DEFENSE THREAT REDUCTION AGENCY
SBIR FY06.1 Proposal Submission Instructions

The Defense Threat Reduction Agency (DTRA) is actively involved in meeting current threats to the Nation and working toward reduction of CBRNE threats in the future. To meet these requirements, the Agency is seeking small businesses with strong research and development (R&D) capability. Expertise in weapons effects (blast, shock and radiation), arms control, dispersion modeling, chemical and biological defense, and counterproliferation technologies will be beneficial. Proposals (consisting of coversheets, technical proposal, cost proposal, and company commercialization report) will be accepted only by electronic submission at www.dodsbir.net.

The proposals will be processed and distributed to the appropriate technical offices for evaluation. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Threat Reduction Agency
ATTN: Mr. Doug Sunshine, SBIR Program Manager
8725 John J. Kingman Drive, MSC 6201
Fort Belvoir, VA 22060-6201
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Use of e-mail is encouraged for correspondence purposes.

DTRA has identified 13 technical topics numbered DTRA 06-001 through DTRA 06-013. Proposals must be submitted electronically. Proposals which do not address the topics will not be considered. The current topics and topic descriptions are included below. The DTRA technical offices that manage the research and development in these areas initiated these topics. Proposals may define and address a subset of the overall topic scope. From November 1, 2005 until December 12, 2005, this solicitation is issued for pre-release on the DoD SBIR/STTR Web Site, and technical questions concerning the topics should be submitted to the POC identified for the topic, or to Mr. Doug Sunshine at the address above (during the pre-solicitation period), or through the SITIS system. Questions should be limited to specific information related to improve the understanding of a particular topic's requirements. Offerors may not ask for advice or guidance on solution approach, nor submit additional materials to the topic author. After the pre-solicitation period, written questions must be asked through the SBIR Interactive Topic Information System (SITIS) at http://www.dodsbir.net/Sitis/Default.asp.

Potential offerors must submit proposals in accordance with the DoD Program Solicitation document at www.dodsbir.net/solicitation. Consideration will be limited to those proposals that do not exceed $100,000 and six months of performance. For information purposes, Phase II considerations are limited to proposals that do not exceed $750,000 and 24 months of performance.

DTRA selects proposals for award based on the following evaluation criteria consistent with mission priorities and subject to available funding; the ability of the proposal to address the R&D requirement solicited in the topic that addresses DTRA's mission, the soundness and technical merit and innovation of the proposed approach and its incremental progress toward topic solution, the potential for commercial application (government or private sector) and the benefits expected to accrue from the commercialization, and the qualifications of the proposed Principal Investigator, supporting staff and consultants. Qualifications will include not only the ability to perform the R&D, but also the ability to commercialize the results. The measure of Phase I success includes technical performance toward the topic objectives and 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, in accordance with Section 4.3. As funding is limited, DTRA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and filling the most critical requirements. As a result, DTRA may fund more than one proposal under a specific topic or it may fund no proposals in a topic area. Proposals applicable to more than one DTRA topic must be submitted under each topic.

While funds have not specifically been set aside for bridge funding between Phase I and Phase II, DTRA does not preclude FAST TRACK Phase II awards, and the potential offeror is advised to read carefully the conditions set out in this solicitation.

Notice of award will appear first in the Agency Web site at http://www.dtra.mil. Unsuccessful offerors may receive debriefing upon written request only. E-mail correspondence is considered to be written correspondence for this purpose and is encouraged.

DTRA accepts Phase II proposals only upon a specific invitation only which will be based on Phase I progress and/or results as measured against the criteria in Section 4.3 and relevance to DTRA mission priorities. Phase II invitations are typically issued in early to mid-November with proposals being due in early January. DTRA does not utilize a Phase II Enhancement process.

DTRA SBIR 06.1 Topic Index

DTRA SBIR 06.1 Topic Descriptions

DTRA06-001 TITLE: Characterize the urban environment for transport and dispersion modeling

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

ACQUISITION PROGRAM: TDOC

OBJECTIVE: Develop method for using high-resolution weather observations, especially those collected in urban environments, to drive numerical weather prediction (NWP) forecast models in support of atmospheric transport and dispersion (ATD) prediction systems.

DESCRIPTION: Emergency management decision makers in urban areas must be prepared to respond to threats, such as coordinating evacuations and rescue/recovery after a chemical, biological, radiological or nuclear (CBRN) accident or attack. Their response must be quick and correct, often with minimal intelligence upon which to base their decisions. One form of intelligence is prediction of the atmospheric transport and dispersion (ATD) of contamination plumes. The accuracy, and therefore the usefulness, of predictions of ATD depend mostly upon the quality of weather information from observations and numerical weather prediction (NWP) forecast models. Urban areas are notoriously difficult places to predict ATD, because of the complicated terrain (i.e., buildings and street canyons) and because of an unfilled need for very high-resolution weather observation information. Also, ATD and NWP models are currently constructed to operate best in non-urban areas, with less complex terrain and demanding lower resolution observation information. To operate best in urban environments NWP and ATD model systems must be modified to correctly simulate the unique atmospheric behavior observed within cities. This includes correcting the weather observations to account for the influence of nearby obstacles such as buildings, towers, water areas, parks, streets, and other flow obstructions. This project will address the deficiency in using weather observations in urban environments in conventional NWP and ATD modeling systems

PHASE I: Design and develop methods for correcting urban weather observation data to account for typical flow obstructions and make the data more representative of the actual weather observed within the city. Deliverables include algorithms for using the method in NWP and ATD models.

PHASE II: Test and implement the methods developed for the Phase I demonstrated concept, possibly to include integration into DTRA consequence assessment tools. Demonstrate the method for any urban location around the world, comparing results against the current method of using conventional weather observation and forecast model data.

PHASE III DUAL USE APPLICATIONS: Results from this project could be easily integrated into any urban-based decision-making or command and control system (and into any modeling and simulation program) that uses weather observation and forecast information as part of mission planning, rehearsal, training, and/or execution in urban operations. Example mission area applications include targeting, transportation and logistics, and force and resource protection. Potential commercial benefits include better planning and decision-making through better understanding of urban-scale weather affecting energy production and usage, urban hydrology, and ground, sea and air transportation system usage.

REFERENCES:
1. Observing urban weather and climate using 'standard' stations; T. R. Oke, Department of Geography, University of British Columbia, Vancouver, B.C. Canada V6T 1Z2; Email: toke@geog.ubc.ca. see http://www.meteo.bg/EURASAP/35/paper1.html
2. Proceedings of the Forum on Urban Meteorology; Office of Federal Coordinator for Meteorology, 2005. See http://www.ofcm.gov/urbanmet/proceedings%202004/proceedings%20index.htm
3. Urban Meteorology: Meeting Weather Needs in the Urban Community; Office of Federal Coordinator for Meteorology, 2004. See http://www.ofcm.gov
4. Federal Standard for Sitting Meteorological Sensors at Airports; Office of Federal Coordinator for Meteorology, 1994. See http://www.ofcm.gov/siting/text/a-cover.htm

5. The Adequacy of Urban Weather Observations: A View Based on Oklahoma Mesonet Experiences; Ken Crawford, Program Director Integrated Surface Observing Systems, NWS Office of Science and Technology Presented at the “Challenges in Urban Meteorology: A Forum for Users and Providers”, September 21, 2004, see www.ofcm.gov/urbanmet/Presentations/ 03-Panel%203/02%20-%20crawford.ppt

KEYWORDS: Uncertainty, Decision Making, Urban environment, Threat Reduction, Meteorology, Modeling and simulation, Chemical and biological defense, Transport and dispersion

DTRA06-002 TITLE: Integrated Weapons of Mass Destruction Toolset Near Real Time Response

TECHNOLOGY AREAS: Information Systems, Weapons, Nuclear Technology

ACQUISITION PROGRAM: TDOI

OBJECTIVE: While the current release of the Integrated Weapons of Mass Destruction Toolset (IWMDT) system is functional and deployable, it does not meet the spectrum of needs from the DepSecDef Memorandum dated 05 Jan 05 that requires from the Director, DTRA that the IWMDT system be able to operate in Near-Real Time. The IWMDT current architecture provides chemical, biological, radiological, nuclear, and high explosives (CBRNE) capabilities in both the Network Centric Enterprise Service (NCES) and the Global Information Grid (GiG) environments. The expectation of this SBIR Phase I program is to identify and define proposed concept(s) to enhance/reconfigure an innovative solution for the IWMDT architecture framework in order to meet the requirement to define a configuration that will increase the speed of throughput to 30 seconds average response time for 1000 simultaneous user calculations while complying with the Department of Defense Architecture Framework (DoDAF) version 1.0 and IEEE 12207 standards, requirements and guidelines.

DESCRIPTION: The Defense Threat Reduction Agency (DTRA) safeguards America's interests from weapons of mass destruction (chemical, biological, radiological, nuclear and high explosives) by controlling and reducing the threat and providing quality tools and services for the warfighter. DTRA’s Technology Development (TD) Directorate reduces Weapons of Mass Destruction (WMD) threats by conducting innovative research and development that supports the nation’s counterproliferation, consequence management, arms control, and combating terrorism needs through the use of the IWMDT.

The IWMDT consolidates validated DTRA modeling and simulation tools to enable rapid access for target planning, emergency response and consequence assessment capabilities. The capabilities are used by Combatant Commands, the Joint Staff, other government agencies, first responders, planners, managers and operational and technical personnel who have the mission to respond to the full spectrum of CBRNE threats. The basis of IWMDT is a net-centric implementation of the underlying DTRA computational tools, including the Hazard Prediction Assessment Capability (HPAC), the Integrated Munitions Effects Assessment (IMEA), a hybrid of nuclear tools under the Nuclear Tool server, and the Mission Degradation Analysis System (MIDAS), for Mission Assurance, and High Level Architecture (HLA), and Distributed Interactive Simulation (DiS) interfaces for simulation integration.

PHASE I: The expectation of this SBIR Phase I program is to identify and define proposed concept(s) to enhance /reconfigure an innovative solution for the IWMDT architecture framework in order to meet the requirement to define a configuration that will increase the speed of throughput to 30 seconds average response time for 1000 simultaneous user calculations while complying with the Department of Defense Architecture Framework (DoDAF) version 1.0 and IEEE 12207 standards, requirements and guidelines. Develop key component technological milestones to demonstrate the feasibility of the defined concept(s).

PHASE II: Using results from Phase I, construct and demonstrate the operation of a prototype architecture/framework with defined field test objectives. Conduct limited proof of concept testing using DoDAF and IEEE 12207 standards, requirements, and guidelines.

PHASE III: Using results from Phase II, design and develop operational low rate initial production (LRIP) guidelines IAW DoDAF and IEEE 12207 standards, requirements, and guidelines for military and commercial applications. The military application will be used by Combatant Commands, the Joint Staff, other government agencies, and operational and technical personnel who have the mission to respond to the full spectrum of CBRNE threats in a military environment. The commercial application will be utilized by first responders, planners, managers, and operational and technical personnel who have the mission to respond to the full spectrum of CBRNE threats in a civilian and Homeland Defense environment.

REFERENCES:
1. "Defense Threat Reduction Agency, 2003 Strategic Plan", http://www.dtra.mil.

2. “DOD Architecture Framework Version 1.0”, 15 August 2003.

3. “IEEE 12207 Standard for Information Technology—Software life cycle processes”, 1 August 1995.

4. Mr. Jim Miles, Defense Threat Reduction Agency, Systems Integration Branch, "IWMDT Program technical documentation".

KEYWORDS: near-real time response, decision support tool, IWMDT, HLA, DiS, web-browser, web services, HPAC, IMEA, architecture framework, configuration

DTRA06-003 TITLE: Next Generation Blast Protection Technologies and Combined Blast and CBRN Protection Technologies

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: TDOS

OBJECTIVE: To develop a new simulation model, validated through innovative test methods for next generation progressive collapse of buildings subjected to multiple hazards or combination of hazards (e.g., blast and CBRN)

DESCRIPTION: A variety of approaches ranging from first principles computations to simplified methods have been proposed for design and evaluation of structures to resist progressive collapse as a consequence of terrorist attacks [1-5]. The next step is to focus on the progressive collapse due to multiple hazards or combination of hazards. The ultimate objective of these procedures is their incorporation into a fast running tool for verification or evaluation of structural integrity following an attack with multiple hazards or a combination of hazards. Both threat-related and threat independent methods exist. Despite the existence of recommended procedures, there is a lack of experimental validation of the various assumptions. Full-scale testing is expensive because of the extent of the construction required and the range of phenomenology necessary to be explored. Examples include steel and reinforced concrete multi-bay, multistory structures with different connection details subjected to a range of explosive yields. Innovative, yet realistic testing and modeling is needed to help reduce the cost of validation of the assumptions and potentially lead to a new model for simulation of, and/or design against progressive collapse with multiple hazards or combination of hazards. The new test and modeling technique should monitor the structural response to include structural deformation, joint failure, and support reaction forces due to a multiple hazard or combination of hazards event.

PHASE I: Demonstrate the fidelity of an innovative test method for structural components, such as a beam-column joint, and correlate measured behavior with a computational model that focuses on next generation blast protection from multiple hazards or a combination of hazards.

PHASE II: Generate a fast running modeling and design tool capable of predicting structural response and conditions leading to progressive collapse from multiple hazards. Demonstrate the capability of the model to accurately predict the conditions for the onset of progressive collapse and to demonstrate the capability as a design tool to prevent progressive collapse, in both cases by comparisons with tests which simulate blast damage under realistic loading conditions.

PHASE III: Transition the modeling and design tool developed in Phase II to commercial applications. Currently there are no complete fast-running, validated tools for analyzing the progressive collapse of buildings subjected to a combination of hazards such as blast and CBRN. The tool could be used by both military and civil designers and analysts to assess and design commercial buildings to resist terrorist attacks and protect against combined blast and CBRN.

REFERENCES:
1) Draft Unified Facilities Criteria (UFC 4-012-06), Design of Buildings to Resist Progressive Collapse, May 4, 2004.

2) British Standard, BS 6399: loading for Buildings, Part 1: Code of Practice for Dead and Imposed Loads, 1996.

3) British Standard, BS 8110: Structural Use of Concrete, Part 1: Code of practice for Design and Construction, 1997.

4) Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, 2002.

5) Progressive Collapse Analysis and Design Guidelines for New Federal Office Buildings and Major Modernization Projects, General Services Administration, June 2003.

KEYWORDS: progressive collapse, connections, blast damage, joint failure, load path, tie forces

DTRA06-004 TITLE: "Typical day" Meteorological Data for Atmospheric Transport and Dispersion (ATD) modeling

TECHNOLOGY AREAS: Chemical/Bio Defense, Information Systems, Battlespace, Nuclear Technology

ACQUISITION PROGRAM: TDOC

OBJECTIVE: Develop a method to provide ATD modeling systems, such as the Hazard Prediction Assessment Capability (HPAC) program, with “typical day” weather data for any spatial domain, at any time during the year

DESCRIPTION: Planners who model ATD of chemical, biological, radiological, and nuclear (CBRN) agents for time periods beyond 10 days must use historical or climatological weather data to drive their models. Climatology data represent mean, or averaged, fields, while historical data represent actual weather for one specific period of time. Current methods in the HPAC model uses either 20-year averaged climatology data or historical weather data from the 15th and 16th of each month of 1990. Neither of these data sets represents the “typical” weather conditions experienced over a given domain and time. As a result, plume predictions based on these data can not represent typical dispersion and/or deposition behavior.
Much research has been done to extract “typical” day weather information from the climate record; however none of the research has developed a method suitable for ATD modeling.

- Some of the current research has been directed at the energy applications (refs 1-5), focused on temperature and solar factors, which are not appropriate for ATD modeling which depends mostly upon winds.
- Some of the research on finding typical wind regimes is looking at monthly, seasonal, and annual time scales (refs 6-7), which, again, is not appropriate for ATD modeling at scales of hours to days.
- Some of the research has looked at “typical day” climate for “point” locations and times (ref. 8), which is not appropriate for ATD modeling over large domains and time periods.
- Other research on “typical day” climate has looked at the most accurate way to capture the most variability in averaged or mean meteorological data fields (refs 9-10). These “typical day” data are then produced once, published, and stored for use at a later time, which has limited use for the way most users employ ATD modeling for plume analysis.

Non-ATD-model users of “typical day” data can use statistical average or mean data for their modeling and simulation work (e.g., modeling and simulation [M&S] war game applications that use weather effects to drive battle scenarios for planning, rehearsal, and training purposes). The requirements of ATD modeling programs are much more stringent; point- and time-based methods for providing average and/or mean weather data are not sufficient for ATD modeling, which requires four-dimensionally realistic gridded weather data, at fine-scale resolution, over a large space (100's to 1000's of kms) and time (hours to days) domain, in order to correctly simulate weather effects/impacts on CBRN dispersion and deposition. In addition, ATD modeling requires that all wind data, in four dimensions (three spatial dimensions plus time), be consistently correlated, so that atmospheric mass balance is maintained and wind flow (and resulting plumes) do not artificially go into terrain features. When the usual "typical day" averaging techniques are used, this mass balance is violated, and ATD models using these winds produce grossly inaccurate results.

Innovative data search, analysis, selection, retrieval, and processing methods are required to enable "typical" weather data to be quickly and correctly produced, and incorporated into ATD modeling systems. The method should select on weather variables that have the largest impact on ATD predictions (e.g., wind, temperature, and moisture, most importantly in the near-surface planetary boundary layer); and should provide data that are physically consistent in four dimensions, for a minimum of 48 hours in duration and global in coverage. Another unique requirement of ATD modeling is the evaluation and selection criteria must provide an optimum solution for as many gridpoint locations as possible within the space and time domain. It is highly desirable that the method use global weather and climate data from the U.S. National Climate Data Center (NCDC) and/or the U.S. National Centers for Environmental Prediction (NCEP) reanalysis projects.

PHASE I: Design, develop and test a method for selecting or generating "typical" weather data out of historical weather and climate information. Demonstrate the method using ATD models (such as HPAC) for any location worldwide, comparing results against the current method of using historical weather data.

PHASE II: Implement the methods developed for the Phase I demonstrated concept, and integrate into DTRA's consequence assessment tools.

PHASE III DUAL USE APPLICATIONS: Results from this project could be easily integrated into any modeling and simulation program that uses weather data as part of mission planning, rehearsal, and training operations. Example mission area applications include targeting, transportation and logistics, and force and resource protection. Potential commercial benefits include identification of weather and climate data that is more appropriate for predicting energy usage, agriculture production, and ground, sea and air transportation system usage, for designing and constructing built structures.

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2. Thevenard, D. and A. Brunger. 2002: "The Development of Typical Weather Years for International Locations, Parts I and II: Algorithms -and- Production", to be published in ASHRAE Transactions, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, GA.
3. Qingyuan, Z., J. Hunag, and L. Siwei. 2002: "Development of Typical Year Weather Data for Chinese Locations", ASHRAE Transactions 2002, v. 108. Pt. 2, Honolulu, HI.
4. Krusinger, A.E. 1992: Long-Term Data Collection and Empirical Background Temperature Modeling. Defense Technical Information Center Report TEC-R-162, Fort Belvoir, VA.
5. Bruhn, J.A., W.E. Fry, and G.W. Fick. 1980: Simulation of Daily Weather Data Using Theoretical Probability Distributions. Journal of Applied Meteorology: Vol. 19, No. 9, pp. 1029–1036.
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8. Whiteman, C.D. and J.C. Doran. 1993: The Relationship between Overlying Synoptic-Scale Flows and Winds within a Valley. Journal of Applied Meteorology: Vol. 32, No. 11, pp. 1669–1682.
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17. Acock, M.C., and Y.A. Pachepsky. 2000: Estimating Missing Weather Data for Agricultural Simulations Using Group Method of Data Handling. Journal of Applied Meteorology: Vol. 39, No. 7, pp. 1176–1184.
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26. National Climatic Data Center (NCDC) 1998: International Surface Weather Observations 1982-1997, Volumes 1 through 5, jointly produced by NCDC, National Oceanic and Atmospheric Administration, US Dept. of Commerce and the US Air Force Combat Climatology Center (AFCCC), Asheville NC.
27. HPAC Version 4.0.4 and User Guide, DTRA/TDOC, HPAC-UGUIDE-01-RBC0, 27 April 2004.
28. PC-SCIPUFF Version 2.1 Technical Documentation, R. Ian Sykes, et al., Titan Corp., A.R.A.P. Report No. 725, May 2004.

KEYWORDS: Climatology, Meteorology, Modeling and simulation, Chemical and biological defense, Transport and dispersion

DTRA06-005 TITLE: Improve High Altitude Transport and Dispersion Modeling Capability

TECHNOLOGY AREAS: Chemical/Bio Defense, Information Systems, Battlespace, Nuclear Technology

ACQUISITION PROGRAM: TDOI

OBJECTIVE: Improve threat reduction by demonstrating a capability to collect and use remotely sensed upper-atmospheric weather data to improve numerical weather prediction (NWP) and atmospheric transport and dispersion (ATD) models.

DESCRIPTION: Current ATD modeling systems suffer from lack of measured and forecast weather conditions in the upper atmosphere. In this region of the upper atmosphere, adverse impacts from the transport and dispersion of hazardous material easily spread rapidly around the globe. The threat from this phenomenon is increasing, notably due to an increasing probability of the need to destroy ballistic missiles and their warheads while in flight. Requirement is for understanding weather conditions worldwide, at altitudes between 20-120km. Conventional atmospheric observing techniques either do not extend into the upper atmosphere or do not resolve that region well. What little data from these regions already exist (e.g., from reduction of data from global prediction satellites) is not readily usable by NWP or ATD model systems. Priority is for understanding the state of weather variables with most impact on the transport and dispersion of hazardous materials (e.g., winds, temperatures). Factors that will help determine the success of the proposed effort include: efficient data domains; consistency at boundary; and handling of measurement and forecast uncertainty.

PHASE I: Develop method for observing and forecasting weather in upper atmosphere. Deliverables include algorithms for using weather from upper-atmospheric region in ATD (Second-order Closure Integrated PUFF [SCIPUFF] and Hazard Prediction and Assessment Capability) and NWP models.

PHASE II: Demonstrate, validate, and integrate the algorithms developed in Phase I into existing NWP and ATD modeling systems. Make more efficient the specification of meteorological data domains to speed computations.

PHASE III DUAL USE APPLICATIONS: Follow-on activities are expected to be aggressively pursued by the offeror, namely in seeking opportunities to integrate the algorithms, procedures, protocols, and software of the developed approach into all NWP and ATD modeling systems. Commercial benefits include improved characterization of upper-atmospheric environments (which is valuable to many commercial and government enterprises), improved civil weather forecasting, better understanding of ozone depletion, climate change, and solar radiation (with related improvements to health and safety protection), and improved homeland security applications. All of these are consistent with the open systems frameworks of information technology and other systems.

REFERENCES:
1. US Weather Research Program; see: http://box.mmm.ucar.edu/uswrp/main_page/main.html
2. Radio Occultation Observations using Global Navigation Satellite Signals, A New Tool for Exploring the Atmosphere; P. Silvestrin and P. Ingmann; see: http://esapub.esrin.esa.it/eoq/eoq54/silve54.htm
3. High resolution stratospheric tracer fields estimated from satellite observations using lagrangian trajectory calculations, Sutton, R.T., MacLean, H., Swinbank, R., O'Neill, A., Taylor, F. W., J. Atmos. Sci., 2995-3005, 1994.
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5. PC-SCIPUFF Version 2.1 Technical Documentation, R. Ian Sykes, et al., Titan Corp., A.R.A.P. Report No. 725, May 2004.

KEYWORDS: Uncertainty, Decision Making, Threat Reduction, Meteorology, Modeling and simulation, Chemical and biological defense, Transport and dispersion

DTRA06-006 TITLE: Calibration of Ensemble Forecasts Using Reforecast Datasets

TECHNOLOGY AREAS: Chemical/Bio Defense, Information Systems, Battlespace, Nuclear Technology

ACQUISITION PROGRAM: TDOI

OBJECTIVE: Develop an innovative solution for generation of reforecast datasets for the purpose of calibrating fine-scale NWP ensemble forecasts to reduce uncertainly in plume prediction from atmospheric transport and dispersion (ATD) models.

DESCRIPTION: DTRA seeks innovative approaches to ensemble forecasting calibration methodology using reforecast datasets (i.e., multi-year comparison between forecasts and observations). DTRA uses an atmospheric transport and dispersion model embedded in the Hazard Prediction and Assessment Capability (HPAC) to predict plumes of hazardous material. DTRA requires a robust description of all aspects of uncertainty involved in atmospheric transport and dispersion modeling in order to produce useful, probabilistic plume predictions. Plume predictions are done probabilistically to account for inherent uncertainties. One of the greatest sources of uncertainty is the forecast data from fine-scale, numerical weather prediction (NWP) models. Since numerical weather forecasts are one of the most significant sources of uncertainty, DTRA requires well-calibrated, stochastic, fine-scale weather forecast data. Details of NWP uncertainty can be supplied as input to HPAC through a process called ensemble forecasting in which multiple solutions from the NWP model are produced to define an envelope of possible future states of the atmosphere. The challenge in that process is that systematic errors can corrupt the quality of the resulting probabilistic prediction, thus requiring a calibration to maximize utility by ensuring reliability and sharpness. Many current calibration techniques are limited by use of small, short-term training periods and may be significantly improved via application to large, long-term datasets.

PHASE I: Determine the technical feasibility of producing long-term, reforecast datasets with state-of-the-art fine-scale NWP models. Explore innovative techniques to calibrate ensemble forecasts and determine their applicability in improving probabilistic weather forecast data for HPAC. Develop prototype system that generates extensive reforecast datasets and calibrates fine-scale NWP ensemble forecasts. Perform initial validation of the impact to the quality of both the probabilistic weather forecast data and the HPAC probabilistic plume forecast.

PHASE II: Develop the prototype system into an operational system that generates extensive reforecast datasets and calibrates fine-scale NWP ensemble forecasts. Develop and document a process to validate the impact to the quality of both the probabilistic weather forecast data and the HPAC probabilistic plume forecast.

PHASE III DUAL USE APPLICATIONS: DTRA will pursue further implementation of the resulting calibration system, which will significantly improve not only theatre and homeland security plume predictions, but also all military and commercial weather-dependent activities. Follow-on activities are expected to be aggressively pursued by the offeror, namely in seeking opportunities to integrate the algorithms, procedures, protocols, and software of the developed approach into all NWP and ATD modeling systems. Commercial benefits include improved characterization of upper-atmospheric environments (which is valuable to many commercial and government enterprises), improved civil weather forecasting, better understanding of ozone depletion, climate change, and solar radiation (with related improvements to health and safety protection), and improved homeland security applications. All of these are consistent with the open systems frameworks of information technology and other systems.

REFERENCES:
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3. Raftery A.E., F. Balabdaoui , T. Gneiting, and M. Polakowski, 2003: Using Bayesian Model Averaging to Calibrate Forecast Ensembles. Technical Report no. 440, Department of Statistics, University of Washington
4. Gel, Y., A.E. Raftery, and T. Gneiting, 2004: Calibrated Probabilistic Mesoscale Weather Field Forecasting: The Geostatistical Output Perturbation Method. Journal of the American Statistical Association, 99, pp. 575-590

KEYWORDS: Threat Reduction, Meteorology, Modeling and Simulation, Chemical and Biological defense, Transport and Dispersion

DTRA06-007 TITLE: Novel Methods of IED Suppression and Neutralization to Include Next Generation WMD Dispersal Devices

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: TDPC

OBJECTIVE: Using novel technologies and methods or novel employment of conventional technologies and methods, demonstrate the feasibility of suppressing the detonation of an Improvised Explosive Device (IED) and Weapons of Mass Destruction (WMD) dispersal device, or outright neutralization of the IED or WMD dispersal device.

DESCRIPTION: IEDs are devices placed and/or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. They may incorporate military stores, but are often devised from nonmilitary components (DOD definition). IEDs are commonly disguised and/or camouflaged to blend in with the environment to which it is deployed making it very difficult to visually discriminate. They can be autonomously detonated through a sensor fuse or remotely or locally command-detonated by an individual. WMD dispersal devices have the same functions and may even have the same components as IEDs.

The purpose of this research is to identify and explore new and creative technologies and associated methods for suppressing the detonation of an IED, and/or neutralizing the IED altogether, and including creative technologies and associated methods for countering the follow on threat of WMD dispersal devices. Once an IED has been identified, it may be destroyed with destructive charges placed on it by EOD personnel, by engagement with a weapon (50 caliber gun, etc.), or by other render safe procedures. However, IEDs are often booby-trapped or have secondary detonators used to command-detonate the IED when EOD personnel are present, thereby ensuring a conciliatory kill even if the prime target is not realized. Additionally, regardless of the origin for detonation (the insurgent's command detonation signal or the coalition's method used to detonate it); the IED can inflict significant material damage and collateral casualties.
For these reasons, a means is required to remotely suppress the detonation of an IED to include WMD dispersal devices or to outright "kill" the IED without exploding it and thereby exposing EOD or other personnel to potential harm from the exploding IED. The means for suppressing the IED should be readily deployable to support tactical operations, and it should be employable from a stand off distance greater than 100 feet, preferably from a covered position or armored vehicle. Robotic vehicles might be used to approach closer to the IED in order to suppress or neutralize it with the proposed suppression/neutralization technology. However, direct mechanical neutralization by a robot is not of interest unless it offers some unique feature or capability not currently offered or prototyped by one of the several robot vendors currently offering products in this area.

PHASE I: Examine the various IED reports and studies conducted to date, and develop an IED Detonation and Vulnerability Taxonomy that identifies the subsystems, components, technologies, physical characteristics, and operational characteristics of IEDs that are required to ensure the IED detonates and functions explosively. Include WMD dispersal device in the taxonomy. Develop a concept of operations supported by one or more technologies, or a fusion of technologies that can offer a high probability of suppressing or negating an IED without it exploding. If pragmatic within the resources and time frame of the Phase-1 effort, demonstrate through objective experimental testing, the suppression or negation of real or surrogate IEDs using the proposed technologies and/or techniques. Ideally this should be against realistic IED targets, in a representative urban environment, but alternatively it can be to demonstrate proof of principle technique and/or phenomenology in a laboratory setting as long as it has direct traceability to the objective methods and techniques.

PHASE II: Develop an IED Suppression and Neutralization Testbed that demonstrates the performance of suppressing and/or neutralizing IEDs in realistic outdoor settings. Determine ways to neutralize, counter, and suppress WMD dispersal devices as well. Deliverables will include: 1) the developed hardware and software source code; 2) a technical report describing the phenomenology, how the system works, decision and classifier algorithms; 3) a technical manual on tactics, techniques, and procedures (TTPs), how to install, operate and employ the system in an operational environment, and any models and simulations (including source) used in optimizing the design.

PHASE III DUAL USE APPLICATIONS: The technology developed in Phase II will have a growth path to be militarized for type-classified deployment to assist in preventing, protecting, neutralizing, mitigating, and detecting WMD dispersal devices. The technology may also be capable of suppressing and neutralizing UXO and mines. The technology may be modifiable for off-route usage. The technology can potentially be commercialized for use by law enforcement, homeland defense, in theater, and airport security for suppressing and neutralizing bombs.

REFERENCES:
1) http://call.army.mil/, http://www.tswg.gov/tswg/idd/idd_ma.htm,

2) http://www.dtic.mil/, www.adtdl.army.mil/cgi-bin/atdl.dll/fm/9-15/ch3.pdf

3) http://www.galaxyscientific.com/areas/securtech/simied.htm,

4) http://www.enterprisingsecurities.com/training/search_protocol.html,

5) http://www.respondersafety.com/downloads/standoff.doc

KEYWORDS: Improvised Explosive Device, IED, Ultra-Wide Band, High Power Microwave, High Power Laser, High Power Acoustics, Homemade Explosives, Unexploded Ordinance (UXO), Mines, Mine Detection, Homeland Security

DTRA06-008 TITLE: Standoff Detection of IED Laden Vehicles to Include Next Generation WMD Dispersal Device Defeat

TECHNOLOGY AREAS: Sensors, Weapons

ACQUISITION PROGRAM: TDPC

OBJECIVE: Demonstrate the feasibility of detecting Improvised Explosive Devices (IED) and Weapons of Mass Destruction (WMD) dispersal devices hidden within vehicles, from a safe and covered standoff distance, while the IED laden vehicle is moving and/or while it is stationary, using sensors and/or their fusion. In addition, use sensors and/or their fusion to identify and attribute all aspects of WMD dispersal devices concealed in vehicles, packages, or carried by adversary personnel before they can be brought into contact with friendly forces.

DESCRIPTION: IEDs are devices placed and/or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. WMD dispersal devices have the same functions and may even have the same components as IEDs. They may incorporate military stores, but are often devised from nonmilitary components (DOD definition). IEDs and WMD dispersal devices are commonly disguised and/or camouflaged to blend in with the environment to which it is deployed making it very difficult to visually discriminate. They can be autonomously detonated through a sensor fuse or remotely or locally command-detonated by an individual. Technologies to detect command and control and firing system components of IEDs will be applicable to WMD dispersal devices

Since IEDs have proven to be very effective against Coalition Forces and civilians in Iraq, it is likely that US Forces will face this threat in future conflicts for many decades. U.S. Forces abroad and domestic authorities in the Homeland can also expect to face the logical follow on threat - the WMD dispersal device. The current trend in the War on Terror is for insurgents to load and/or hide IEDs in vehicles. The future trend will involve WMD dispersal devices. Sometimes the IED is not particularly well hidden (they have been found openly placed in the passenger seat beside the driver). Other times they are disguised as cargo in the back seat or concealed in the trunk of a car, or in the bed of a truck or van. Sometimes they have been found implanted within voids of the vehicle, such as behind the door and side panels of the vehicle. The quantity can range from a few pounds of explosive or single artillery shell, to hundreds of pounds of explosive. They are increasingly being manually detonated by suicide drivers, but have also been remotely command-detonated by wire or wireless triggers or even time-delay detonated. More recently, insurgents are outfitting commandeered vehicles with IEDs, often using kidnapping and hostages to force family members to drive the vehicle to conduct the attack. Occasionally, the IEDs have been hidden in a vehicle and command-detonated with the driver unaware of the IEDs in the vehicle. All of the current trends of the War on Terror are applicable to the future threat of WMD dispersal devices.

The purpose of this research is to identify and explore new and creative methods for detecting IED laden vehicles to include WMD dispersal devices from a safe standoff distance such that the detector's position is not endangered by premature IED detonation, and so there is sufficient distance and time to effect a suppression or neutralization response on the IED laden vehicle. The standoff distance should exceed 100 feet, ideally in an urban setting, the sensor should be capable of being protected from an IED blast at the standoff range, and it should be concealable in some manner (for example, it could possibly be installed in an disguised van).

PHASE I: Examine the various IED reports and studies conducted to date, and develop an IED Laden Vehicle Taxonomy for Standoff Detection that identifies the subsystems, components, technologies physical characteristics, and operational characteristics of IEDs in vehicles to include WMD dispersal devices. Use the Taxonomy to recommend one of two approaches as follows: Alternative #1, develop a multi-sensor concept using a suite of sensors and associated sensor fusion to meet the requirements; or Alternative #2, propose a single or dual sensor combination with less sensor fusion needs that meets the requirements.

Alternative #1: Use the Taxonomy to perform analysis to identify common elements and characteristics (i.e. features) that are indicative of IED laden vehicles and WMD dispersal devices. Identify candidate sensor technologies and techniques that might detect the indicative features from the above Taxonomy analysis to include WMD dispersal devices. Show sensor performance capabilities from hardware specifications or reports or presentations that support the measurement of the features identified above. Design a top-level sensor fusion architecture and decision matrix or decision method for classifying a candidate vehicle as belonging to the class of IED Laden Vehicles to include WMD dispersal devices using the proposed sensor suite.

Alternative #2: Alternatively to the above top-down analytic and associated sensor suite approach, propose any single or complimentary set of sensor technologies and/or techniques that promise detection of a unique or semi-unique feature of IED laden vehicles with high probability and low false alarm. If pragmatic within the resources and time frame of the Phase-l effort, demonstrate through objective experimental testing, the detection of IED laden vehicles using the proposed sensor technologies and/or techniques to include WMD dispersal devices. Ideally this should be against realistic IED and vehicle targets, but alternatively it can be to demonstrate proof of principle of a new unique signature and/or phenomenology in a laboratory setting as long as it has direct traceability to IEDs.

PHASE II: Develop a Non-Real Time IED Laden Vehicle Testbed that demonstrates the required performance against IED laden vehicles in realistic outdoor settings to include WMD dispersal devices (Real-Time performance is preferred but not required in deference to getting the sensor/sensor suite to work in a Non-Real Time basis). Deliverables will include: 1) the developed hardware and software source code; 2) a technical report describing the phenomenology, how the system works, decision and classifier algorithms; 3) a user manual on technical performance parameters, how to install, operate and employ the system in an operational environment, and any models and simulations (including source) used in optimizing the design.

PHASE III DUAL USE APPLICATIONS: The technology developed in Phase II will have a growth path to be militarized for type-classified deployment and assist in preventing, protecting, neutralizing, mitigating, and detecting WMD dispersal devices. The technology may also be capable of detecting UXO and mines. The technology may be modifiable for off-route usage. The technology can potentially be commercialized for use by law enforcement, homeland defense, in theater, and airport security for detecting suspicious explosives laden vehicles.

REFERENCES:
1) http://call.army.mil/,or http://www.tswg.gov/tswgiidd/idd_ma.htm,

2)http://www.dtic.mil/, www.adtdl.army.mil/cgi-bin/atdl.dll/fm/9-15/ch3.pdf

3) http://www.galaxyscientific.com/areas/securtech/simied.htm,

4) http://lwww.enterprisingsecurities.com!trainingisearch-protocol.html,

5) http://www.respondersafety.com!downioads/standoff.doc

KEYWORDS: Improvised Explosive Device, IED, Radar, Infrared, Hyperspectral, NMR Acoustic, Automatic Target Recognition (ATR) Algorithms, Homemade Explosives, Sensor Fusion, Unexploded Ordinance (UXO), Mines, Mine Detection

DTRA06-009 TITLE: Enhanced Stability and Penetration Depth in Deep Earth Penetrators

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: TDSH

OBJECTIVE: Identify, develop and demonstrate innovative new concepts to significantly reduce frictional drag and enhance trajectory stability of deep-earth penetrating warheads. For example, novel concepts for creation of a high-pressure gas or fluid layer that envelops the warhead and that exerts sufficient pressure and flow to minimize or eliminate direct contact between the penetrating body and the surrounding geologic media are of interest.

DESCRIPTION: The Defense Threat Reduction Agency (DTRA) is seeking new and highly innovative approaches to significantly enhance the ability of earth-penetrating weapons to reach deeply buried and hardened (protected) targets. A number of difficult technical challenges continue to severely limit current-design weapon's capabilities to penetrate through various layers of geologic materials to reach potential targets that may be buried many meters underground. These buried facilities may be hardened with multiple layers of reinforced concrete, rock and stone, and other structural materials. In addition to the requirement to overcome the structural strength and inertia of solid geologic materials and other reinforcements placed in their path, the penetrating weapon body may be subjected to very high frictional drag acting along any contact surfaces with the solid medium. In general, the materials encountered are highly heterogeneous, consisting of various layers of dissimilar materials of varying strengths and densities. Soil layers generally include many large rocks or other variations, while rock layers contain numerous discontinuities such as joints, fractures, bedding planes at various inclinations, and so on. The high density and strength of earth materials, together with large frictional drag forces, act to severely limit the depth of penetration for an impacting body. The highly heterogeneous nature of the materials, with consequent unbalanced resistance and lateral forces, acts to severely limit the stability of the trajectory of the penetrating body. The contact forces as the crushed materials flow past can also act to severely erode and damage the penetrating warhead body; these frictional forces can also heat the outer surface and may cause localized melting of the warhead case. Such heating and melting, followed by re-solidification, can result in welding of the crushed geologic material to the warhead at random locations. All of these effects may distort the effective shape of the penetrator, also leading to unbalanced drag and lateral forces, and further path curvature and instability. Traditional design approaches for maximizing depth of penetration have included use of ogive nose shapes, high cross-sectional density, and high impact velocity. Traditional design approaches for minimizing frictional drag forces have included use of various blunt-nose designs, body diameter reduction behind the fore-body of the penetrator, and similar geometric design approaches intended to result in "flow" separation along most of the length of the warhead body. A traditional design approach for increasing the stability of the path trajectory in the earth media has been use of high length-to-diameter ratios, as high as 8 to 10 or more.

In this work, highly innovative new concepts are sought for creation and maintenance of a high-pressure fluid (gas or liquid) layer between the warhead (nose and body) and the surrounding cavity during the entire time of earth penetration, to result in significant reductions in frictional drag and unbalanced lateral forces. For purposes of this work, traditional approaches (for instance variations in nose and/or body shape design, case strength, warhead mass, or cross-sectional density) are not considered innovative. Active design approaches that may make use of additional energy sources during penetration (beyond the impact kinetic energy, for instance), dynamic shape variations, chemical interactions with the media, etc., are examples of conceptual approaches which could be considered innovative in this context.

Research that improves the knowledge and detailed understanding of the complex processes of solid-solid interaction between a high velocity earth penetrator and the media being penetrated, and that manipulates or alters these processes through insertion of an intermediate fluid layer to significantly enhance performance, is sought.

Actual design and development of a specific earth penetrating warhead (EPW) is NOT sought in this work. However, to help bound the parameter space and guide the work, it should be noted that understanding and technology enabling significant performance improvements over current EPW penetration and path-stability capabilities are sought. Based on current EPW designs then, it can be assumed that the impact velocity of improved EPWs could vary from as low as 180 m/s (600 ft/s) to as much as 1500 m/s (4900 ft/s), depending on the specific application. Weight of improved EPWs is expected to be in the range from 230 kg (500 lbs) to as much as 2300kg (5000 lbs). Typical length for these new warheads is expected to vary from around 90 cm (36 in) to around 330 cm (130 in), diameter from 15 cm (6 in) to 50 cm (20 in). It can be assumed that the angle of attack and impact angle for the EPW will be held to within less than 2 degrees of normal. Significant improvement in penetration depth over current capabilities is sought, so that the time duration of penetration following impact will be in the approximate range from 50 ms to 1000 ms. The new design EPW should maintain less than 5 degrees variation from a straight-line path after impact through layered and variable earth media.

PHASE I: Determine the scientific and technological merits, and the feasibility, of the innovative high-pressure fluid layer concepts. Analyze requirements for generation and maintenance of an effective layer, including required thickness, pressure, flow rates, temperature, etc. Demonstrate proof-of-principle for the innovative concepts through modeling and/or scaled experiments.

PHASE II: Define key elements and requirements for sub-scale laboratory phenomenology experiments, and for field prototype phenomenology tests. Demonstrate and measure penetration enhancement and path stability improvements for penetration through multiple heterogeneous layers of typical man-made reinforcing and geologic materials, at an appropriate scale. Model the principle physical processes of penetrator interaction with earth media for the case of a fluid separation layer as used in the concept, and calibrate the model for the scaled penetration experiments performed.

PHASE III: Produce full scale concept penetrator test items; demonstrate and measure enhanced penetration performance and path stability in suitable field trials. Produce validated computer model for prediction of concept penetrator performance. Produce detailed design and specifications for full-scale production of concept penetrator. Establish commercialization plans and identify commercial markets for technology developed in Phases I and II. Explore and develop commercial prospects for applying earth-penetration drag-reduction technology in civilian mining, oil well stimulation, and tunneling construction industries, as well as for military use in development of new earth-penetrating weapon concepts.

REFERENCES:
1. Alekseevskii V.P., “Penetration of a Rod into a Target at High Velocity”, Comb Expl Shock Waves, 1966; 2:63-66

2. Tate A., “A Theory for the Deceleration of Long Rods After Impact”, J Mech Phys Solids, 1967; 15:387-399

3. Walters W.P., Segletes S.B., “An Exact Solution of the Long Rod Penetration Equations”, Int J Impact Eng, 1991; 11(2):225-231

4. Segletes S.B., Walters W.P., “Extensions to the Exact Solution of the Long Rod Penetration/Erosion Equations”, Int J Impact Eng, 2003; 28;363-376
5. Caudle W.N., Pope A.Y., “Project Trump: Progress Report No. 1, Sandia Program for Earth Penetrating Systems”, Sandia Corp., Albuquerque, N.M., 1962; SCTM 56-62 (71), April

6. Colp J.L., Caudle W.N., Romine K.L., “Annotated Bibliography of Sandia Laboratories Publications Related to Terradynamics”, Mar 01 1974, Sandia National Laboratories, Albuquerque, N.N.; Sandia Report SLA-73-345.

7. Young C.W., “Penetration Equations”, Sandia National Laboratories, Albuquerque, N.M.; Sandia Contractor Report SAND97-2426

8. Effects of Nuclear Earth-Penetrator and Other Weapons (2005), Chapter 3, “Earth-Penetrator Weapons”, Committee on the Effects of Nuclear Earth-Penetrator and Other Weapons, National Research Council; National Academies Press, prepublication edition available on-line at http://www.nap.edu/books/0309096731/html

KEYWORDS: Earth-penetrator , terradynamics, hard target, deeply buried target

DTRA06-010 TITLE: New Thermobaric Materials and Weapon Concepts

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: TDSH

OBJECTIVE: Develop innovative new thermobaric materials and/or energy release processes that will lead to significant enhancements in destructive energy delivered on targets, and/or significant improvement in munitions effectiveness for weapons designed to defeat hard and deeply buried targets (HDBT), for use in military operations in urban terrain (MOUT).

DESCRIPTION: The Defense Threat Reduction Agency (DTRA) is seeking new and innovative thermobaric materials and weapon concepts that will enable and lead to development of much smaller, more effective weapons for use against potential threat targets in deeply buried and hardened tunnels, hardened bunkers, or targets expected to be encountered in MOUT. Some general technology areas of promise in achieving these objectives include, but are not limited to, thermobaric and enhanced blast materials and formulations and weapon concepts.

DTRA has identified three critical technical challenges in performance enhancement of thermobaric weapons. They are: (1) turbulent mixing of fuel from thermobarics and air, (2) ignition of the fuel and (3) combustion of the fuel. Traditionally, a few to tens of micron size aluminum particles have been used in many thermobaric formulations. These formulations do not normally release most of its available energy in the time scales of interest. For smaller weapons, the desired time scale for this energy release is about ten milliseconds or less, and for large weapons, the time scale may be order of several tens of milliseconds.

In order to achieve a desired level of energy release in these time scales, more effective ways of mixing the fuel cloud/particles with air, such as an introduction of jetting by means of non-uniform weapon casing design, needs to be introduced. Fireballs from current thermobarics weapons entrain and get mixed with air through the turbulent vortices on the surface of the fireballs. Use of larger fuel particles may enhance the fuel particle mixing with air, but this may have some other complications such as long burning times.   Aluminum particles have a high ignition temperature due to their oxide coating, and therefore many particles do not get ignited when the surrounding gas is cooled enough (below 2000 K). There have been efforts to lower the ignition temperature, through coating and such, but these efforts have been only partially successful. Even when they are ignited, their combustion time may not be fast enough to contribute to the enhancement of blast energy. Large aluminum particles are known to burn in long times.

Research that improves the knowledge and understanding of these processes, that overcomes some of the challenges mentioned above, and that produces new types of thermobarics with significantly enhanced performance, is sought. The work described here will complement current DTRA's efforts such as the Thermobarics ACTD, the Thermobaric Hellfire Development and Transition Program, the Advanced Energetics Program and the Agent Defeat, Disrupt and Denial Program.

PHASE I: Determine the scientific and technological merits, and the feasibility, of the innovative Novel Thermobaric Material that can generate at least 100 % more impulse in a typical MOUT targets, as compared to a baseline explosive, PBXN-109. Analyze requirements for mixing, ignition and combustion control, and identify approaches to achieve these controls simultaneously.   Demonstrate production of small quantities of the innovative Novel Thermobaric Material. Explain their mixing, ignition and energy release processes during reaction.

PHASE II: Define key elements and requirements for scale-up of material production to produce quantities of material suitable for field prototype phenomenology tests, typically in kilogram quantities. Demonstrate material production at kilogram level, and produce well-defined prototype product samples suitable for phenomenology tests. Conduct prototype phenomenology tests to demonstrate enhanced mixing, ignition and combustion processes, and quantify performance parameters of these processes.   Validate the theory of their mixing, ignition and combustion processes during reaction.

PHASE III: Weapon types that can benefit from this technology span from small weapons such as shoulder-launched weapons, to medium size weapons such as Hellfire and TOW, to large weapons such as BLU-109 and Mk84. Design weapons that can be most effective for given applications.   Demonstrate manufacture of production quantities needed for these applications. Commercially, understanding obtained by this technology on how these weapons work may be applicable to development of better protection systems against terrorist attacks using enhanced blast explosives.

REFERENCES:
1. "Advanced Energetics Materials", ISBN 0-309-09160-8; report by Committee on Advanced Energetic Materials and Manufacturing Technologies, Board on Manufacturing and Engineering Design, Division on

Engineering and Physical Sciences; National Research Council of the National Academies, The National Academies Press, Washington, D.C.; 2004; http://www.national-academies.org/bmed

2. "Energetics of Aluminum Combustion"; Peter Politzer, Pat Lane, and M. Edward Grice; J. Phys. Chem A 2001, 105, 7473-7480.

3. “Combustion of Aerosolized Spherical Aluminum Powders and Flakes in Air,” B.Z. Eapen, V.K. Hoffman, M. Schoenitz, E.L. Dreizin; Combustion Science and Technology, 176, 1055-1069, 2004.

4. “Method of Improving the Burn rate and Ignitability of Aluminum Fuel Particles and Aluminum Fuel so Modified,” A. Hahma, at Forsvarets Forskningsinstitut, SE-172 90 Stockholm, Sweden; International patent publication #WO 2004/048295 Al.; June 10, 2004

KEYWORDS: thermobarics, formulation, weapon design, enhanced blast explosives

DTRA06-011 TITLE: Test Diagnostics for Chemical and Biological Agent Defeat

TECHNOLOGY AREAS: Chemical/Bio Defense, Sensors, Electronics

ACQUISITION PROGRAM: TDSD

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Establish approaches and develop a full scale testing diagnostic capability that will enable the tester to simultaneously locate and quantify live/biologically active simulants for various Biological Warfare agents and simulants for various Chemical Warfare agents in near-real time released as the result of a test employing an Agent Defeat weapon against a target containing these agents separately or in various combinations.

DESCRIPTION: One of the major challenges to developing Agent Defeat weapons is the current inability quantify with any level of certainty the quantity of “untouched” Biological and/or Chemical simulant that was released (if any) from the test facility as a result of the test event. “Test event” refers to the employment of an Agent Defeat weapon against a simulated chemical or biological agent, facility or weapon, and the subsequent release of chemical or biological agents due to that event. Weapons employed for this purpose may vary in size for several pounds (sub-scale) up to a thousand pounds (full-scale) of energetic material (explosive or pyrophoric). Several methods exist for measuring with greater or lesser degrees of precision the chemical or biological simulants existing in the atmosphere. Unfortunately all of these methods require some degree of after-the-fact laboratory analysis, especially in the case of biological simulants, and are therefore of limited use to the testing community. Innovative and novel concepts are desired for rapidly identifying and quantifying, in near real time, the types and amounts of chemical and/or biological simulants present in the aftermath of a full scale test event at a given target.

The technical approach to accomplish this mission should consider such issues as the ability of a technology to identify a variety of chemical and live biological simulants in a full scale test environment, to be useable in near real time, and to provide a quantitative result of the simulant(s) used in the test.

PHASE I: Concept study with preliminary data included for a mixed-mode chemical and biological agent diagnostic capability potentially suitable for use in the full scale weapon testing environment.

PHASE II: Using the results of Phase I, validate the multifunction chemical and biological diagnostic capability to provide qualitative and quantitative near real time analysis of combined chemical and biological simulants plumes. Offerors are encouraged to devise employment schemes compatible with both air and ground employment of the diagnostic capability.

PHASE III: The outcomes of the investigation will have a wide variety of military and commercial applications in military and civil homeland security plume hazard analysis applications. Follow-on activities are expected to yield opportunities to apply this technology to commercial or other government uses. Homeland Security and state and local agencies may be possible applications.

REFERENCES:
1."Defense Threat Reduction Agency, 2003 Strategic Plan", http://www.dtra.mil.

2. “Defense Threat Reduction Agency, Weapons of Mass Destruction Terms Reference Handbook", September 2001.

3. DOD Directive 5105.62, "Defense Threat Reduction Agency", September 1998.

KEYWORDS: Chemical Agents, Biological Agents, Testing, Near Real Time, Quantitative Analysis, Live Biological Agents, Multifunction Biological and Chemical Detection

DTRA06-012 TITLE: Chemical and Biological Agent Deny

TECHNOLOGY AREAS: Chemical/Bio Defense, Weapons

ACQUISITION PROGRAM: TDSD

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: To provide innovative technologies to enable the tactical commander to deny enemy forces the ability to employ chemical and biological WMD.

DESCRIPTION: There is presently no method available to the tactical commander to deny enemy forces the specific ability to use their chemical and biological WMD other than the general purpose area deny tactics, such as mining or direct attack. None of these general purpose deny tactics or weapons will specifically deny the use of WMD, and in some cases, such as direct attack, they may cause unacceptable collateral effects by dispersing the WMD agents.

Ideally, an Agent Deny weapon will make it difficult or impossible for an adversary to develop, produce, store, or employ the chemical and biological WMD in his arsenal, in a manor that will “render safe” the specific agent and/or agent based process for an extended duration (a few days to weeks) without any undesirable collateral agent release. It is envisioned that the Agent Deny weapon will be able to be used in a manor that will primarily effect only those facilities (or parts thereof in the case of dual use facilities such as a research laboratory building), weapons, and/or processes specific to establishing, maintaining, and using Chemical or Biological based WMD. The concepts for Agent Deny should be tactically sound, allowing reasonable employment by normal military organizations (from air or ground). The concepts should not be of a general nature such as to be employed for all area deny missions, but may have secondary uses if so capable. The technologies to be employed in Agent Deny weapons are limited only by the imagination of the offeror and the various treaty and legal constraints of the US government.

Any innovative solutions or improvements in this technology area that are applicable to any or all of the above-mentioned capabilities are being sought.

PHASE I: Concept study with preliminary data included for innovative technologies/methodologies to deny the use of chemical and/or biological weapons.

PHASE II: Based on Phase I work, develop a prototype Agent Deny weapon and demonstrate military utility against simulated chemical and/or biological weapons.

PHASE III: Produce the product or system for military use. The final product or system may also be applicable to other government agencies or departments, law enforcement agencies as well as homeland defense.

REFERENCES:
1. "Defense Threat Reduction Agency, 2003 Strategic Plan", http://www.dtra.mil.

2. "Defense Threat Reduction Agency, Weapons of Mass Destruction Terms Reference Handbook", September 2001.

3. DOD Directive 5105.62, "Defense Threat Reduction Agency", September 1998.

KEYWORDS: Agent Deny, Sensors, Chemical Agents, Biological Agents

DTRA06-013 TITLE: Advanced X-ray Simulator Technologies

TECHNOLOGY AREAS: Nuclear Technology

ACQUISITION PROGRAM: TDTDN

OBJECTIVE: Support innovative technologies to identify and develop advancements for Department of Defense's (DoD) x-ray simulator technology for commercial, industrial, civilian and Government applications.

DESCRIPTION: This solicitation is for research and development (R&D) of concepts, components, hardware, diagnostics, etc., for the development of x-ray and gamma radiation environments generated by a nuclear event.

DoD's x-ray simulator R&D program has historically focused on incremental improvements in pulsed power technologies to produce very intense, short time period x-rays and gamma radiation for testing DoD operational parts and system components and ensuring that the systems will operate if exposed to an offensive or defensive nuclear weapon burst. The goal of this advanced R&D technology is to provide advanced concepts for Nuclear Weapons Effects test environments that more accurately simulate anticipated nuclear threats with necessary radiated energy and pulse widths. It is also desirable to implement technology to be able to perform more tests per day and reduce maintenance costs. Technology areas of interest include, but are not limited to, the following:

Energy Storage - high voltage, high energy density capacitors (> 3 J/cm3) and superconducting inductors (up to 1MJ)

Switches - high coulomb (>1 coulomb), high current opening and closing switches (10 to 100 MA), low jitter trigger systems (< 2ns)
Other hardware devices and improvements which will increase radiation output, test rate and capabilities and provide for reduced maintenance costs
Diagnostics – more accurate measurement and characterization of Plasma Radiation and Bremsstrahlung Sources

DoD's x-ray radiation simulator program has been noted for its efforts to ensure that technical spin-offs address commercial, civilian and government needs. Spin-offs have influenced many industrial/civilian applications, to include modern defibrillators and chemical and biological cleanup systems. New broad spectrum X-ray sources could provide better resolution imaging for construction material inspections such as concrete supports for overpasses and I-beams for buildings. High energy density capacitors can be used for miniaturizing defibrillators, camera flashes, and similar devices powered by capacitors. Large sized superconducting inductors could be used for electrical power storage to eliminate the use of peaking stations by the electrical utilities. They can also be used to prevent parasitic oscillations on the power grid to improve efficiency in transmission through power lines and decrease the need for more power lines. The new technologies and technical advancements related to the DoD's x-ray radiation simulator program that are developed under this solicitation are expected to result in similar important commercial, industrial, civilian and Government spin-offs.

PHASE I: Demonstrate the feasibility of the proposed concept.

PHASE II: Develop, test and evaluate proof-of-principle hardware or software. In the event the contractor proposes to demonstrate the prototype in an above ground test simulator, DTRA will coordinate the demonstration at its facility.

PHASE III DUAL USE APPLICATIONS: The Phase I proposals should describe and quantify the manner in which the technologies to be developed could be useful for commercial, industrial, civilian and Government applications. Phase III, if awarded, is the commercialization stage.

REFERENCES:
1) Report of the Defense Science Board Task Force on Nuclear Weapon Effects Test, Evaluation, and Simulation; April, 2005; Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; Washington, DC 20301-3140
2) Radiation Simulator Research Testbed Facilities and Capabilities, Defense Threat Reduction Agency, Albuquerque, NM, First Edition, August, 2005

KEYWORDS: Advanced Simulator, Above Ground Test (AGT), X-ray, Gamma Ray, Pulsed Power, Radiation, Electronics, Nuclear Weapon Effects, Electromagnetic, High Coulomb Switches, High Energy Capacitors, Static Electrical Storage Devices, Dose, Dose-Rate, High Voltage, High Current.