modified to produce superelastic SMA material. This superelastic material could be used to solve the long standing Naval problem of reliably preventing green water and other fluids or air-born contaminates from entering a vessel. Future surface ships will require advanced hatch and hanger door seals. SMA seals would have the advantage of being non-pyrolytic, large strain (more sealing force), tough, non-corrosive and Radar Cross Section (RCS) compliant. Challenges include adapting the processing techniques to produce superelastic material in sufficient lengths and thickness in near net shape.

PHASE I: Develop a preliminary design and material process technique. Fabricate and test a section for system application. Demonstrate thickness in the range of 4 to 60 mils. Produce materials for test with minimum length of 12 inches and minimum width of 6 inches. Nominal thickness deviation on test pieces not to exceed 10%. Produce a total of 20 square foot of material.

PHASE II: Develop a full up system of the optimal design to produce seals. Develop capability of producing continuous lengths. Use test pieces developed under Phase I to examine superelastic properties. Test system in conjunction with a full-scale panel to address a current Navy usage problem. Demonstrate private sector applications.

DUAL-USE COMMERCIALIZATION: The results of this research will have immediate impact on Navy and commercial problem sealing areas. Transitions are anticipated for new ship construction. Equipment to be affected includes: hatch covers, bulkhead doors, stern closures, between deck ramps. Commercial transitions are anticipated to: merchant marine vessels, railroad container cars, other non-vertical sealing surfaces.

REFERENCES:
1. 1994 Proceedings of the First International Conference on Shape Memory and Superelastic Technologies, copies to be obtained from SMA, Inc. 2380 Owen Street, Santa Clara, CA 95045, or from MIAS, P.O. Box 975, Monterey, CA 93942-0975, or from NDC, Inc., 48501 Warm Springs Blvd., Fremont, CA 94539.
2. 1997 Proceedings of the Second International Conference on Shape Memory and Superelastic Technologies, copies to be obtained from SMA, Inc. 2380 Owen Street, Santa Clara, CA 95045, or from MIAS, P.O. Box 975, Monterey, CA 93942-0975, or from NDC, Inc., 48501 Warm Springs Blvd., Fremont, CA 94539
3. "Superelastic NiTi Wire", Stoeckel and Yu, Wire Journal International, March 19, 1991.

OSD 98-042 TITLE: Development of a Self-Cleaning Filter System for Navy Shipboard Reverse Osmosis Application

TECHNOLOGY: Materials/Processes

OBJECTIVE: Develop a small/lightweight self-cleaning filtration system for shipboard Reverse Osmosis (RO) desalination plants to enable operation in port and other areas close to shore.

DESCRIPTION: The Navy is presently developing a RO desalination plant for aircraft carrier application. The major problem foreseen with the operation of such a plant is when the ship is operating in coastal areas and in the open ocean where large quantities of colloidal solids and plankton/small animal matter occasionally exist. High concentrations of colloidal solids and plankton/small animal matter in the seawater feed stream to the RO system have been found to plug and blind strainers and filters on Navy surface ships (such as destroyers), virtually disabling the filtration system from operating. The typical solution to this problem often proposed by commercial vendors is to use large multimedia filters (volumes in excess of 750 cu. ft. and weights above 25,000 lbs.) to remove these foulants from the 300 to 400 gal/min feed seawater stream. Filtration systems of this size and weight are unacceptable for Navy shipboard application. Therefore, a small lightweight self-cleaning/back-flushable filter is sought for shipboard RO application.

PHASE I: Develop a design for and demonstrate the feasibility of a concept for a lightweight self-cleaning/back-flushable filter for shipboard RO application. The design should consider the type(s) of foulants encountered, compatibility with shipboard system materials, a minimum required operator interaction (less than 1 hour per day), and requirement for noninterference with RO system performance.

PHASE II: Develop a prototype self-cleaning/back-flushable filter sized for 42 gal/min operation. Test the system at a shore-based natural seawater test site and, subsequently, aboard ship (to be coordinated with NAVSEA 03Z13). Determine reliability, effectiveness, and maintenance/labor requirements of prototype system.

COMMERCIAL POTENTIAL: Fouling of RO membrane elements is a continual problem for operators of all coastal seawater desalination systems. A small lightweight self-cleaning/back-flushable filter system would be a highly sought by RO system vendors who frequently install such systems in coastal facilities (hotels, power plants, municipalities, personal residences, etc.) and on ships and boats that operate in coastal areas. With commercial partners, manufacture, deliver, and evaluate a full-size self-cleaning/back-flushable filter sized for 400 gal/min operation. Install full-size system on a Navy aircraft carrier and evaluate its reliability, effectiveness, and maintenance/labor requirements.

REFERENCES:
1. Henley, Mike, "Proper Pretreatment Enhances Membrane Operation," Ultrapure Water, Vol. 12, No. 3, pp. 16-21 (Apr 1995).
2. Adamson, W.L., Weber, B.E., and D. J. Nordham, "Navy Shipboard Three-Pass Reverse Osmosis System for Production of High Purity Water from Seawater," Ultrapure Water, Vol. 13, No. 2, pp. 21-30 (Mar 1996).
3. Pizzino, Joseph F., "Investigation of Multimedia Filtration for Reverse Osmosis Desalination Systems," NSWCCD Technical Rept. DTNSRDC/PAS-82/40 (Feb 1983).

OSD 98-043 TITLE: High Temperature Multifunctional Core Material for Lightweight Composite Structures

TECHNOLOGY: Materials/Processes

OBJECTIVE: Develop structural core material, which can be used with composite material processing which can be used as a fire barrier system and can provide multifunctional capability to the composite section.

DESCRIPTION: Composite materials are currently being investigated for use as the structural material for topside structures as well as other Naval applications. Low cost composite processing materials such as glass/vinylester composites are the material of choice. Solid cores (balsa) and foam cores (pvc, urethane, etc.) have been considered. These core materials have high temperature performance limitations. A core material which could maintain structural integrity after the UL 1709 fire testing is goal for a core material. In addition, incorporation of various signature characteristics is desired, such as Radar Cross Section (RCS) control, electromagnetic interference (EMI) shielding, and frequency selective surfaces for antenna concerns. These characteristics, for example, were incorporated in the Advanced Enclosed Mast/Sensor System (AEM/S). The core material should be compatible with vacuum assisted resin transfer molding (VARTM) type processing and should be environmentally stable in the temperature range of -60 to 180 ^{0}F, not be degraded by water and be capable of surviving 30 year service life. Large quantity acquisition costs should be comparable to that of high temperature foam, e.g. pvc foam ($16/board foot).

PHASE I: Develop core material which has a density < 10 lb/ft3 with the following fire performance characteristics: 1) flame spread < 30; 2) smoke density < 200; 3) peak heat release at 50kW/m2< 65; time to ignition at 50kW/m2< 150 sec. Demonstrate that glass composite face sheets can be bonded to the core material to provide a structural part. Flexural testing of this cored configuration should result in face sheet failure.

PHASE II: Develop a manufacturing process, which can scale up fabrication of foam sections to areal dimensions of at least 4 x 8 ft. and thickness up to 4 inches. Fabricate large scale components using the foam core and glass face sheets using a low cost manufacturing process such as VARTM which can be assembled for testing using the UL 1709 procedures. Demonstrate reduced RCS performance and improved signature characteristics.

DUAL-USE COMMERCIALIZATION: This material system has potential for use in commercial cruise ships for deckhouse components as well as in internal spaces, commercial aircraft components including engine cowlings and floors, as well as numerous other civil structures such as buildings. In addition, military applications where this would be of benefit include tank structures and military aircraft.

REFERENCES:
1. UL 1709 test standard
2. Mil Standard 2031
3. "Marine Composites-The U.S. Navy Experience, Lessons Learned Along the Way", I.L Caplan, pp 91-114
4. "Flammability and Fire Safety of Composite Materials" U.Sorathia, pp 309-318
5. Composite Materials for Offshore Operations: Proceedings of the First International Workshop, NIST Special Publication 887, Aug 1995

OSD 98-044 TITLE: Lightning Protection for Ship Topsides Fabricated of Composite Materials

TECHNOLOGY: Electromagnetics, Composite Materials

OBJECTIVE: Effective, low signature, low cost, lightning protection system for topsides of ships that are fabricated of non-metallic materials.

DESCRIPTION: To develop, demonstrate and document an effective, low signature, low cost, lightning protection system for topsides of ships that are fabricated of non-metallic materials. The lightning protection system must be capable of providing sufficient protection against lightning strikes in a natural environment as specified in MIL-STD 464.

PHASE I: Develop detailed criteria for surface ship lightning protection and survey the state of the art to identify candidates which have the potential to be effective, low signature, low cost, lightning protection systems for topsides of ships that are fabricated of non-metallic materials. Quantify the requirement and establish detailed criteria for evaluating alternatives. Develop test plan.

PHASE II: Fabricate and test a large scale model to demonstrate the lightning protection features for ship applications.

DUAL-USE COMMERCIALIZATION: In addition to commercial boats, there are many non-metallic structures that are exposed to the risk of lightning strikes. This system would provide needed protection for such systems.

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