

CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) required the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) Program into a single office within the Office of the Secretary of Defense. The public law also directed the Secretary of Defense to designate the Army as the Executive Agent for coordination and integration of the CBD Program. The executive agent for the Small Business Innovation Research (SBIR) portion of the program is the Army Research Office-Washington (ARO-W).

The objective of the DoD CBD Program is to enable U.S. forces to survive, fight and win in chemical and biological warfare environments. Numerous rapidly-changing factors continually influence the program and its management. These forces include declining DoD resources, planning for warfighting support to numerous regional threat contingencies, the evolving geopolitical environment resulting from the breakup of the Soviet Union, U.S. participation in the Chemical Weapons Convention, and the continuing global proliferation of chemical and biological weapons. Improved defensive capabilities are essential in order to minimize the impact of such weapons. U.S. forces require aggressive, realistic training and the finest equipment available that allows them to avoid contamination, if possible, and to protect, decontaminate and sustain operations throughout the non-linear battlespace. Further information about the DoD CBD Program (and related programs) is available at the DoD Counterproliferation and Chemical Biological Defense Homepage at Internet address <http://www.acq.osd.mil/cp/>.

The overall objective of the CBD SBIR Program is to improve the transition or transfer of innovative CBD technologies between DoD components and the private sector for mutual benefit. The CBD SBIR Program includes those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection; information assessment, which includes identification, modeling and intelligence; contamination avoidance; and protection of both individual warfighters and equipment.

CBD SBIR Program

The U.S. Army, Navy, and Air Force have developed separate SBIR topics for research and development in various CBD areas of interest. As lead agency, the Army will coordinate efforts related to the receipt, evaluation, selection, and award of Phase I proposals and similarly for potential follow-on Phase II efforts under this program.

Submitting Your Phase I CBD SBIR Proposal

New this year: Your entire proposal (consisting of Proposal Cover Sheets, the full Technical Proposal, Cost Proposal, and Company Commercialization Report) must be submitted electronically through the DoD SBIR/STTR Proposal Submission Website. A hardcopy is NOT required for CBD. Hand or electronic signature on the proposal is also NOT required. The DoD-wide SBIR Proposal Submission system (available directly at <http://www.dodsbir.net/submission>) will lead you through the preparation and submission of your proposal. Refer to section 3.5 at the front of this solicitation for detailed instructions on Phase I proposal format. You must include a Company Commercialization Report as part of each proposal you submit however, it does not count against the proposal page limit. If you have not updated your commercialization information in the past year, or need to review a copy of your report, visit the DoD SBIR Proposal Submission site. Please note that improper handling of the Commercialization Report may result in the proposal being substantially delayed and that information provided may have a direct impact on the review of the proposal.

Be reminded that section 3.5.a of this solicitation states: "If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet therefore, do not include

proprietary or classified information in these sections”. Note also that the DoD web site contains timely information on firm, award, and abstract data for all DoD SBIR Phase I and II awards going back several years. This information can be viewed on the DoD SBIR/STTR Awards Search website at www.dodsbir.net/awards.

Please Note: Potential offerors must follow the proposal content rules and funding for the agency that has proponentry for topics. Topics are numbered in series, with Army topics starting at 100, Navy topics starting at 200, and Air Force topics starting at 300. Please refer to the appropriate Navy and Air Force sections in this Solicitation for information on proposal preparation, proposal guidelines, and funding limits. Detailed instructions for proposals to be submitted against Army topics are given below.

Army Proposal Guidelines

The Army has enhanced its Phase I-Phase II transition process by implementing the use of a Phase I Option that the Army may exercise to fund interim Phase II activities while a Phase II contract is being negotiated. The maximum dollar amount for a Phase I feasibility study is \$70,000. The Phase I Option, which must be proposed as part of the Phase I proposal, covers activities over a period of up to four months and at a cost not to exceed \$50,000. All proposed Phase I Options must be fully costed and should describe appropriate initial Phase II activities which would lead, in the event of a Phase II award, to the successful demonstration of a product or technology. **The Army will not accept Phase I proposals which exceed \$70,000 for the Phase I effort and \$50,000 for the Phase I Option effort.** Only those Phase I efforts selected for Phase II awards through the Army’s competitive process will be eligible to exercise the Phase I Option. To maintain the total cost for SBIR Phase I and Phase II activities at a limit of \$850,000, the total funding amount available for Phase II activities under a resulting Phase II contract will be \$730,000.

Companies submitting a Phase I proposal to the Army under this Solicitation must complete the Cost Proposal within a total cost of \$70,000 (plus up to \$50,000 for the Phase I Option). Phase I and Phase I Option costs must be shown separately. In addition, all offerors will prepare a Company Commercialization Report, for each proposal submitted, which does not count toward the 25-page limitation.

Selection of Phase I proposals will be based upon scientific and technical merit, according to the evaluation procedures and criteria discussed in this solicitation document. Due to limited funding, the Army reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded.

Proposals not conforming to the terms of this solicitation, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

Army Phase II Proposal Guidelines

Phase II proposals are invited by the Army from Phase I projects that have demonstrated the potential for commercialization of useful products and services. The invitation will be issued in writing by the Army organization responsible for the Phase I effort. Invited proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing the developed technology. Fast Track participants may submit a proposal without being invited, but the application must be received NLT 120 days after the Phase I contract is signed or by the Phase II submission date indicated later, whichever date is earliest. The Fast Track technical proposal is due by the Phase II proposal submission date indicated later. Cost-sharing arrangements in support of Phase II projects and any future commercialization efforts are strongly encouraged, as are matching funds from independent third-party investors, per the SBIR Fast Track program (see section 4.5 at the front of this solicitation) or the ***Phase II Plus*** program. The Fast Track application form must be completed electronically by firms through the DoD SBIR/STTR Submission Site (www.dodsbir.net/submission). Commercialization plans, cost-sharing provisions, and matching funds from investors will be considered in the evaluation and selection process, and Fast Track proposals will be evaluated under the Fast Track standard discussed in section 4.3 at the front of this solicitation. Proposers are required to submit a budget for the entire 24 month Phase II period. During contract negotiation, the contracting officer may require a cost proposal for a base year and an option year, thus, proposers are advised to be mindful of this possibility. These costs must be submitted using the Cost Proposal format

(accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet, Proposed Cost. At the Contracting Officer's discretion, Phase II projects may be evaluated after the base year prior to extending funding for the option year.

The Army is committed to minimizing the funding gap between Phase I and Phase II activities. All Army Phase II proposals will receive expedited reviews and be eligible for interim funding (refer to top for information on the Phase I Option). Accordingly, all Army Phase II proposals, including Fast Track submissions, will be evaluated within a single two-tiered evaluation process and schedule. Phase II proposals will thus typically be submitted within 5 months from the scheduled DoD Phase I award date (the scheduled DoD award date for Phase I, subject to the Congressional Budget process, is 4 months from close of the DoD Solicitation). The Army typically funds a cost plus fixed fee Phase II award, but may award a firm fixed price contract at the discretion of the Contracting Officer.

Key Dates

03.1 Solicitation Open	2 December 2002 – 16 January 2003
Phase I Evaluations	January - March 2003
Phase I Selections	March 2003
Phase I Awards	May 2003*
Fast Track Applications Due	September 2003
Phase II Invitations	September 2003
Phase II Proposals Due	October 2003

*Subject to the Congressional Budget process.

CBD SBIR PROPOSAL CHECKLIST

This is a Checklist of Requirements for your proposal. Please review the checklist carefully to assure that your proposal meets the CBD SBIR requirements. **Failure to meet these requirements will result in your proposal not being considered for review or award.**

- _____ 1. The Proposal Cover Sheets along with the full Technical Proposal, Cost Proposal and Company Commercialization Report were submitted via the Internet using the DoD's SBIR/STTR Proposal Submission website at <http://www.dodsbir.net/submission>.
- _____ 2. The proposal cost adheres to the individual Service (Army, Navy, Air Force) criteria specified.
- _____ 3. The proposal is limited to only **ONE** solicitation topic. All required documentation within the proposal references the same topic number.
- _____ 4. The Project Summary on the Proposal Cover Sheet contains no proprietary information and is limited to the space provided.
- _____ 5. The Technical Content of the proposal, including the Option (if applicable), includes the items identified in Section 3.5.b of the solicitation.
- _____ 6. The proposal, including the Proposal Cover Sheets and Cost Proposal, is 25 pages or less in length. (Excluding the Company Commercialization Report.) Proposals in excess of this length will not be considered for review or award.
- _____ 7. The Company Commercialization Report, is submitted online in accordance with Section 3.5.d. This report is required even if the company has not received any SBIR funding. (This report does not count towards the 25-page limit).
- _____ 8. The proposal contains no type smaller than 10-point font size (except as legend on reduced drawings, but not tables).

Chemical and Biological Defense 03.1 Topic List

CBD03-100	Amplification of Molecular Signals
CBD03-101	Synthetic Recognition Elements for Chemical and Biological Sensors and Assays
CBD03-102	AOTF Based Imaging Sensor for Enhanced Stand-off Chemical Detection
CBD03-103	Botulinum Neurotoxin Inhibitors
CBD03-104	Identification of Compounds to Induce Suspended Animation or Hypometabolism
CBD03-105	Standoff Detection of Biologically Contaminated Surfaces
CBD03-106	Improved Protein Manufacturing in Insect Expression Systems
CBD03-107	Aerosol Collector Technology
CBD03-108	Novel Surface Modification Technologies for Improved Chemical Biological (CB) Protective Materials
CBD03-109	Electron Microscopy for Mobile Laboratory Systems
CBD03-200	Surface Contamination Monitors
CBD03-201	Monitoring Food and Water for Pathogens
CBD03-202	Microorganism Imprinted Polymers (MIOPs) for Detection of Biological Warfare Agents
CBD03-203	Multi-mission Chemical Sensor (MMCS)
CBD03-300	Multivariate Feature Extraction for Autonomous Unmixing of Spectral Data
CBD03-301	Short-Range Standoff Surface Detector
CBD03-302	Novel Methods for Capture of Chemical/biological Agents
CBD03-303	Novel Methods for Decontamination of Biological Agents
CBD03-304	Nanoparticle-Bound Polymers as Structural Materials Reactive Against CBW agents
CBD03-305	Rapid Repair of CB Hardened Systems

CHEMICAL AND BIOLOGICAL DEFENSE 03.1 TOPIC DESCRIPTIONS

CBD03-100

TITLE: Amplification of Molecular Signals

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: Identify and develop a biological amplification system for detecting rare, unique biosignatures of microbial threat agents.

DESCRIPTION: The rapid detection of the specific biological agents in an attack is crucial for developing an appropriate response. In contrast to chemical agents, which must be deployed in substantial amounts, biological agents can be in very small quantities to elicit an infection or toxic response. Without appropriate detection, the first evidence of a biological attack could be wide spread sickness in the targeted population. Early detection, therefore, requires some mechanism to amplify a rare, specific biosignature for detection by chemical, microbiological, immunologic, or molecular biological techniques. The polymerase chain reaction (PCR) is widely touted as such a tool, but this requires rigorous sample preparation, complex reactive components of limited shelf life, precise temperature regulation, sophisticated hardware, a complex detection process, and trained personnel. This is appropriate for laboratory diagnosis, but is of limited utility in the field. Further, PCR would be useless in detecting toxic protein exposures. The critical link in most detection systems is to provide a sufficient amount of the material for analysis, or to elicit a distinctive, detectable signal that is responsive to a particular biosignature of the agent. Enzymatic cascades have been shown to elicit thousands-fold amplified response to the input elicitor. The initiation of most pathogenic responses involves the interaction of the biothreat with a particular cellular receptor. Advantage could be taken of that agent:receptor interaction in a bioengineered complex linked to an amplification cascade, yielding a specific, detectable response by way of a color reaction, light production, electrochemical gradient, etc. Critical in the evaluation of a proposal to develop such a signal amplification system will be the uniqueness, specificity, simplicity, and ease of operation of the amplifying system in a field-deployable detection module.

PHASE I: The proposers will begin to investigate what types of amplification modules could be used to provide an adequate detection signal that is specific to the biothreats. At the end of Phase I, the investigators will have demonstrated significant progress toward "proof of principle" for a biothreat surrogate and will provide sufficient insight into the anticipated developed system to make a critical evaluation of potential. The Phase I deliverable will be the identification of a novel biological amplification process, a plan for making this complex usable in commercial or military applications, and data from ongoing research in support of the proposed system.

PHASE II: The investigators will continue to test the unique system for the ability to detect biothreat surrogates, reliably, specifically, and rapidly. Effective systems will be tested under a variety of operating conditions appropriate for field deployment. The system will be developed to a point that the company or commercial partner would have an interest in taking over development at the end of Phase II. The detector itself could be one that is already available commercially or could be unique to the product being developed. The Phase II deliverable is a system ready for commercial development.

PHASE III COMMERCIALIZATION: If successful, this program will lead to a commercially viable system for amplifying distinctive biothreat signatures for detection using a suitable, deployable amplification-detection system. It is also anticipated that this system would be used in routine clinical testing, which is a multimillion dollar market.

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Howard M, Kaplan D, 2002, Applications of enzymatic amplification staining in immunophenotyping hematopoietic cells, *Front Biosci* 2002 Apr 1; 7:c33-43.

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Vivier E, Biron C A, 2002, Immunology: Enhanced: A Pathogen Receptor on Natural Killer Cells, *Science* 2002 May 17; 296(5571):1248-9.

Wehrman T, Kleaveland B, Her J H, Balint R F, Blau H M, 2002, Protein-protein interactions monitored in mammalian cells via complementation of beta-lactamase enzyme fragments, *Proc Natl Acad Sci U S A* 2002 Mar 19; 99(6):3469-74.

KEYWORDS: Signal Amplification

CBD03-101 TITLE: Synthetic Recognition Elements for Chemical and Biological Sensors and Assays

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: To replace labile biological recognition elements such as antibodies with rugged, synthetic organic molecules serving as artificial receptors.

DESCRIPTION: Many currently fielded or planned assay formats and biological detectors require antibodies as their biological recognition element. These are large molecules which are expensive to develop and manufacture, subject to degradation in extreme environments, and of limited shelf life. Further, their use is primarily limited to BW agents such as pathogens and toxins, and they are less efficient at detecting small molecules such as chemical warfare (CW) agents and toxic industrial chemicals (TICs). Detection of BW, CW and TICs by the same sensor platform would simplify operations and logistics.

A number of commercial biosensors are being developed for long-term physiological monitoring, medical diagnostics and environmental monitoring, the most efficient being optical sensors which require only microwatts of power. The challenge is to develop a matrix that is physically altered by the analyte, such as sorbent polymeric matrices, or one in which specific molecular interactions reflect altered excitation states of an embedded fluorophore. In the latter, synthetic organic molecules with unique binding abilities would replace traditional antibody reagents.

PHASE I: Proof of concept by identifying synthetic organic molecules capable of selectively recognizing BW, CW and TIC analytes or their simulants with comparable sensitivities to antibodies.

PHASE II: Develop sol-gel or other matrix compatible with the diffusion and binding of BW, CW and TIC analytes or their simulants. Select synthetic organic molecules, couple to an optical reporter, and demonstrate binding and signal transduction following aerosol and aqueous challenge with analytes.

PHASE III: Dual use opportunities include hospital emergency room triage to separate the "worried well" from true casualties, monitoring physiological levels of cardiac enzymes and other diseases markers, and environmental monitoring.

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Fernando, J. C., Rogers, K. R., Anis, N. A., Valdes, J. J. and Eldefrawi, M .E. J. Agricultural and Food Chemistry, 1993, 41, 511-516.

Valdes, J. J. Biological Agent Detection Technology. In, Verification of the Biological and Toxin Weapons Convention. NATO Adv. Studies Inst. Series, 2000, 32, 181-197.

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KEYWORDS: Sensors, Reagents, Signal Transduction, Biosensors, Artificial Receptors

CBD03-102 TITLE: AOTF Based Imaging Sensor for Enhanced Stand-off Chemical Detection

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: Build an AOTF Imaging System for Enhanced Standoff Chemical Detection in the Long-wave Infrared Region.

DESCRIPTION: Chemical agent infrared absorption/emission is largely confined to the 8 to 10 micron region of the EM spectrum. Tunable filters such as Acousto-Optic Tunable Filters (AOTF) are just becoming available in this wavelength region. AOTF technology is based on the interaction of very high frequency sound waves in a crystal causing transparent windows to form in the crystal. As the sound frequency is changed, only infrared radiation with wavelength matching the resulting transmission band of the crystal will pass and hit the detector. Inexpensive infrared longwave focal-plane-arrays are just now becoming available allowing for low cost imaging capabilities. These include the rugged and inexpensive microbolometer based focal-plane-arrays. The resulting imaging system would have a number of advantages over a conventional FTIR interferometer: 1) it would contain no mechanical moving parts, making it inherently rugged and precise, 2) it would directly measure spectra, dramatically reducing data sampling rate while enhancing spectral throughput, and 3) it would have a large dynamic range. Furthermore, the system would be compact and thus easily integrated into a variety of configurations. This system would directly support the Army's Chemical Imaging Program, which has been identified as a far-term need in the DoD Joint Detection Program Strategy as defined by the Joint Panel for Chemical and Biological Defense.

PHASE I: Demonstrate laboratory-scale proof-of-concept, including the design of a laboratory AOTF with a longwave infrared focal plane array.

PHASE II: Build and test the Phase I laboratory-scale AOFT imaging system. The testing would include system performance and measured spectra. Design of a prototype field testable system would evolve from the tests on the lab instrument.

PHASE III DUAL USE APPLICATIONS: Applications range from research spectrometers to atmospheric monitoring devices.

REFERENCES:

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KEYWORDS: Standoff Detection, Passive Detection, Infrared Sensor, Imaging, Tunable Filter

CBD03-103

TITLE: Botulinum Neurotoxin Inhibitors

TECHNOLOGY AREAS: Chemical/Bio Defense, Biomedical

OBJECTIVE: The objective is to design, develop, and produce effective botulinum neurotoxin (BoNT) inhibitors. The inhibitors must be more effective than current first generation lead compounds and potentially therapeutic compounds (small drugs, peptides, or immunoglobulins) and nontoxic. As pretreatments, the inhibitors could prevent binding of the toxin(s) to external receptors, interfere with the exquisite targeting and translocation into the neuronal cell, and as post-treatments, the inhibitors would block the proteolytic endopeptidase activity. For post-treatment, a delivery system to specifically transport inhibitors to the target cholinergic nerve terminals would be advantageous.

DESCRIPTION: Currently, there are no effective pretreatments to non-immunized individuals or therapeutic agents for BoNT poisoning. While immunoglobulin therapy may have some usefulness for ameliorating post-exposure symptoms by scavenging residual BoNTs, it is available in small quantities and prohibitively expensive for treatment of mass casualties. Small organic compounds show some efficacy in vitro against BoNT endopeptidase activity but currently have toxic side-effects. Peptide inhibitors such as Buforin I (BI), while nontoxic to red blood cells, dose-dependently and competitively inhibited BoNT B subtype inhibitory activity. Therefore, small compounds, peptides, and peptide mimetics can be applicable for the development of therapeutics to penetrate BoNT intoxicated neurons and inhibit further proteolytic activities.

PHASE I: Phase I research will be to design, synthesize, and evaluate new inhibitors: the generation of more potent pharmacologically active compounds/peptide mimetics of the catalytic endopeptidase domain or to BoNT/A, B, C, E, or F; these toxins are considered to be the most likely threat agents. As a first screen, 5-10 compounds would be evaluated. The inhibitors produced for further development must be more effective than current BI peptide inhibitors, other peptide mimetics, or small drugs.

PHASE II: Promising inhibitor candidates from Phase I will be further explored via QSAR. Ideally, therapeutic compounds will be designed to be efficacious against all the botulinum serotypes and tetanus toxin. In addition, a candidate which acts as a suicide inhibitor would be advantageous since some botulinum toxins are very persistent intracellularly. The compounds will be evaluated for pharmacokinetic parameters and toxicity in mice. This may include conjugation of the prodrugs (compounds/peptides) to a delivery system (such as heavy chain of BoNT) to target the drug to neuronal cells. These compounds will also be tested to demonstrate efficacy in the mouse model against BoNT(s).

PHASE III: (1) Produce BoNT inhibitors for therapeutic treatment of BoNT(s) poisoning. (2) Produce a single therapeutic compound with efficacy to all BoNT serotypes. (3) Initiate IND for these inhibitors.

PHASE III DUAL USE APPLICATIONS: A) There must be a rapid and effective means for prophylactic protection of first responders against poisoning by BoNTs that could occur after release from terrorist actions with these agents. B) Although improvements in home-canning techniques, food processing, and knowledge of infant botulism have reduced botulisms incidence, deaths still occur and significant and long term supportive hospital care is still required in the general population world wide. C) Wound botulism resulting from injection drug use is increasing.

D) Botulinum toxins have been and are increasingly used as treatment for a variety of human diseases such as dystonias, pain relief, temporomandibular disorders, focal hyperhidrosis, and others. In the limited use of botulinum toxins to date for medical treatment, accidental overdosing has already been documented. Therefore, there is an immediate requirement for a therapy for overdose of BoNT.

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Park, C. B., Kim, M. S., Kim, S. C. A novel antimicrobial peptide from *Bufo bufo gargarizans*. *Biochem. Biophys. Res. Comm.* 218:408-413 (1996).

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KEYWORDS: Botulinum, Neurotoxin, Inhibitors, Buforin, Terrorist, First Responders, Biochemical Warfare Agents

CBD03-104 TITLE: Identification of Compounds to Induce Suspended Animation or Hypometabolism

TECHNOLOGY AREAS: Chemical/Bio Defense, Biomedical

OBJECTIVE: To identify compounds to induce suspended animation or reduced metabolism.

DESCRIPTION: It has recently been shown that suspended animation can be induced in complex organisms. Complete suspended animation or incomplete suspended animation (hypometabolism) of whole organisms, tissues, organs, and cellular products has a multitude of uses for DoD, many of which would have a major impact on survivability and logistics: 1) increasing the length of time that a critically injured warfighter can survive without medical care, 2) reducing or eliminating air intake in troops while exposed to chemical or biological agents, 3) enabling shelf-stable blood, plasma, organs, 4) reducing food requirements of troops during travel, 5) reducing logistical costs of transporting and guarding POWs, 6) increasing survival and performance in adverse conditions or extended operations, and 7) transport of military dogs and other animals used by DoD.

Phase I: Establish and begin using a system for high throughput testing of genes or drugs to induce a state of suspended animation and/or reduced metabolism.

Phase II: In this phase the investigators will screen either a complete genome or a complete chemical library representative of the majority of chemical space, for proteins or compounds that induce suspended animation or hypometabolism in a model test organism. Depending on when in phase II such a molecule is found, the investigators may conduct research to enable clinical trials of the compound as a therapeutic agent.

Phase III- This phase would involve testing for FDA approval as a therapeutic drug. It is anticipated that commercial interest would be high. For example, people who are far from medical care might carry an injection kit

in case of medical emergency. Also populations of high risk patients (such as nursing homes) would use the compound in critical cases, such as heart attack, or other medical conditions that need immediate high tech care. Persons waiting for organ transplants might need to be put into a state of reduced metabolism until the appropriate organ could be obtained. Sheep and other animals being sent to market might be put into a state of reduced metabolism to reduce food, handling costs, and stress during transportation. This technology would also enable human space travel beyond our solar system.

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KEYWORDS: Suspended Animation, Hypometabolism

CBD03-105

TITLE: Standoff Detection of Biologically Contaminated Surfaces

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: PM Artemis

OBJECTIVE: To demonstrate innovative technologies for detecting and identifying biological materials on various surfaces, from a standoff distance of 1 meter or more.

DESCRIPTION: Standoff passive and active systems are currently being developed by the Department of Defense (DoD) to answer the chemical and biological aerosol threat. Systems such as the Artemis, Warning and Identification LIDAR Detector for Countering Agent Threats (WILDCAT), Joint Service Lightweight Standoff Chemical agent Detector (JSLSCD), Joint Biological Standoff Detection System (JBSDS) are currently the state of the art in standoff chemical and biological detection systems.

But what happens to this threat when it settles onto the terrain? The surface hazards, presented by these agents, are an effective means of terrain denial. When traveling through an affected area, personnel and equipment can be recontaminated causing casualty and equipment downtime. A quick and effective means of detecting the contamination perimeter is necessary to decontaminate these surface hazards. There are currently programs to develop remote sensing systems for chemical detection on surfaces but not for biodetection.

Biohazards are usually in three forms: bacterial, viral, and bio-toxins. Spore-forming bacteria and matrix-bound bio-toxins are of concern since they can remain viable as long or longer than chemicals. Absorption and fluorescence characteristics have been used to distinguish biological from non-biological samples. These characteristics were used to create sensors for biological aerosol detection however no data is available for use against ground contamination.

The results of this effort will be applied in the near-term to the Joint Surface Contamination Detection project as well as the Artemis acquisition program to enhance its CB detection capabilities on the multiple platforms for which it is being developed.

PHASE I: Demonstrate proof of concept through theoretical modeling as well as controlled laboratory data. Through this effort a database of backgrounds and simulant samples will be compiled and sensitivities calculated from data.

PHASE II: In Phase II, the Phase I approach will be used as a model for the development of an integrated, breadboard device. Automated data acquisition and signal analysis/detection algorithm will be developed for this breadboard system. Theoretical studies will be initiated for use of this system as an on-the-move device.

PHASE III DUAL-USE APPLICATIONS: Phase III military applications will develop a breadboard system for on-the-move applications. In addition, dual-use intelligence and homeland defense applications could directly benefit from having a standoff detection device with optimized performance. Phase III commercial applications include spin-off detectors for standoff environmental pollution monitoring and for biological contamination in food service industries.

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KEYWORDS: Detection, Surface, Standoff, Biological

CBD03-106

TITLE: Improved Protein Manufacturing in Insect Expression Systems

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

OBJECTIVE: To develop improved and/or novel systems for the expression and manufacture of recombinant proteins in insect cells.

DESCRIPTION: Bringing the benefits of the biotechnological revolution to practical applications requires cost- and resource-efficient, scalable, flexible systems for protein manufacture and purification. Such systems have broad applications in the development of new reagents for biological warfare agent detection, novel enzyme-driven chemistries for decontamination, among other uses. An optimal expression system would incorporate features useful to the production molecular engineer such as reporter systems that allow real-time continuous monitoring of product accumulation, ease of subcloning of recombinant material into expression vectors, modified insect cell lines that glycosylate or otherwise modify proteins in ways that mimic mammalian (especially human) patterns of post-translational protein modification, strong promoters, signal peptides that direct the secretion or sequestration of recombinant proteins, mechanisms for the rapid separation of recombinant proteins from cell cultures, or the adaptation of any of the foregoing to protein production in intact insect larvae.

PHASE I: Develop novel DNA cloning vectors that incorporate as many of the features mentioned above as possible. Demonstrate the expression of a protein of interest to the sponsor.

PHASE II: Integrate the vectors demonstrated at the end of Phase I into a coherent scalable industrial process using either intact larvae or suspension culture cells. The process should be monitorable in real time and should not rely on physical sampling of the culture contents to determine the extent of product accumulation.

PHASE III DUAL USE APPLICATIONS: Such a process would serve both DoD biotechnology goals and provide the developer with a technology for producing recombinant proteins for a wide variety of commercial customers and applications, including the manufacture of vaccines and therapeutic proteins under current Good Manufacturing Practices (cGMP).

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KEYWORDS: Baculovirus, Plasmid, Gene Expression, Recombinant, Protein, Insect, Cells, Antibodies, Enzymes

CBD03-107

TITLE: Aerosol Collector Technology

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: Develop new aerosol collector devices to maximize the quantity of aerosol collected in the 1-10 micrometer size range while reducing the portion of the aerosol outside of this range. Optimize collectors to reduce collector size, weight, cost and power requirements.

DESCRIPTION: Aerosol collectors are required for all point biodetection systems and future chemical point detectors. Given that dangerous or lethal doses are available from BW aerosol agents at low concentration and the relative insensitivity of immunoassay based test strips, the aerosol collector must bridge the gap by stripping a large volume of air (several cubic meters) of its particulates and transferring them to a small liquid volume (a few ml) for analysis. Currently wetted wall cyclone aerosol collectors are employed by BIDS and JBPDS, but their power requirements are high (400-500 Watts) – driven by the need to collect particles as small as 1 micrometer. Cyclones and all inertial separation devices are intrinsically very inefficient at capturing small particles.

A highly efficient well-known technology for removing small particles from gas is electrostatic precipitation. We are seeking innovative proposals that apply electrostatic technology to the problem of small particle aerosol collection. The challenge is to devise a system that automatically transfers the precipitated particles into a small volume of collection fluid.

PHASE I: The contractor will design an electrostatic based aerosol collection system with a target aspiration of at least 500 l/min. We will consider systems based purely on electrostatic principles, and hybrid systems in which larger particles are collected by conventional means (inertial) and smaller particles are collected electrostatically. The target collection efficiency is 80%, from air to water, over the aerodynamic size range 1 to 10 micrometers. Wind is not a concern at this stage; one may assume that sampling is done from quiet ambient air.

PHASE II: In this phase a successful and promising design from Phase I will be optimized for specific collection characteristics in consultation with the government. The contractor will build two complete units of the collector and test their characteristics in aerosol chambers. The two collector systems will be delivered to the government.

PHASE III DUAL USE APPLICATIONS: It is anticipated that the collector(s) developed in this program will be integrated into CB-detection units fielded for Joint Service use. Applications exist in other government activities

such as Treaty Verification, Domestic Preparedness, Demilitarization, and Homeland Defense. Civilian applications should be discovered in many areas such as medical monitoring and food packaging.

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KEYWORDS: Aerosol, Aerosol Collector, Electrostatic Precipitator, Concentrator, Biological Collector, Chemical and Biological Detector, Aerosol Sampling

CBD03-108 TITLE: Novel Surface Modification Technologies for Improved Chemical Biological (CB) Protective Materials

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: PM-Soldier Equipment

OBJECTIVE: Explore innovative surface modifying technologies that impart enhanced liquid repellent properties to the outer shell material layer of CB protective garments.

DESCRIPTION: Currently fielded CB protective garments for Army, Navy, US Marine Corps, Air Force, and Special Operations personnel, such as the Joint Service Lightweight Integrated Suit Technology (JSLIST), employ a liner containing the carbon adsorbent and an outer shell made from a textile material providing both durability and water repellency. Durability is achieved by use of strong fibers woven in a tight pattern, often a ripstop weave that resists rips and tears. Resistance to water or liquids occurs through application of a Quarpel type finish to the surface of the material. The Quarpel type finish provides the needed liquid repellency, but this treatment is difficult to apply successfully and its effectiveness diminishes over time, field wear, and repeated launderings. To maintain the water repellent property of the outer shell material after laundering, a higher drying temperature than that used to dry garments in field laundries is recommended. Even if the increased temperature were controllable on the field laundry unit, use of the higher temperature can lead to garment shrinkage and other damage, such as melted or fused components (zippers, hook and loop fasteners, etc.). The ideal outer shell material would have a novel surface modification to either its fibers or the fabric, resulting in a water repellent material for the life of the garment. The modified material would withstand ten launderings (Objective of the Operational Requirements Document), not require "resetting" at increased dryer temperatures, and have enhanced durability properties. Elimination of the Quarpel type repellent finish, effectively a coating, will gain improvements to CB chemical protective clothing.

PHASE I: Show candidate materials/treatments with improved water repellency, chemical resistance [petroleum, oil, & lubricant (POL) and chemical warfare agent simulants], durability/laundryability, and breathability when compared to current garment systems.

PHASE II: Select best Phase I candidate(s) and scale process to produce fabric in standard widths for the production of garment prototypes. Demonstrate desired physical properties, including chemical agent resistance, of the fabric and prototypes and cost-effectiveness of the approach.

PHASE III DUAL USE APPLICATIONS: Fabric systems developed in this SBIR program would have a broad range of commercial applications. Developed materials would be useful for industrial chemical protective garments; Federal, state and local emergency responders to chemical spills or attacks; improved water-repellent garments for sporting and outdoor activities; and protective tarps & temporary shelters.

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KEYWORDS: Surface Finishes, Water and Oil Repellency, Chemical Protection, Quarpel Type Finishes

CBD03-109

TITLE: Electron Microscopy for Mobile Laboratory Systems

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: To conduct basic and developmental research to design and build a miniaturized electron microscope for field analysis of unknown materials and potential products of WMD incidents.

DESCRIPTION: The US military community has a need for methods for rapidly and efficiently identifying materials involved in potential terrorist incidents at home and abroad. Numerous technologies for rapid and efficient pathogen identification, detection of chemical agents, and nuclear monitoring have been developed for both homeland defense and military applications. Many of these have been developed with the goal of miniaturizing, multiplexing and accelerating the identification process. Most of these technologies have been developed and are applied with the intent of proving or disproving the presence of specific select agents. With the expanding number of threat sources and possible scenarios there is need for fieldable analytical tools that go beyond the first screening level and that provide some information about what is present if the initial screens indicate that the specific targets are not present. With the current emphasis on defense against and response to localized terrorist threats the demand for rapidly deployable small detection and identification schemes has increased dramatically.

Although not directly applicable to the soldier-in-the-field scenario, microscopy integrated with x-ray analysis is one approach to gaining rapid information about solid substances. The goal of this topic is to investigate the possibility of applying recent advances in digital electron microscopy, vacuum systems, and x-ray detectors to the design of an electron microscope/x-ray analysis system that can be readily mounted on a mobile platform, ideally a mobile laboratory van platform in which the designed instrument will not be the only piece of analytical equipment. That is, it shouldn't fill the entire vehicle

PHASE I: Identify, develop and test component technologies. Demonstrate sensitivity and selectivity. Design overall system mock-up. Demonstrate practical feasibility of approach. Deliverable for Phase I is a report on the system design including data indicating the validity of the integrated technologies.

PHASE II: Optimize and test prototype system. Deliverables of phase II are a comprehensive report including final system design and a prototype system for testing.

PHASE III DUAL USE APPLICATIONS: For military applications the product should be a user-friendly, bioidentifying system with output that is easy to read and interpret even under nonideal circumstances. In the private sector this technology has a huge market audience in homeland defense, remote clinics, and other government and crime prevention markets where mobile analytical capabilities are becoming increasingly important.

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KEYWORDS: Microscopy, Electron Microscopy, X-ray Microanalysis, Mobile Laboratory Systems

CBD03-200 TITLE: Surface Contamination Monitors

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: To develop technologies that would identify areas of CW contamination on surfaces.

DESCRIPTION: Current technologies/hardware for the detection of surface contamination depend either on modifications to existing CW detector or the use of M8/M9 paper. Neither of these approaches will provide an adequate solution. Adaptors to fielded detectors include such devices as the funnel or cone that fits over the inlet of the CAM. While this has some usefulness in still-air conditions, it is very slow when used to scan a moderate size area and, when the air is moving across the surface as is the case on a ship's deck, has very limited use. M8 and M9 paper are only useful when free liquid remains on the surface. If the surface adsorbs the agent as in the case of painted surfaces, asphalt, concrete and fabric, the use of the M8/M9 paper is inadequate.

A reactive material to detect surface contamination is needed that would provide an indication of the presence of CW agents. This could be either an obvious color change or a reaction that requires the application of an external agent, such as a UV light, to see a response. This material could either be incorporated onto or into the surface material or sprayed on suspected areas. It would be an advantage if the material could differentiate between OP and vesicants. If the reactive material is placed in the surface material, it should not effect the critical requirements of that surface material.

PHASE I: (1) Identify a technology that could be used to identify the presence of CW contamination on/in surfaces. (2) Perform an initial evaluation to determine the level of contamination detected and integrate with user's needs.

PHASE II: (1) Initiate an evaluation of the effects of the detection material on selected surfaces. (2) Demonstrate the prototype system with simulants.

PHASE III: A high potential exists for such a technology in the hazardous chemical transport area as well as in pollution control work.

KEYWORDS: Chemicals, Materials, Paints, Surfaces, Detection

CBD03-201 TITLE: Monitoring Food and Water for Pathogens

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: The goal of this program is to develop a new hybrid instrument system for early and rapid detection of environmental bacterial and viral pathogens by harnessing technological components currently available at commercial and national laboratories. It is the intent of the program to produce a device that is easily used by untrained personnel but can significantly enhance the operational efficiency and readiness of shipboard, land-based and expeditionary naval forces.

DESCRIPTION: Throughout history, military forces have sustained far greater casualties and troop incapacitation from infectious diseases than from enemy fire. The U.S. Navy has been actively involved in efforts to monitor and prevent endemic diseases among its OCONUS personnel since the South Pacific campaigns of World War II. DOD

has become increasingly concerned with the threats of emerging and weaponized infectious pathogens. Many factors contribute to the urgency. There is a concern that U.S. forces will need to be deployed in countries with underdeveloped local sanitation and minimum infectious disease identification/control capabilities. The likelihood of personnel contact with food or waterborne epidemic organisms or newly emerging zoonotic or vector-borne pathogens is increased under these conditions. The same environment and political realities increase the chances of personnel encounters with weaponized biologicals since these are thought to represent attractive alternatives to costly weapons technology programs.

The DOD has identified the need for a capability for diagnosing infectious disease and biological warfare agents in clinical specimens (Defense Technology Objective MD.17.J00). Despite these initiatives, neither the epidemiologic surveillance infrastructure for monitoring infection threats nor technology for real-time monitoring of infectious threats in the environment required to achieve them currently exist. Current technologies require a lengthy collection and sampling time to properly detect the presence and identity of infectious agents. This effort will provide the preliminary research and design to produce a system that is/can be miniaturized, lightweight, durable, and easy to operate.

PHASE I: (1) Determine and document current capabilities for pathogen detection in the commercial, academic, and national laboratories. (2) Identification and prioritization of target pathogens. (3) Protocol development to be used for identification of each of the target pathogens.

PHASE II: (1) Develop a prototype sample interface system for liquid and aerosol environmental samples. (2) Preliminary assessment of the feasibility of incorporating an array of molecular markers of pathogenic potential into the system. (3) Adapting/refining prototype sampling and sample preparation devices

PHASE III: This device could have wide application in the food industry, medical diagnostics, waste water treatment facilities and civilian agencies.

KEYWORDS: Biologicals, Pathogen, Detection, Sampling

CBD03-202 TITLE: Microorganism Imprinted Polymers (MIOPs) for Detection of Biological Warfare Agents

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: PM NBC Defense Systems, MARCORSYSCOM

OBJECTIVE: To develop an innovative real-time Biological Warfare Agent (BWA) detection technique suitable for hand-held point sensors.

DESCRIPTION: Sensors being developed for detection of biological and chemical agents generally consist of a molecular recognition element to impart selectivity for the target organism or analyte. The receptors can be highly specific like DNA probes or generic to a class of agent [1,2]. Molecular imprinting of polymers (MIP) is being used to make artificial receptors for various chemical species and has recently been investigated for detection of Chemical Warfare Agents(CWA)[3-5].

The recent development of MIP artificial recognition sites has only recently been extended to detection of biological species [6, 7]. Microcontact printing of polyurethane was used to make recognition sites and collection surfaces for selected cell types such as *S. cerevisiae* yeast cells. When used with a mass sensitive detector, selectivity for different yeast species and good sensitivity was reported. Gram-positive cells were also shown to be distinguished from gram negative bacteria. However, mass-based detection is inherently susceptible to various interferences and high noise levels.

Application of the microorganisms imprinted polymers (MOIPs) to optical sensing represents a promising new approach that should improve capture efficiency and also mitigate interference from non-biological particulates through enhanced selectivity. Combining MOIPs with fluorescent reporter molecules already being used to detect

BWAs will result in a sensitive and robust detection platform. The MOIPs offer selectivity not realized in other porous materials.

PHASE I: Conduct a proof of concept for MOIPs using representative bacteria, spores and viruses. Develop and test protocols for preparation of MOIPs. Test selectivity and capture efficiency of MOIPs for the target organism using fluorescence microscopy and digital imaging. Co-immobilize selected fluorescent reporter molecules and measure signal changes in the presence of target organisms. Identify and test alternative matrices for preparation of MOIPs to improve optical properties of the sensing film. At the conclusion of Phase I demonstrate potential of the MOIPs for detection of airborne and waterborne BWA simulants.

PHASE II: In Phase II the MOIP and sensor formulations will be optimized for target BW simulants including bacteria, spores and viruses. Sensing films will be fully characterized for sensitivity, response time, selectivity, stability and reversibility. A prototype optical detection system based on MOIP receptors and fluorescent reporters should be designed, fabricated and tested. The detection system will have multiple sensor channels responsive to specific BW simulants and targets. Demonstrate detection primarily of airborne organisms and feasibility of detecting waterborne agents. Assess sensor reversibility and evaluate methods to refresh the MOIP sensors. The system will be tested and evaluated at an independent laboratory. If Government testing facilities are used, MARCORSSYSCOM will fund the test directly at no cost to the investigators. The Phase II deliverable will be prototype demonstration and delivery to the sponsor.

PHASE III DUAL USE APPLICATIONS: The proposed project will demonstrate prototype instrumentation for rapid detection of BWAs in air or water. This technology is directly transferable to non-military use in indoor air quality monitoring for allergens, and monitoring of potable and recreational water supplies for enteric pathogens. The core MOIP technology could also be used for rapid, simple sample extraction at the front end of a more sophisticated analytical instrument such as a PCR unit.

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KEYWORDS: Molecular Imprinting, Artificial Receptors, Microorganism Detection, Biological Warfare Agents, Optical Sensors

CBD03-203

TITLE: Multi-mission Chemical Sensor (MMCS)

TECHNOLOGY AREAS: Chemical/Bio Defense, Weapons

ACQUISITION PROGRAM: MARCORSSYSCOM, PM Nuclear Biological Chemical Defense Systems

OBJECTIVE: The objective of this program is to develop and test a chemical warfare agent (CWA) sensor system that is robust and small enough to be used in multiple applications including: as payload in an artillery projectile; air dropped from unmanned air vehicles (UAVs); mounted on unmanned ground vehicles (UGVs); or as an emplaced network of sensors for installation protection. Successful completion of this project will result in the design and construction of an integrated, autonomous sensor that may be deployed on the battlefield and used for homeland

security. Functional components of the chemical agent detection system will include the detection module, GPS receiver, RF communications, and modular platform interfaces.

DESCRIPTION: The intent of this project will be to develop the technology that will lead to a quickly deployed CB agent early warning capability to support personnel participating in expeditionary force operations. Specifically, the intent is to develop the agent detection subsystems of a chemical warfare agent detector payload for 120mm mortar rounds, 155mm howitzer projectiles, and UAV platforms which can be delivered quickly and accurately in advance of dismounted personnel. The system must be rugged enough to withstand the forces associated with delivery (up to 15,000 gs/300rev/sec), miniaturized to fit within size (290 in³) and weight (10 lbs.) constraints and must be able to communicate alerts back to commanders over distances of up to 20 kilometers. The subsystem should be capable of performing simultaneous analyses of multiple chemical agents and be easily upgraded to detect new threat agents as they are identified.

When employed as an artillery payload, the chemical agent detection system must be capable of withstanding very high launch forces and the associated rotational spin. Over the area of interest, a nose charge will initiate deployment and distribution over the ground. After sampling the air surrounding the detector, the communications system will transmit the location and battlefield condition back to the commander for use in formulating safe corridors and/or instructing the ground forces on the type of gear to wear while in the exposed area. When deployed on small to mid-sized UAVs, the MMCS must operate at altitudes up to 5,000 ft and be employable as a fixed detector or an air droppable detector. In the Homeland Security application the sensors must operate as a network.

PHASE I Project: Determine the feasibility of developing a ruggedized microelectromechanical system (MEMS) Infrared emitter and detector array usable as a sampling, data processing and detection subsystem that can be integrated with other components to produce a complete chemical agent detector payload. Fabricate a breadboard system and demonstrate the detection of a minimum of two chemical agent simulants.

PHASE II Project: Construct and demonstrate the prototype sampling, data processing and detection subsystem based on the design developed in Phase I. The prototype demonstration system shall be designed to detect multiple selected simulants for proof-of-principle. The approach for extension to specific agents of interest in Phase III and beyond must be addressed and a test plan developed. A form/fit chemical and biological detector will be built to support launch testing. The other required support functions, GPS, RF link, and batteries, will be incorporated in Phase III. Therefore these functions, in phase II, will be represented as mass equivalents. This prototype unit will be used to verify the ability to withstand projectile launch and subsequent dissemination without impacting the performance of the chemical agent detector payload.

PHASE III Project: Design and construct a complete miniaturized and ruggedized chemical agent detector payload. This phase will incorporate the GPS, RF communication, and the battery technology. Final product objective for Phase III and beyond is a system that can simultaneously detect, analyze and identify up to six chemical agents. Design must be capable of extended storage in mortar rounds and artillery projectiles without degradation of performance.

COMMERCIAL POTENTIAL: The specific sensors developed would have significant potential for airport inspection applications and for remote sensing in public areas such as subway stations. Additionally, miniature automated titration analysis systems that can be manufactured in large numbers would be of significant interest to educational institutions and commercial chemical and pharmaceutical companies.

KEYWORDS: Chemical, Detection, Sensor, Projectile, Remote

CBD03-300 TITLE: Multivariate Feature Extraction for Autonomous Unmixing of Spectral Data

TECHNOLOGY AREAS: Chemical/Bio Defense, Information Systems, Sensors

ACQUISITION PROGRAM: Joint Services Technology Panel

OBJECTIVE: Perform a complete statistical trend analysis on electro-optical (EO) spectral data to identify unique features that can be used for autonomous spectral classification, detection, and unmixing. Unmixing refers to the

separation of noisy composite signals comprised of a variety of known candidate signatures. Several classes of spectral data will be considered.

DESCRIPTION: Electro-optical (EO) sensors are being developed for chemical and biological defense, and commonly produce two-dimensional data sets characterizing spectral amplitude. Conventional feature extraction techniques previously considered for this task require qualified users to intervene in the feature selection and unmixing process for field measurements. A fully autonomous spectral unmixing program will significantly enhance the performance of spectral sensors used for contamination warning and avoidance. It will be unacceptable to exclusively apply textbook techniques to this problem; they have been thoroughly investigated and are inadequate for fully automating spectral identification. Each spectral sensor retains its own unique statistical character, related to the mechanics and specifications for that detector. A limited library of pure spectra from individual chemicals will be provided for up to four different classes of sensors. Three families of features will need to be identified for each data set to allow classification and unmixing of chemical species. All proposals must include a detailed description of the style for the intended approach to this problem. A plan with specific techniques is not necessary in this case, since the focus is on identifying and exploring innovative solutions using government-furnished data. High emphasis on statistical pattern recognition and artificial intelligence will be favored.

PHASE I: The primary deliverable in Phase I is a report that describes the full statistical character of government-furnished data sets; based on the analysis results, three families of features for each set will be identified for spectral unmixing. For each feature family, a metric is required to independently quantify projected performance of the selected features. One feature proven to be unreliable is the absolute spectral amplitude due to noise, clutter, and interference. The development of actual algorithms not required for Phase I.

PHASE II: The primary deliverable in Phase II will be a demonstration based on the component libraries from the Phase I sensors. This demonstration should include algorithms that use the features identified in Phase I to autonomously unmix field data using spectral libraries. Feature selection and extraction must occur autonomously; no user intervention is allowed.

PHASE III DUAL USE APPLICATIONS: Government users will assess algorithm performance independently using data from controlled experiments. From this, a confidence metric should be required to accompany each result. For example, consider a field measurement containing three chemicals at various concentrations used as the input for one algorithm. The algorithm determines which chemicals are present, relative concentrations, and the confidence behind the result.

REFERENCES: None. The purpose of this topic is to generate a truly innovative solution not reliant on textbook techniques; though there are many sources for autonomous signal processing algorithms and pattern recognition, we choose not to include them to avoid limiting innovation.

KEYWORDS: Chemical and Biological Defense—Contamination Avoidance; Counterproliferation—Strategic and Tactical Intelligence, Battlefield Surveillance, Battle Damage Assessment, Facility Characterization, Domestic Preparedness.

CBD03-301 TITLE: Short-Range Standoff Surface Detector

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: Joint Surface Contamination Detection

OBJECTIVE: Develop and demonstrate the operation of a standoff detector that can detect chemical contamination on conductive and dielectric surfaces from a range no greater than 2 meters. The system must be portable (defined in the description) such that it may be used for ground vehicles, cargo, aircraft, dirt, asphalt, and other surfaces.

DESCRIPTION: The DoD continuously looks for improved methods for measuring trace contaminants on surfaces. The purpose of this SBIR is to develop a short-range sensor that can measure low-level contamination on a variety of surfaces without physical contact. Such a sensor must be able to measure and identify a variety of contaminants and must be operationally feasible to employ. Any standoff phenomenology or combinations thereof can be used to

achieve sensor performance requirements. Proposals must include an overall development strategy for Phase I that considers the projected performance of the system.

The maintenance and support requirements for the prototype must be negligible to support field experimentation. The total volume of the system must be less than 1 m³ at a weight less than 50 pounds (not including power source). The projected power source for the system will be a conventional 110 V 60 Hz source with less than a 15 Ampere current draw. Selection of chemicals and specific sensitivities will occur after contract award through negotiations between the government agent and the contractor. The contractor must demonstrate in the proposal an understanding of the interaction between chemical analytes and conductive substrates, and tailor the design to overcome the issue.

PHASE I: The primary deliverable in Phase I is a prototype design based on theoretical and experimental results. This design will be provided to a government panel for critical design review to determine continuation into Phase II. The design must be accompanied by projected performance, including sensitivity, cross-reactivity, power requirements, maintenance requirements, size, weight, lifetime, and system cost. An algorithm concept/plan is required to accompany the design; however, actual computer program development is neither precluded nor required in this Phase.

PHASE II: The primary deliverable in Phase II will be the laboratory prototype system designed in Phase I. The system must stand alone, meaning that all signal processing, optical, and mechanical components are located within the prototype. The system will be designed to detect 10 different chemicals at low sensitivities during continuous water monitoring; simultaneous measurement and indication of several chemicals is required. The system will alarm upon detection and will provide a readable signal indicating which contaminant(s) is (are) present and in what concentrations, assuming the measurement is below saturation.

PHASE III DUAL USE APPLICATIONS: The government will verify the performance of the sensor independently in controlled laboratory conditions; the contractor may be present during these tests but will not be allowed to interface with the sensor system.

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KEYWORDS: Chemical and Biological Defense-Contamination Avoidance; Counterproliferation-Strategic and Tactical Intelligence, Battlefield Surveillance, Battle Damage Assessment, Facility Characterization, Domestic Preparedness

CBD03-302

TITLE: Novel Methods for Capture of Chemical/biological Agents

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: USTC/TCJ-5SC

OBJECTIVE: Method to permanently encapsulate chemical/biological agents on aircraft exteriors without surface damage

DESCRIPTION: Presently, decontamination procedures for aircraft exteriors involve spraying a liquid solution or foam on the surface. These decontaminating solutions may be caustic to the materials on which they are sprayed, such as tires or landing gear struts. The method envisioned in this topic involves "spraying" the surfaces with a solid material (e.g., beads, powder) that will encapsulate the chemical/biological agents (e.g., anthrax, foot-and-mouth disease virus) and form a non-toxic solid that can be cleaned up and disposed of at a later time. The encapsulating material will be non-reactive with standard aircraft exterior materials.

Phase I: The offeror will research several materials that hold promise for encapsulating chemical/biological agents (e.g., anthrax, foot-and-mouth disease virus) on exterior surfaces. The offeror should perform some preliminary tests and present the data demonstrating the effectiveness of the materials.

Phase II: The offeror will down select to no more than two materials to test on chemical and biological agents of interest (e.g., nerve agents, anthrax). The tests should demonstrate not only that the materials will encapsulate the agents but also that they will not harm standard aircraft exterior materials. The primary product of this phase is the encapsulating material.

PHASE III DUAL USE APPLICATIONS: Government use will be for non-destructive decontamination of exterior aircraft parts. Dual use applications for this technology are in homeland defense and biological warfare clean up.

KEYWORDS: Non-toxic Solid, Chemical/Biological Agents, Non-destructive Decontamination

CBD03-303 TITLE: Novel Methods for Decontamination of Biological Agents

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: USTC/TCJ-5SC

OBJECTIVE: Methods to achieve non-line-of-sight kill for biological agents and leave no residue.

DESCRIPTION: Decontamination of an interior/enclosed area after a biological incident presents unique problems. Agents may penetrate into areas that usual decontamination solutions cannot reach. Also usual decontamination solutions may leave residue that must also be cleaned in order for the area to be useful again. The method envisioned will kill biological agents upon contact but leave no residue to be cleaned and it will be able to kill those agents even though they may not be in the line-of-sight of the decontaminant. Methods might include a gas that is toxic to agent organisms, penetrates into every part of an enclosed area and dissipates leaving no residue.

Phase I: The offeror will develop the kill methodology and demonstrate destruction of biological agents such as anthrax. The offeror should also have a preliminary design for the applicator.

Phase II: The offeror will characterize the kill mechanism of the decontaminant and the lethal dosage for biological organisms. The offeror will build a prototype applicator and demonstrate that it will deliver the decontaminant throughout the contaminated area in high enough concentrations to kill biological agents of interest.

PHASE III DUAL USE APPLICATIONS: Government use will be to destroy biological agents in the interior of aircraft and buildings. This product should be of interest to hospitals for use in decontaminating operating rooms and other parts of the hospital where bacterial infections present problems for patients.

KEYWORDS: Decontaminating, Biological agents

CBD03-304 TITLE: Nanoparticle-Bound Polymers as Structural Materials Reactive Against CBW Agents

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: USTC/TCJ-5SC

OBJECTIVE: This project is intended to identify nontoxic and nonhazardous structural materials that exhibit selectable porosity and specific reactivity against at least one category of chemical or biological warfare agent (CBWA). It presumably will be used as one component of a layered composite individual or collective protection (IP/CP) device or garment to be developed separately, and the order of preference in selection will be self-regenerating>regenerable>consumable protection.

DESCRIPTION: Existing IP/CP equipment is expensive both to procure and as a logistical element of a deployment, and IP equipment in particular is provided only to a specifically trained subgroup of personnel. Whereas a long-term goal is to improve the working properties, cost, and logistical footprint of equipment affording maximal protection against CBWAs, a more-urgent need is to incorporate a significant measure of CBWA resistance into standard-issue materiel (particularly but not exclusively uniforms and shelters, including air filters---component materials range from cotton and cotton blends to polypropylene and vinyl-coated polyester to fluorocarbon--aramid blends) without drastically altering the desirable properties of the current inventory. These reactive materials are expected to contribute to the evolution of CBWA protectiveness in standard-issue materiel.

No constraint is placed on the technology to be proposed, other than the usual conventions of safety, practicality, and affordability, and preference will be shown to approaches that usefully exceed any or all of the requirements above.

Phase I: During phase I, contractor must accomplish an experimental demonstration that the proposed technology has useful structural properties and that it reacts with one or more CBWAs or chemically or biologically similar surrogates by a process that neutralizes the agent as a threat.

Phase II: During phase II, contractor must assemble an engineering prototype model incorporating the candidate material and use it to demonstrate 1) neutralization of at least one CBWA under conditions that the ultimate treatment capacity can be estimated reliably; 2) material properties consistent with permanent incorporation as a structural element of a garment, shelter, costing, or some other component of protective gear or shelters; 3) some measure of assurance that human toxicity will not attach to this material as applied.

Phase III: During phase III, contractor is expected to proceed with commercialization of the material or, better, development of practical embodiments of the material as CBWA-protective products commercially accessible to DoD. Concurrent pursuit of civilian-market products is consistent with the aims of this procurement.

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KEYWORDS: Biological Agent, Chemical Agent, Electrophile, Collective Protection, Individual Protection, Nerve Gas

CBD03-305 TITLE: Rapid Repair of CB Hardened Systems

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: CB Protection

OBJECTIVE: Develop generic adhesion chemistry capable of binding a variety of synthetic polymer surfaces together, to include polyfluorinated synthetic surfaces for the purpose of repairing and coupling unlike CB hardened structures.

DESCRIPTION: Current chemical and biological collective protection assets are expensive and difficult to assemble, causing a constraint on the number of fielded CB collective protection systems at forward locations. These constraints create a vulnerability; if these systems are breached, either by accident or by design, they can't provide the required protection from CBW agents thus increasing risk and vulnerability exponentially.

The contractor will develop technologies that allow for the adhesion of like and unlike synthetic materials associated with collective protection systems (Kevlar, polyfluorinated coatings and surfaces, etc.) so that an expedient repair mechanism is in place in the case of a loss of integrity with regards to CBW agent protection of a collective protection system. The system must be easily field applied (user friendly), able to be used across a wide range of temperatures and humidity's, have equal or greater strength than the matrices to which it binds, and have durability characteristics equivalent to those of the matrices it binds.

PHASE I: Demonstrate soundness of treatment design and proof of concept of adhesion chemistry.

PHASE II: Demonstrate strength and durability of treated bonded materials over time. Demonstrate ability to adhere to a variety of different matrices with minimal application and cure time.

PHASE III DUAL USE APPLICATIONS: Demonstrate the ease of practical field application. During phase III, contractor is expected to proceed with commercialization of the material or, better, development of practical embodiments of the material as CBWA-protective products commercially accessible to DoD. Concurrent pursuit of civilian-market products is consistent with the aims of this procurement.

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KEYWORDS: Adhesives, Collective Protection, Binding, Glue, Tents, Chemical Agent, CB Hardened.