DEFENSE THREAT REDUCTION AGENCY
SBIR FY05.1 Proposal Submission

The Defense Threat Reduction Agency (DTRA) is actively involved in meeting current threats to the Nation and working toward reduction of threats of all kinds in the future. To meet these requirements, the Agency is seeking small businesses with strong research and development capability. Expertise in weapons effects (blast, shock and radiation), arms control, 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
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Use of e-mail is encouraged for correspondence purposes.

DTRA has identified 14 technical topics numbered DTRA 05-001 through DTRA 05-014. 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. Questions concerning the topics should be submitted to Mr. Kehlet at the above address, to the POC identified for the topic (during the presolicitation period), or through the SITIS system.

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 evaluation criteria contained in this solicitation document consistent with mission priorities and subject to available funding. 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 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 05.1 Topic Index

DTRA 05.1 Topic Descriptions

DTRA05-001 TITLE: Radiation Effects in Semiconductor Electronics

TECHNOLOGY AREAS: Sensors, Nuclear Technology

OBJECTIVE: The objective of this task is to establish and validate innovative, cost-effective and accurate methods to perform mixed-mode modeling and simulation of the radiation response of deep submicron semiconductor integrated circuits to support the development of radiation hardened microelectronics to support DoD strategic space and missile systems. Mixed-mode simulation allows a designer to simultaneously model the response of a circuit at the physics level (within a transistor) and transfer the output of the micro-response to a full circuit level that is comprised of 1000's of transistors.

DESCRIPTION: The overarching mission of the DTRA Radiation Hardened Microelectronics Program is to ensure the availability of hardened microelectronics to support various DoD systems that include Space Based Radar, Space Tracking and Surveillance Systems, Miniature Kill Vehicle and other such systems that must provide prolonged and interruption free operation in a harsh radiation environment.

The technical approach to accomplish this mission includes the development and insertion of specific technology to mitigate the effects of radiation and the modeling and simulation of these effects. Moreover, as the complexity of these circuits continues to increase, to meet mission needs, the requirement for accurate radiation effects mixed-mode modeling and simulation has grown exponentially.

At present the suppliers of these devices are using commercial software tools that have been modified to comprehend radiation effects. In addition, there are other tools that will allow small portions of a circuit to be modeled. However, at present there are no dedicated software tools that will support a 3-D mixed-mode simulation of a complete circuit. This shortfall imposes a significant problem concerning the development of the types of circuits required by the above noted systems and forces manufacturers to adopt an empirical approach that is time consuming, very expensive and does not readily support the development of these complex devices.

Thus, the availability of such a capability will be of very significant benefit to the DoD programs that are developing radiation hardened technology and their contractors and result in significant improvements in device performance and reductions in overall development costs.

PHASE I: Develop and demonstrate a prototype mixed-mode radiation effects simulation capability suitable for deep submicron semiconductor integrated circuit technology for digital integrated circuits.

PHASE II: Using the results of Phase I, validate the digital mixed-mode simulator through experimentation and extend the capability of the simulator to address analog circuitry. Perform Beta Site testing of the digital simulator.

PHASE III: Integrate the digital and analog mixed-mode radiation effects simulation capabilities and validate the integrated simulator. In addition, perform Beta Site testing of the combined simulator. Provide a commercial version of the completed simulator. Capability has application to all commercial satellite electronics.

KEYWORDS: mixed-mode simulation, radiation effects in semiconductor circuits, radiation hardening

DTRA05-002 TITLE: Novel Energetic Materials

TECHNOLOGY AREAS: Materials/Processes, Weapons

OBJECTIVE: Develop innovative new energetic 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), or to defeat weapons of mass destruction (WMD). Energetic materials and/or energy release processes that reduce risk of collateral damage while increasing energy delivered on these targets of interest are also sought.

DESCRIPTION: The Defense Threat Reduction Agency is seeking new and innovative energetic materials 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, chemical and biological WMD, or targets expected to be encountered in MOUT. For MOUT and WMD targets in particular, reduction of the potential for collateral damage due to weapon operation is also highly important. Some general technology areas of promise in achieving these objectives include, but are not limited to, thermobaric and enhanced blast materials and formulations, reactive structural materials, intermetalic or other high heat-flux materials, nanometric energetic materials, and novel new chemical synthesis of detonable energetic materials or high heat-flux materials.

Thermobaric and Enhanced Blast Materials/Processes. Enhancements to blast pressure, duration, propagation, and range of action are believed to be highly effective ways to improve lethality of blast-effect weapons, especially those designed for use within enclosed targets such as buildings, bunkers, tunnels and caves. Many blast-effect weapons were designed to take advantage of ambient air in a fuel-oxidizer reaction for enhanced effective energy density of the payload. The dynamic processes identified as important for effective, efficient use of thermobaric and enhanced blast weapons are many, but details of these processes are not yet well known or understood. They include: non-equilibrium detonation chemical kinetics; fuel (e.g., Aluminum particles or other) ignition and combustion behavior at high pressure; reaction product expansion and interaction with ambient air (including mixing and reaction); re-shock, reheat, re-ignition, additional mixing of expanding product cloud upon rebound with rigid boundaries or obstacles; and effects of charge-casing material and fragmentation on reaction kinetics. Research that improves the knowledge and understanding of these processes, and that manipulates or alters these processes to significantly enhance performance, is sought. Also sought is development of new, innovative types of energetic materials that enhance blast pressure, duration, propagation and range through processes other than those listed above. Examples include but are not limited to composite energetic particles having variable reaction rates to achieve high pressure energy release after distribution within the target volume; composite formulations containing components that act to enhance the ignition or reaction rate of fuel components, etc.

Reactive Structural Materials. Most of the mass and volume of current weapon systems is not directly related to energy release at targets, but to other functions such as load-bearing (structural members, payload casing) or fragment formation (bomb casing), etc. If some of these other functions could be performed by an energetic material, total energy delivered by a given weapon could be increased, and/or weapon size could be reduced. Approaches to achieving energetic structural materials include but are not limited to consolidation of metal/metal-oxide mixtures, metal/fluoropolymer mixtures, or intermetalic mixtures, etc. Mixture and consolidation techniques that achieve strength approaching or comparable to that of structural metals and mass density approaching that of steel, while also providing energy density approaching that of RDX and controllable reaction initiation are particularly sought.

Other Novel New Energetic Materials. In addition to the two examples given above, novel new chemistry or synthesis of non-detonable high heat-flux energetic materials, or of stable, detonable energetic materials having energy density significantly higher than that of traditional high explosive materials such as RDX, is also sought.

PHASE I: Determine the scientific and technological merits, and the feasibility, of the innovative Novel Energetic Material and its energy release processes. Analyze requirements for initiation and reaction chemistry control, and identify approaches to achieve initiation and reaction control. Demonstrate proof-of-principle for the innovative Novel Energetic Material and its appropriate initiation and energy release processes, and measure energy release rates from laboratory samples. Demonstrate production of small gram quantities of the candidate material.

PHASE II: Define key elements and requirements for scale-up of material production to produce quantities of material suitable for laboratory and 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 characterize initiation and energy release processes, and measure reaction initiation thresholds and energy release rates. Produce kilogram quantities of material needed for sub-scale prototype weapon effects and lethality tests.

PHASE III: Commercial potential for high-blast and for high-energy materials is good in civil construction (excavation, over-burden removal, etc.), surface and sub-surface mining, petroleum exploration and oil well-stimulation, building demolition, and law enforcement applications. Commercial potential for structural energetic materials is also possible in building demolition, mining, oil well stimulation, and law enforcement applications. In Phase III, produce production quantities needed to demonstrate civil construction, mining, exploration, building demolition and law enforcement applications, as well as quantities needed for military applications.

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

5. "Relation Between Early and Late Energy Release in Non-Ideal Explosives," R.H. Guirguis; Proceedings of the 1994 JANNAF PSHS Meeting, 1994.

6. "Ignition dynamics of boron particles in a shock tube," H. Krier, R.L. Burton, M.J. Spalding, and T.J. Rood; Journal of Propulsion and Power, 14, 166 (1998)

7. "Ignition and combustion of aluminum particles in H-2/O-2/N-2 combustion products," R.O. Foelsche, R.L. Burton, H. Krier; ; Journal of Propulsion and Power, 14, 1001 (1998)

8. "Constant Volume Explosions of Aerosols of Metallic Mechanical Alloys and Powder Blends," M. Schoenitz, E.L. Dreizin, and E. Shtessel; ; Journal of Propulsion and Power, (2003) 19(3):405-412

9. "Explosive Launch Studies for Reactive Material Fragments," M.E. Grudza, D. Jann, C. Forsyth, W. Lacy, W. Hoye, and W.E. Schaeffer; 4th Joint Classified Bombs/Warheads and Ballistics Symposium, Newport, R.I., 2001.

10. "Detonation-like Energy Release from High-Speed Impacts of Polytetrafluoroethylene-Aluminum Projectiles," R.G. Ames, R.K. Garrett, and L. Brown; 5th Joint Classified Bombs/Warheads and Ballistics Symposium, Colorado Springs, Co; June, 2002

11. "N-5-+: A Novel Homoleptic Polynitrogen Ion as a High Energy Density Material," Karl O. Christe, William W. Wilson, Jeffery A. Sheehy, Jerry A. Boatz; Angewandte Chemie, V. 38, Issue 13/14, pp 2004-2009

12. "Synthesis and Calculation of Properties of N-Difluoroaminoazoles, the Novel Type of Energetic Materials," I.L. Dalinger, et al; Propellants, Explosives, and Pyrotechnics, V. 23, Issue 4, pp 212-217.

13. "Computer-Assisted Prediction of Novel Target High-Energy Compounds," T.S. Pivina et al, ; Propellants, Explosives, and Pyrotechnics, V. 20, Issue 3, pp 144-146.

KEYWORDS: reactive materials, thermobarics, formulation, enhanced blast, agent neutralization, high explosives

DTRA05-003 TITLE: Light-weight Stand-off High Explosive Detection

TECHNOLOGY AREAS: Materials/Processes, Sensors

OBJECTIVE: The Lightweight Stand-off High Explosive Detection program goal is to explore and develop the means to detect and identify shielded explosive materials to include TNT, C4, etc. at a safe distance to the operator.

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 Directorate supports the Global War on Terrorism by providing technology to detect and defeat weapons of mass destruction (WMD).

The number of KIA and WIA associated with Improvised Explosive Devices (IEDs), Vehicle Borne IEDs and similar weapons have made early detection more critical. Current detection technologies depend on situational awareness, change detection methods or detectors that do not provide a safe standoff distance for the operator leaving them vulnerable to terrorist tactics. Hence, there is a requirement to develop and demonstrate an unconventional methodology that can non-invasively detect explosive material through shielding. Interim goal is a product that can be mounted to a HMMWV and detect explosives at a distance equal or greater than 20m. The final goal is a lightweight product that can be attached to an unmanned platform (air or ground) and controlled remotely.

PHASE I: Identify and define the proposed concept and develop key component technological milestones to demonstrate feasibility of concept.

PHASE II: Using results from Phase I, fabricate prototype, define field test objectives, and conduct limited testing.

PHASE III: Using results from Phase II, design and develop operational low rate initial production (LRIP), and demonstrate utility for commercial and military 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: explosive detection; antiterrorism; weapons of mass destruction; standoff

DTRA05-004 TITLE: Chemical/Biological Agent Stand-Off Detection

TECHNOLOGY AREAS: Chemical/Bio Defense, Sensors

OBJECTIVE: To provide innovative technologies that enable personnel to detect the presence of chemical and/or biological warfare agents from large (multiple kilometer) distances.

DESCRIPTION: An instrument capable of detecting chemical and/or biological agents from large distances is needed. The detector should be usable from distances of multiple kilometers from the intended target and be able to detect multiple agents.

Ideally, the detector would be able to not only detect but also identify and quantify the agents as well. It would need to be usable in a wide variety of environments (e.g., hot/cold, arid/humid, desert/water, etc.) and not be affected by interferents (e.g., dirt, exhaust fumes, etc.).

For chemical agents, the detector will need to detect multiple classes of agents (e.g., blister, nerve) and ideally other toxic industrial chemicals (TICs). For biological agents, the detector will need to distinguish between pathogenic and non-pathogenic entities, and also between respirable and non-respirable hazards.

As with all detectors, false positives and false negatives need to be minimized as much as possible. Innovative solutions to address the objective, or innovative improvements over previously researched methods or technologies, are needed to meet the objectives while keeping the false responses at a minimum.

Any innovative solutions or improvements in this technology area are being sought.

PHASE I: Develop innovative technologies/methodologies to be able to detect chemical and/or biological agents from large distances.

PHASE II: Based on Phase I work, develop a prototype product or system and demonstrate military utility to be able to detect chemical and/or biological agents from large distances.

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 hazardous material or environmental remediation companies.

KEYWORDS: Chemical Agents, Biological Agents, Detection, Stand-Off

DTRA05-005 TITLE: Chemical/Biological Agent Non-Instrusive Detection

TECHNOLOGY AREAS: Chemical/Bio Defense, Sensors

OBJECTIVE: To provide innovative technologies that enable personnel to detect the presence of chemical and/or biological warfare agents inside sealed containers.

DESCRIPTION: An instrument capable of detecting chemical and/or biological agents inside sealed containers is needed. The detector should be usable from distances of zero to several meters from the intended target and be able to detect multiple agents.

Ideally, the detector would be able to not only detect but also identify the agents as well. It would need to be usable in a wide variety of environments (e.g., hot/cold, arid/humid, desert/water, etc.) and not be affected by interferents (e.g., dirt, exhaust fumes, etc.). To be non-intrusive, the detector must be usable without having direct contact with the target agents.

For chemical agents, the detector will need to detect multiple classes of agents (e.g., blister, nerve) and ideally other toxic industrial chemicals (TICs). For biological agents, the detector will need to distinguish between potentially pathogenic and non-pathogenic entities.

As with all detectors, false positives and false negatives need to be minimized as much as possible. Innovative solutions to address the objective, or innovative improvements over previously researched methods or technologies, are needed to meet the objectives while keeping the false responses at a minimum.

Container types to be interrogated are varied. They could include, for example, 55-gallon steel drums, chemical/biological munitions, plastic or glass containers, large storage vessels, fermenters, reactors, etc.

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: Develop innovative technologies/methodologies to be able to detect chemical and/or biological agents inside sealed containers.

PHASE II: Based on Phase I work, develop a prototype product or system and demonstrate military utility to be able to detect chemical and/or biological agents inside sealed containers.

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 hazardous material or environmental remediation companies.

KEYWORDS: Chemical Agents, Biological Agents, Detection, Non-intrusive

DTRA05-006 TITLE: Higher Resolution Radiation Detectors

TECHNOLOGY AREAS: Sensors, Nuclear Technology

OBJECTIVE: DTRA requires a high resolution portable gamma-ray detector that will not require the difficult logistic requirements associated with liquid nitrogen cooling of high purity Germanium. The detector should be capable of resolutions on the order of one percent or better at 662 keV.

DESCRIPTION: International agreements and homeland defense may require the ability to detect plutonium and distinguish weapon-grade plutonium from reactor-grade plutonium. Detection of other radioisotopes may also be required. Present high-resolution detectors use High Purity Germanium which provides resolutions as low as 0.1 percent. However, High Purity Germanium requires cooling to cryogenic temperatures – either by liquid nitrogen or an electromechanical cooler. Cooling by these means often is not practical for remote or portable applications. Room temperature semiconductor-based (HgI_2 and CdZnTe) and scintillator-based detectors (e.g., NaI(Tl)) are available but with poorer resolutions. The two semiconductors mentioned above can achieve resolutions of better than two to three percent while most scintillators can achieve resolutions on the order of six percent. Some recent advances in scintillators (e.g., $LaCl_3$:Ce) show that resolutions between three and four percent may be achievable. None of these existing room-temperature detectors can, at present, satisfy DTRA needs. DTRA therefore seeks detectors based on new materials that can offer the potential of resolutions (at 662 keV) on the order of one percent or better. Improved detection schemes based on improved software or improved electronics are not of interest – only new materials.

PHASE I: Develop a gamma-ray detection system design that offers the potential of achieving a resolution of one percent or better. This system must offer significant reduction in logistics associated with liquid nitrogen cooling of high purity Germanium. Demonstrate that the design is feasible experimentally and that achieving a one percent or better resolution is theoretically feasible.

PHASE II: Develop and demonstrate a prototype system and conduct tests sufficient to demonstrate proof-of-concept performance in a non-laboratory situation.

PHASE III: The detector proposed has a wide variety of military and commercial applications in surveillance and security, particularly in homeland security. Examples are remote and perimeter monitoring, securing industrial facilities, border and event monitoring, and container security evaluations

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: Arms control verification and compliance, plutonium, radionuclides, plutonium detection, room-temperature detectors, gamma detectors, gamma radiation, homeland security, counter-terrorism

DTRA05-007 TITLE: Individual Digital Dosimeters

TECHNOLOGY AREAS: Sensors, Human Systems

OBJECTIVE: The Defense Threat Reduction Agency (DTRA) seeks a low-level radiation individual dosimeter to improve the capability of U.S. Forces to operate in low-level radiation environments. Current U.S. and NATO doctrine specifies recording individual dose readings for low-level radiation environments at levels far below fielded dosimeter capability. For radiological safety in a low-level environment and for after-mission dose assessment, it is essential that there be a personal dose record for the individual soldier downloadable into a comprehensive database.

DESCRIPTION: NATO (STANAGs 2473, 4590, and 2957) and U.S. (JP 3-11, FM 4-02.283) doctrine mandate the improvement in the capability for forces to operate in low-level radiation fields during military operations other than war. Recent Radiation Exposure State (RES) categories specify the capability to record individual dose readings down to potential exposures of 0.05 cGy in such operations. The current A/UDR-13 Pocket RADIAC dosimeter can meet these stringent low-level radiation requirements but is far too costly for general fielding. This solicitation seeks a dosimeter that meets these sensitivity requirements and a dose record in a electronic digital format that can be downloaded into a comprehensive database. Naturally an audible alarm to prevent exposure upon entry into an area containing an unexpected radiological hazard or to enforce dose limits in a known environment is necessary. Numerous low-cost commercial alarming digital dosimeters are available but neither tested nor optimized for military use. This solicitation seeks proposals for just such a low cost, high sensitivity individual digital dosimeter, either based on a COTS instrument or on an innovative approach.

PHASE I: Develop an alarming digital dosimeter design sensitive to 0.05 cGy that will be inexpensive when produced in mass quantities. The device must automatically alarm on exposure to high fields or exposure to dose limits in a low-level radiation environment. Demonstrate that the unit cost of the dosimeter will be less than <$100 per unit in bulk and the weight such that it could be issued to all personnel.

PHASE II: Develop & demonstrate a prototype system having the weight, ruggedness, and environmental resistance appropriate for field use under harsh conditions. Conduct testing to prove feasibility over extended operating conditions and a wide range of temperatures.

PHASE III: An individual digital dosimeter at a minimal price has a wide variety of military and commercial applications in surveillance and security. Examples are outfitting of security, Customs, border, and search personnel.

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.

4. "Army Specific Military Requirements for Radiation and Nuclear Weapons Effects", 9 December 2003.

KEYWORDS: Radiological Monitoring, Dosimeters, Individual monitoring, Medical Surveillance

DTRA05-008 TITLE: Alternate Technologies for Radiological Material Detection

TECHNOLOGY AREAS: Sensors, Nuclear Technology

OBJECTIVE: The Defense Threat Reduction Agency (DTRA) seeks new concepts and approaches in detecting and identifying uranium, plutonium, and other nuclear and radiological materials of interest without relying solely on ionizing radiation signatures. This effort is in support of DoD efforts in countering terrorism, counter-proliferation, and nonproliferation.

DESCRIPTION: A portion of DTRA's detection technology program seeks to improve detection and identification capabilities for uranium, plutonium and other nuclear and radiological materials of interest without relying on ionizing radiation signatures. Technologies providing signatures or indicators relatively unique to radiological material or radiation fields are of interest. Passive and active radiation detection systems will not be considered. In particular, DTRA is interested in possible methods to detect such materials at a significant distance (above 10 m) in both shielded and unshielded configurations in kilogram-scale quantities. Methods that might be of interest include, but are not limited to, optical, laser, radar, mass, or acoustic techniques either alone or in combination with each other or with some information systems technology. All technologies that are not primarily based on passive or active nuclear radiation detection signatures for detection and identification may be submitted in response. A secondary reliance on radiation confirmation is acceptable, but will not be used in evaluating the proposal. An operational deployment concept indicating how the concept would be realized, including distance and quantity would greatly assist evaluation.

Ideally technologies should be safe to use around the general public without inflicting damage or injury, but technologies may entail nominal safety constraints (e.g. personnel stand-off distance, shielding, etc.) in order to achieve significant advances in detection. Power requirements are a restrictive condition for this topic, but technologies that have the potential for battery operation for extended periods (up to 8 hours) are of particular interest.

PHASE I: Develop a system design based on detecting a nominal 1 kg of uranium, plutonium or other nuclear or radiological materials of interest at a nominal distance of 1 meter in less than 15 s in a shielded configuration (1 mm thick lead shielding). Demonstrate that the system weight will be such that it is man-portable by 1-2 people of average strength for a short distance, roughly 75 lbs. Provide a detailed concept of operations illustrating how this technology would be used by field, guard, portal, search, or evaluation personnel.

PHASE II: Develop and demonstrate two prototype systems with a weight, ruggedness, and environmental resistance sufficient for adequate field evaluation under relatively harsh conditions. Conduct testing to prove feasibility over extended operating conditions and a wide range of temperatures.

PHASE III: An operational screening system for nuclear and radiological material that does not rely on ionizing radiation measurements would have a wide variety of military and commercial applications in surveillance and security. Examples are remote and perimeter monitoring, protection of industrial facilities, and border crossing and portal monitoring of vehicles and containers.

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: Nuclear material detection, radiological material detection, portal monitoring, remote detection

DTRA05-009 TITLE: <u>Active Interrogation for Nuclear Materials Detection</u>

TECHNOLOGY AREAS: Sensors, Nuclear Technology

OBJECTIVE: The Defense Threat Reduction Agency (DTRA) seeks means of extending the standoff distance between detectors and nuclear and radiological sources, which may be shielded or otherwise obscured. This solicitation seeks a stronger, more directional beam of energetic particles, nominally neutrons, although other species are also of interest. The goal is to place a greater fluence of energetic species on target, thus increasing the distance at which an induced signal could be detected. This effort is in support of DoD efforts in countering terrorism, counter-proliferation, and nonproliferation.

DESCRIPTION: DTRA is currently developing systems to detect and identify uranium, plutonium and other nuclear and radiological materials of interest in shielded and unshielded configurations. The combination of insufficient directionality and inadequate intensity has limited the operational standoff distance for active sources. The directionality problem has raised problems of operator and bystander safety. The double r-squared distance problem has meant that the intensity problem inherently limits standoff. This solicitation seeks possible means of increasing fluence on target by an order of magnitude above current commercial levels (approximately 108 n/s for a neutron beam), preferably while lowering off axis exposure. The design goal is to detect 1 kg of uranium or plutonium, possibly with a 1 mm thick lead shield, at a standoff of 3 meters in less than 10 seconds. Although this solicitation is written for neutrons, any energetic beam with similar capabilities is of interest, providing that the offeror indicates how detection would be accomplished.

PHASE I: Develop an energetic source design based on providing an equivalent fluence of 109 neutrons/second onto a target 3 meters away and inducing a detectable response at the source. The target is 1 kg of uranium, plutonium or other radiological material of interest, possibly with a 1 mm thick lead shield between it and the source. Demonstrate that the weight of the source and ancillary power systems will be practical (i.e., transportable), although the lower the weight the more interest there would be. Further demonstrate that the non-axial beam intensity is low enough to provide no significant safety hazard to bystanders. Some experimental feasibility test during Phase I is strongly encouraged. Provide a conceptual operational deployment concept to show how the source could be employed for active interrogation.

PHASE II: Develop and demonstrate a prototype source with a weight, ruggedness, and environmental resistance characteristics appropriate to field use and test the source under realistic conditions. Conduct testing to prove feasibility over extended operating conditions and a wide range of temperatures.

PHASE III: An active interrogation source for containers, vehicles and baggage has a wide variety of military and commercial applications in surveillance and security. Examples are perimeter and portal monitoring, industrial facility security, and port screening.

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: Nuclear detection, active interrogation, directed energy, homeland defense, nuclear materials detection.

DTRA05-010 TITLE: <u>Equipment Detection Using Power Harmonics and Voltage Fluctuations</u>

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Establish the effectiveness of using power system harmonic and voltage fluctuation signatures to identify the types of equipment present in clandestine (hidden) facilities. Develop a database of key equipment types for actual application.

DESCRIPTION: The Defense Threat Reduction Agency (DTRA) supports the intelligence agencies with the objective to find hidden facilities that may have been developed to produce, test-fuze or store weapons of mass destruction. Since many such facilities have been buried in tunnels or other hardened, underground locations, it is difficult to find and to determine the mission of such facilities. In addition, if we choose to attack such facilities with standoff weapons, it would be of great value to remotely detect whether the facility is still operating its equipment after an attack. The technique to be applied is to measure and analyze data to evaluate the low-frequency magnetic fields produced by the power system harmonics and voltage fluctuations emitted by any electronic equipment. Magnetic field nanosensors1, as well as, 3-D flux-gate magnetometers are available to measure the emitted signatures of the electronics equipment operated by diesel or commercial power supply. In fact, power harmonics and voltage fluctuations (spectral signatures) for commercial equipment have recently been evaluated by the International Electrotechnical Commission (IEC)2-5, and it is clear that certain classes of equipment have definite and different characteristics (e.g., computers, lighting, motors, air conditioners, fans, etc.). This work being accomplished in the IEC can be leveraged to examine the characteristic harmonic and voltage fluctuation signals from facilities with different types of equipment and therefore their clandestine missions. Once the harmonic and voltage fluctuation characteristics are determined, there are methods available under different programs to measure the magnetic fields produced by these harmonics at remote distances for buried facilities.

PHASE I: Determine the feasibility of identifying classes of electrical equipment in a given facility based on power harmonic and voltage fluctuation signatures. Evaluate the ability to discriminate the types of equipment present when a mixture of equipment is operating in a single facility.

PHASE II: Develop a prototype instrument (hardware and software) to validate the ability to detect critical types of equipment in a given facility from the power system signatures and to determine if the equipment has ceased operating.

PHASE III: DUAL USE COMMERCIALIZATION: After the approach has been demonstrated, a user-friendly database computer program will be developed that will allow the user to determine the types of electronics present in a remote facility. This computer code capability can be directly applied to the hardened deeply buried target (HDBT) defeat program of DTRA to characterize the targets. The same computer code capability can be used for commercial use by owners of large number of buildings with many tenants that have harmonic and/or voltage fluctuation problems with their power system. This will allow the owner to apply mitigation techniques to improve the power quality for his building.

REFERENCES:
1. Scientific American, July 2004, vol 291, No.1, p 71; Magnetic Field Nanosensors
2. IEC 61000-3-2, Ed.2.1 (2001-10); Limits for harmonic currents, equipment ¡Ü 16 A per phase.
3. IEC 61000-3-3, Ed.1.1 (2002-03); Limits for voltage fluctuation (Flicker) ¡Ü 16 A per phase.
4. IEC 61000-3-11, Ed.1.0 (2000-08); Limits for voltage fluctuation (Flicker) ¡Ü 75 A per phase.
5. IEC 61000-3-12 Limits for harmonic currents, equipment > 16 A per phase (in progress).

KEYWORDS: Clandestine facilities, Signal intelligence data, Weapons of Mass Destruction characterization

DTRA05-011 TITLE: Non-Energetic Payload Technologies

TECHNOLOGY AREAS: Ground/Sea Vehicles, Weapons

OBJECTIVE: To provide new and innovative Non-Energetic concepts and formulations that can be utilized as payloads in current munitions to effectively defeat hardened facilities and dual commercial use in offensive/defensive law enforcement applications where effective use of product can be used to neutralize threat, potential biological threat, and minimize collateral effects damage.

DESCRIPTION: Conventional weapons rely on blast and fragmentation as the primary defeat mechanism, whereas non-energetic payloads rely on other means to defeat the target. Non-energetic weapons may defeat targets by the dispersion of aerosols (solid or liquid) or gasses to interact with critical target elements. The objective is to cause some combination of denial, disruption, degradation, or destruction without the transfer of excessive energy to the target and thereby minimizing collateral effects. The target set includes hardened targets that vary in size, complexity, and may be above or below ground. Initial investigations of Non-Energetic fills in laboratory environments have shown remarkable potential when applied against underground structures that depend upon electro-mechanical equipment and electronics while at the same time demonstrating the potential to neutralize biologically derived weapons. To date, the research has focused on these Modes of Defeat:
- Coatings (e.g., Short Circuiting/Shunting; Adhesives, etc.)
- Oxidizers & Corrosives
- Thermal Accelerants
- Obscurants (e.g., Smoke, Lachrymators, Malodorants, etc.)

Dual commercial applications would include law enforcement applications where the use of a non-energetic product would be most critical in offensive denial while minimizing collateral effects damage. An example of this would be the use of greasy smoke for screening applications; maloderant applications for dispersal effects; corrosive/oxidizers for neutralization of possible bio threats while minimizing collateral damage effects. Interested parties can focus their efforts within these Modes of Defeat, but proposals championing alternative Modes of Defeat are very welcome. Potential investigators are encouraged to contact the sponsoring agency for additional background and technical discussions. The criteria listed below are applicable to all three phases. Candidate materials (or methodology and solutions) must address these issues (not in order of priority):
- Long term (at least 6 months) storage life
- Availability on a large (multi-ton) scale
- Availability of prerequisite materials essential to the manufacture of candidate material
-Performance (mass of candidate needed to defeat target versus size of target)
- Specify how the proposed solution is used with respect to target (e.g. size, volume, structural integrity, internal geometry)
- Cost effectiveness of proposed solutions
- Treaty compliance issues

In addition, successful Phase I investigators will show methods relating to:
- Characterization of effectiveness of the candidate solution to (any) targets
- Dispersion of the candidate materials, if applicable
- Packaging of the candidate material(s) within applicable weapons platforms

PHASE I: Identify one or more formulations with the potential for enhancing defeat of hardened and underground facilities and commercial dual use applications (law enforcement used as example). Potential fills must consider enhancements in agent defeat and minimization of collateral damage.

PHASE II: Demonstrate performance, dispersion, and all other applicable parameters required for one-third (1/3rd) scale and progressively to full-scale application.

PHASE III: Produce production quantities for military and/or special applications. Commercial applications include law enforcement. Potential for neutralization of biological agents could also be employed in industrial accidents/sabotage homeland security situations faced by FEMA, EPA and local and state agencies.

KEYWORDS: Non-Energetic, formulation, Modes of Defeat,
Modes of Denial, agent neutralization, Weaponization

DTRA05-012 TITLE: Improve High Altitude Transport and Dispersion Modeling Capability

TECHNOLOGY AREAS: Information Systems, Electronics

OBJECTIVE: DTRA requires an innovative technical solution that enables collection and use of remotely sensed upper atmospheric data to improve predictive capabilities of both Numerical Weather Prediction (NWP) and Transport and Dispersion (T&D) models.

DESCRIPTION: Currently, the lack of measured and observed meteorological data in the upper atmosphere limits our ability to accurately model high altitude weather and T&D of potentially hazardous substances (such as from a missile intercept). Conventional atmospheric observing techniques either do not extend into the upper atmosphere or do not resolve the atmospheric region well. Additional high altitude meteorological data are needed to improved NWP model forecasts, to directly drive T&D models and for model evaluation. Upper atmospheric meteorological information from GPS satellites already exists, but not in a form useable by NWP or T&D models. Innovative data retrieval and processing methods are required to enable this data to be incorporated (in real time) into these modeling systems

PHASE I: Investigate and develop prototype algorithms for upper atmospheric observation appropriate for existing NWP models (e.g., MM5, COAMPS, RAMS) and probabilistic dispersion prediction via the DTRA Hazard Prediction and Assessment Capability (HPAC).

PHASE II: Generalize a set of algorithms to work with existing NWP models and observational data streams that will take the limited observations and apply them throughout the area of interest.

PHASE III: The outcomes of the investigation will have a wide variety of military and commercial applications in war theatre and civil weather forecasting, in ozone/global warming understanding, and in military and homeland security plume hazard analysis applications. The assimilation techniques developed will be applicable to any NWP model.

REFERENCES:
Grell, G. A., J. Dudhia, and D. R. Stauffer, A description of the fifth-generation Penn State/MCAR mesoscale model (MM5), NCAR Technical Note, NCAR/TN-398+STR, 117 pp., 1994.

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HPAC Version 4.0.4 and User Guide, DTRA/TDOC, HPAC-UGUIDE-01-RBC0, 27 April 2004.

PC-SCIPUFF Version 1.3 Technical Documentation, R. Ian Sykes, et al., Titan Corp., A.R.A.P. Report No. 725, December 2000.

KEYWORDS: Meteorology, numerical weather prediction, NWP, weather, stratosphere

DTRA05-013 TITLE: Waterborne Transport Modeling Capability

TECHNOLOGY AREAS: Chemical/Bio Defense, Information Systems

OBJECTIVE: DTRA requires a waterborne transport and dispersion (T&D) capability to compliment its existing atmospheric T&D model for CBRN (including toxin industrial substances) releases.

DESCRIPTION: The Hazard Prediction and Assessment Capability (HPAC) model does not contain the capability to calculate transport and dispersion of hazardous materials into and through the water. A creative method for developing and coupling this type of capability into HPAC is of interest to DTRA. The current lack of waterborne T&D capability affects hazardous material T&D by limiting its utility solely to atmospheric applications.

PHASE I: Investigate and develop prototype algorithms for a 2-D waterborne transport module in the DTRA Hazard Prediction Assessment Capability (HPAC) model including the incorporation of existing databases and model applications to calculate waterborne transport in various parts of the world.

PHASE II: Expand initial 2-D model to a full 3-D transport and dispersion capacity including a coupled air-sea interaction 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.

REFERENCES:
HPAC Version 4.0.4 and User Guide, DTRA/TDOC, HPAC-UGUIDE-01-RBC0, 27 April 2004.

PC-SCIPUFF Version 1.3 Technical Documentation, R. Ian Sykes, et al., Titan Corp., A.R.A.P. Report No. 725, December 2000.

Hetrick, D.M., C.C. Travis, P.S. Shirley, and E.L. Etnier, "Model Predictions of Watershed Hydrologic Components: Comparison and Verification," Water Resources Bulletin, 22(5), 803-810 (October, 1986).

KEYWORDS: Oceanography, meteorology, waterborne, waterborne transport, dispersion

DTRA05-014 TITLE: Improved Manufacturing Process for Helium-3 and Sodium Iodide detectors

TECHNOLOGY AREAS: Materials/Processes, Sensors, Nuclear Technology

OBJECTIVE: DTRA requires an inexpensive source for outfitting nuclear/radiological systems that lowering the cost of the Helium-3 and sodium iodide detectors to at least $5.00 per system.

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 Combat Support (CS) Directorate provides emergency response support to the Geographic Combatant Commanders (GCCs) and others for matters involving weapons of mass destruction (WMD) incidents/events.

Since 9-11 the specter of future terrorist attacks on the United States has increased. Of significant concern is the use of an actual nuclear weapon, an improvised nuclear device (IND), or a radiological dispersal device (RDD) in an unconventional manner by terrorist groups against the U.S. or its forces overseas. In order to prevent such an attack, nuclear and radiological detection is paramount. However, nuclear detection technology range is limited by our current understanding of the laws of the physics. Therefore an expedient method for achieving the required detection of such type weapons, barring any breakthrough in the science, is to dramatically increase the number of systems. At this time though, Helium-3 and sodium iodide detectors, which make up the heart of these systems, are expensive (cost-prohibitive for mass production). Lowering the costs of manufacturing these materials to around $5.00 per detector, by perhaps finding an alternate use for Helium-3 and sodium iodide material/detectors, would allow DTRA and other organizations concerned with this problem to buy detectors in mass quantities so as to equip the appropriate number of personnel and outfit numerous points of entry. Proposers who desire information concerning current detector baseline capabilities are encouraged to contact the POC.

PHASE I: Identify and define the proposed concept of manufacturing or other markets for Helium-3 and sodium iodide detectors. Develop key component technological or marketing milestones to demonstrate feasibility of concept.

PHASE II: Using results from Phase I, develop a prototype manufacturing line, define production objectives, and conduct limited testing of this line.

PHASE III: Using results from Phase II, design and develop an operational initial production line and demonstrate utility for commercial and military 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: nuclear detection; radiation detection, Helium-3, sodium iodide