DEFENSE NUCLEAR AGENCY

Submission of Proposals

The Defense Nuclear Agency is seeking small businesses with a strong research and development capability and experience in nuclear weapon effects, phenomenology and operations. DNA invites the small business community to send proposals directly to the following address.

Defense Nuclear Agency
ATTN: AM/SBIR
6801 Telegraph Rd.
Alexandria, VA 22310-3398

The proposals will be processes in the Acquisition Management Office and be distributed to the appropriate technical office for evaluation and action. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Nuclear Agency
ATTN: AM, Ms. P. Brooks
6801 Telegraph Rd.
Alexandria, VA 22310-3398
Tel: (703) 325-5021

DNA has identified 25 technical topics, numbered DNA92-001 through DNA92-025 , to which small businesses may respond in this solicitation. Please note that these are the only topics for which proposals will be accepted. A list of the topics currently eligible for proposal submission is included below. The topics were initiated by DNA technical offices. Questions concerning the research topics should be submitted to:

Defense Nuclear Agency
ATTN: OTA, Mr. J. Gerding
6801 Telegraph Rd.
Alexandria, VA 22310-3398
Tel: (703) 325-1217

DNA selects proposals for funding based upon technical merit, critically of the research, and evaluation criteria contained in this solicitation document. As funding is limited, DNA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and most critical. As a result, DNA may fund more than one proposal in a specific topic area of the technical quality of the proposals in question, if deemed superior, or it may fund no proposals in a topic area. Proposals which cover more than one topic need only be submitted once.

DEFENSE NUCLEAR AGENCY
FY 1992 SBIR TOPIC DESCRIPTIONS

DNA92-001 TITLE: Nuclear Weapon Effects Calculation

CATEGORY: Exploratory Development

OBJECTIVE: Improve the accuracy, runtime and or visualization of output of nuclear weapon effects calculations.

DESCRIPTION: The accurate and efficient calculation of nuclear weapon effects and the display/presentation of such calculations are of major concern to DNA. Areas of interest include more accurate calculations, faster running calculations, and new and improved ways to enable users to calculate, estimate, and appreciate nuclear weapon effects and the survivability/vulnerability of structures and equipment to these effects. Nuclear weapon effects include air blast; ground shock; water shock; cratering; thermal radiation; neutron, gamma and x-ray radiation; electromagnetic pulse; fallout; blue out; blackout; red out; dust cloud formation; and the interaction of these effects on personnel, materials and structures. Structures of interest include deep underground, land-based, sea-based, and aerospace structures.

During Phase I, the research will demonstrate the feasibility of the proposed methodology to calculate and display/present nuclear weapon effects and/or the response of materials and structures of those effects.

During Phase II, the research concepts developed in Phase I will be further developed where, if appropriate, the concepts will be incorporated into appropriate codes.

DNA92-02 TITLE: Response of Materials to Nuclear Weapon Effects

CATEGORY: Exploratory Development

OBJECTIVE: Measure the response of new and existing materials to nuclear weapon effects and develop methods to improve the survivability of these materials.

DESCRIPTION: Of interest to DNA is the response of materials, structures and systems to nuclear weapon effects. Materials of interest include metals, ceramics and composites. New materials capable of being used as a structural members for aircraft, missiles, ships, submarines, and military vehicles are of particular concern. The response of underground structures such as missiles silos, command and control facilities, and communications facilities are especially important. Concepts and techniques which will improve the survivability of these types of systems to nuclear weapons effects are required. New materials with enhanced electromagnetic shielding properties are also of interest.

During Phase I, testing plans and feasibility studies on the material will be completed.

During Phase II, the material will be tested and conclusions from the test results will be drawn.

DNA92-003 TITLE: Nuclear Weapon and Neutral Particle Beam Effects on Electronics and Communications

CATEGORY: Exploratory Development

OBJECTIVE: Explore the effects of nuclear weapons, natural space environment, and neutral particle beams on electronics, communications, and photonics.

DESCRIPTION: The nature and magnitude of the effects produced by the interaction of nuclear weapon produced radiation, natural space radiation and neutral particle beams on electronics, photonics, electronic systems, opto-electrical devices, and sensors in the phenomenology areas of Transient Radiation Effects on Electronics (TREE); Electromagnetic Pulse (EMP); and System Generated EMP (SGEMP) are of interest to DNA. Particular areas of

concern include methods by which designers of space, strategic, and tactical systems can assess their susceptibility to TREE, EMP, and SGEMP; hardening technologies to reduce the susceptibilities of electronic systems and devices to acceptable levels; and methods to demonstrate survivability under specified threat criteria. Concepts and techniques to improve the survivability of systems against these nuclear weapon effects, space radiation effects, and neutral particle beams are required.

During Phase I, initial feasibility studies will be completed to demonstrate the viability of the proposed approach.

During Phase II, continue the investigation begun in Phase I to fully develop the proposed approach.

DNA92-004 TITLE: Nuclear Weapon Effects Simulation

CATEGORY: Exploratory Development

OBJECTIVE: Improve the state-of-the-art in nuclear weapon effects simulation.

DESCRIPTION: Simulators are needed to: calibrate gauges; use for developing new gauges; provide experimental data for development of numerical simulations of nuclear weapons effects; simulate one or more nuclear weapons effects at laboratory scale; predict what will occur during an underground nuclear test; and simulate gravity in small scale water shock and dust lofting tests.

Simulation requirements include air blast over various surface conditions, dusty flow, dust lofting, shock propagation in rock, water shock, thermal radiation, EMP, and nuclear radiation.

Existing large scale simulators are often expensive and time consuming to operate, and require travel to the test site. Small scale simulators are needed to provide extensive data to supplement the limited data from the large scale simulators. Innovative simulators are needed which are economical and simple to operate. Innovative ideas are needed on how to use very small scale simulators to produce useful information.

During Phase I, build the basic simulator and demonstrate that it functions properly.

During Phase II, use the simulator to produce useful data and improve the simulator as necessary.

DNA92-005 TITLE: Instrumentation

CATEGORY: Exploratory Development

OBJECTIVE: Develop new instrumentation or make improvements to existing instrument used in nuclear weapon effect simulators and in underground nuclear testing.

DESCRIPTION: Instrumentation is used for measuring nuclear weapons effects, phenomenology parameters and the response of test items exposed to real or simulated nuclear weapon effects. The instrumentation should be capable of operating under very harsh conditions, such as might be encountered in underground nuclear tests, high explosive tests, or tests involving high levels of x-ray, gamma, or neutron radiation. The instrumentation should survive long enough to record the needed data. Instrumentation is needed for the following types of tests: air blast, dusty flow, dust lofting, water shock, shock propagation in rock, thermal radiation, and underground nuclear tests. Facilities are needed to calibrate existing instruments in every environment where they could be used. Any ideas which improve information collection from a test may be submitted under this topic even if the proposed concept is not an instrument per se. One particular need is for fast rise time air blast gage for use on underground nuclear cavity tests.

During Phase I, build a prototype instrument and demonstrate that it functions properly using laboratory tests.

During Phase II, demonstrate that the instrumentation can record useful data in its working environment. This will involve coordination with DNA to schedule testing in a simulator or underground nuclear test.

DNA92-006 TITLE: Directed and Kinetic Energy Effects

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the effects of directed and kinetic energy and identify materials which may survive effects of directed energy weapons and kinetic energy weapons.

DESCRIPTION: The effects of directed energy sources and hypervelocity impacts on materials, structures and systems are of interest to DNA. Or particular interest are establishing the correlation between nuclear weapon effects and directed and kinetic energy effects, identifying materials which are capable of withstanding these effects, and understanding the interaction of directed energy sources with target materials and structures. Development of analysis tools and advanced computational techniques are also of interest.

During Phase I, demonstrate the feasibility of the proposed investigation.

During Phase II, characterize the effects of directed energy on materials, structures, etc.

DNA92-007 TITLE: Nuclear Hardness and Survivability

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques to improve the nuclear hardness and survivability of defense systems.

DESCRIPTION: Techniques for hardening and improving the survivability of systems and structures against nuclear weapons effects and directed energy effects where compatible, are required. These techniques should protect the structure or system against the combined effects of blast, thermal radiation, and dust/debris, in the cases of structures and materials, and should also provide protection against electromagnetic and nuclear radiation effects wherever any electronic capabilities are involved. In particular, the ability to harden communications facilities and surveillance sensors against electromagnetic pulses is required. Systems include planned and operational, strategic and tactical, fixed and ground mobile systems, missiles, aircraft, spacecraft and the subsystems and components that make up these systems.

During Phase I, demonstrate the feasibility and usefulness of the proposed technique.

During Phase II, fully develop the proposed technique and characterize its usefulness in both technical and cost terms.

DNA92-008 TITLE: Security of Nuclear Weapons

CATEGORY: Exploratory Development

OBJECTIVE: Improve the security of U.S. nuclear weapons against all types of threats.

DESCRIPTION: Measures to improve the security of nuclear weapons against all possible threats are required. These methods are expected to include weapon storage facility designs, transportation equipment designs, security sensors and sensor system development, methods to improve the secure handling of nuclear weapons, and methods to improve the effectiveness and efficiency of nuclear weapon security operations. Proposals should describe how they will improve protection against known and predicted threats and should emphasize weapon concealment where appropriate.

During Phase I, demonstrate the feasibility and potential usefulness of the proposed security measures.

During Phase II, fully develop the proposed security measures so they can be compared to existing techniques.

DNA92-009 TITLE: Theater Nuclear Forces (TNF) Survivability

CATEGORY: Exploratory Development

OBJECTIVE: Improve the survivability of U.S. nuclear weapons.

DESCRIPTION: The prelaunch survivability of the TNF is of vital concern. New and innovative concepts to improve PLS are needed to retain a viable nuclear strike capability and to enhance deterrence. The threats to the TNF include enemy forces conducting unconventional, conventional, chemical and nuclear warfare during periods of peacetime, transition to war, and war. Long range program thrusts include peacetime and field storage, deceptive/OPSEC practices, theater nuclear force movements, and operational survivability of theater nuclear systems. Concepts should employ innovative ideas and make use of new and emerging technologies.

During Phase I, demonstrate the feasibility and potential usefulness of the proposed survivability measures.

During Phase II, fully develop the proposed survivability measures so they can be compared to existing techniques.

DNA92-010 TITLE: Automated Tools for Planning, Targeting, and Analysis

CATEGORY: Exploratory Development

OBJECTIVE: Improve the ability of U.S. decision makers and commanders to plan for nuclear engagements and target their nuclear weapons.

DESCRIPTION: The nuclear employment planning and analysis capabilities of operational commanders and decision makers in tactical, strategic, and integrated warfare environments should be improved. Improvements desired include development of automated planning systems, techniques to determine target damage objective and criteria, post strike target damage assessment capabilities, and automated nuclear weapon employment codes. Techniques to account for electromagnetic effects in operational planning and exercises are also desired.

During Phase I, develop the proposed technique in sufficient detail to demonstrate its feasibility.

During Phase II, continue the development of the proposed technique to the point it can be incorporated into existing planning/targeting methodologies.

DNA92-011 TITLE: Underground Nuclear Testing

CATEGORY: Exploratory Development

OBJECTIVE: Improve the design, execution, and evaluation of underground nuclear tests.

DESCRIPTION: Underground nuclear effects tests are used in situations for which no suitable above ground simulator exists. Areas of interest include improvements in the design and execution of tests, the design of new experiments which extend the capability of current test beds, and innovative test concepts to meet future needs. Improvements to the mathematical methods used to perform various calculations within the test design and analysis program are needed to improve our understanding of the results. New methods of characterizing existing materials which are used in critical portions of the test bed and new materials for such applications, new approaches to the geological problems encountered in the construction of the test beds, and new methods for all test activities are also of interest to DNA.

During Phase I, demonstrate the feasibility of the proposed test/experiment improvement. This will be done using laboratory and/or above ground testing.

During Phase II, demonstrate the proposed techniques with underground nuclear testing and/or above ground testing.

DNA92-012 TITLE: Verification Technology Development

CATEGORY: Advanced Development

OBJECTIVE: Improve/develop U.S. technical capability to verify/monitor compliance with existing and potential future arms control treaties.

DESCRIPTION: New arms control measures are being negotiated which could drastically alter existing inventories of nuclear weapons, chemical weapons, and conventional forces. New verification technologies and methods will be required to accurately monitor compliance to the provisions of any treaties or agreements that could result from the on going negotiations. The problem is being able to distinguish between permitted activities and prohibited activities where the technical signatures between the two could be very minor. All verification technologies are for use as part of on site inspections. The technology will be used cooperatively with other nations and must be exportable. Designs must be shared with other nations.

During Phase I, demonstrate the feasibility of the proposed technology.

During Phase II, develop a proof of design to demonstrate the proposed technology.

DNA92-013 TITLE: Tactical Application of Pulsed Power Technology

CATEGORY: Exploratory Development

OBJECTIVE: Development of new applications of existing pulse power technology.

DESCRIPTION: Recent advances in energy storage and switching now make possible the application of DNA pulsed power technology to such areas as armor/anti-armor; electromagnetic/electro thermal guns; mine-countermine; high power microwave weapons; and radar applications. Concepts proposed should be highly innovative and make full use of the emerging pulse power technology.

During Phase I, demonstrate the feasibility of the proposed pulsed power application.

During Phase II, continue the development of the concept to an engineering model and conduct tests of the effectiveness of the idea.

DNA92-014 TITLE: Advances in Pulsed Power Technology

CATEGORY: Exploratory Development

OBJECTIVE: Dramatic improvements in energy storage, switching, and power conditioning state of technology.

DESCRIPTION: Future systems employing pulsed power will require improvements in efficiency, energy density, reliability, and performance. Innovative approaches for component or subsystem development are sought to meet the needs of radiation simulators and tactical applications requiring operation at kilovolts to megavolts, kiloamperes to mega amperes, and repetition rates from single pulse to 10 kilohertz.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof of principle hardware.

DNA92-015 TITLE: X-Ray Source Development

CATEGORY: Exploratory Development

OBJECTIVE: Innovative concepts for the production of x-ray radiation used in nuclear weapon effects testing.

DESCRIPTION: Future requirements for x-ray nuclear weapon effects testing will require vast improvements in existing radiation source capability as well as new concepts for producing soft x-rays, warm x-rays, and hot x-rays. Soft x-rays are used for optical and optical coatings effects testing. Warm x-rays are used for thermo mechanical and thermo structural response testing; and hot x-rays are used for electronics effects testing. The proposer should be familiar with the present capability to produce x-rays for weapon effects testing.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof-of-principle x-ray source capability.

DNA92-016 TITLE: Rise-Time Enhancement for Flash Gamma Ray Simulators

CATEGORY: Exploratory Development

OBJECTIVE: Identify and develop new techniques for substantial reduction of radiation pulse rise-time on flash x-ray simulators.

DESCRIPTION: High fidelity simulation of tactical source region electromagnetic pulse is required to test the vulnerability of critical military systems. To achieve higher performance and versatility than presently available a substantial reduction of the electron rise-time at the converter is required. DNA is seeking innovative approaches which offer significant improvement over existing techniques without reducing close rate. Hardware reliability and survivability in the harsh simulation environments and shot-to-shot repeatability are of primary importance. Proposed techniques must also be compatible with existing hardware, space constraints, and simulator operational requirements.

During Phase I, demonstrate the feasibility of the proposed concept through calculations and modeling. Perform a preliminary design for concept implementation and testing in Phase II. This will involve coordination with DNA to identify a test facility.

During Phase II, develop hardware and demonstrate concept viability on the simulator identified in Phase I.

DNA92-017 TITLE: Structural Response to Nuclear Weapon Effects

CATEGORY: Exploratory Development

OBJECTIVE: Improve the design and hardness assessment of structures to nuclear weapons effect.

DESCRIPTION: Improved designs of hardened structures are needed as well as a better understanding of failure mechanisms of structures. Types of structures include deep underground, land-based, sea-based and aerospace structures. Designs are needed to resist conventional as well as nuclear weapons effects. Models are required for energy deposition and thermo mechanical response of heterogeneous and anisotropic composite materials subjected to x-ray exposure. The models for material behavior must be compatible with conventional structural dynamics computer codes.

During Phase I, the research will demonstrate the feasibility of the proposed designs/methodology to determine structural response to nuclear weapon effects.

During Phase II, the research concept developed in Phase I will be further develop where, if appropriate, the concepts will be incorporated into other existing methodology/codes.

DNA92-018 TITLE: Advanced Instrumentation Concepts for Nuclear Effects Testing

CATEGORY: Exploratory Development

OBJECTIVE: To develop an enhanced instrumentation architecture that will effectively incorporate recent computer and instrument technology advances.

DESCRIPTION: Next generation nuclear effects simulators, such as the DECADE X-ray facility, present unique instrumentation problems in the areas of data acquisition management, system diagnostics and productivity/throughput. The scale of next generation simulators will be approximately ten times greater than present capabilities with an attendant increase in instrumentation requirements complexity. Technology is required to provide on-demand diagnostic and operational support to users. Recent advances in computer hardware and information processing techniques such as digital signal processors, parallel architectures, neural networks, artificial intelligence/expert systems, hypermedia, and intelligent databases need to be integrated with emerging instrumentation technology such as Virtual Instruments, very high speed analog to digital converters, Standard Commands for Programmable Instrumentation, etc. An intelligent system architecture is needed that will support these diverse but complementary technologies.

During Phase I, a conceptual design for an advanced instrumentation architecture will be developed. Key functions of the design shall be demonstrated through a proof of principle prototype.

During Phase II, the advanced instrumentation design shall be implemented including all hardware and software. The system shall be applied to the relevant data acquisition/instrumentation problem identified under Phase I.

DNA92-019 TITLE: Plasma Sources for Plasma Switches

CATEGORY: Exploratory Development

OBJECTIVE: Improve the quality of plasma generation for plasma opening switches.

DESCRIPTION: The plasmas source for plasma opening switches is the critical element for the operation of the switch. The ability to control the plasma density and density distribution from shot to shot is necessary to ensure reliability of the switch. Current techniques for plasma generation involve flashboards or gas puff. Innovative methods for controlling the plasma through flashboard configuration, coatings, gas nozzle shapes, or new methods for generating plasmas of this type will be considered.

During Phase I, feasibility studies and design plans on plasma generation will be completed.

During Phase II, plasma generation techniques will be demonstrated.

DNA92-020 TITLE: Diagnostics for Plasma Opening Switches

CATEGORY: Exploratory Development

OBJECTIVE: Develop the diagnostics needed for evaluating the plasma in plasma opening switches.

DESCRIPTION: Techniques for making time and space resolved measurements of plasma properties are needed to order to effectively model and optimize plasma opening switches and plasma sources. Important properties include density, gradients, fluctuations in density, magnetic field distributions, ion and electron temperatures, and directed ion directed ion drift velocities. Innovative techniques are required for making plasma measurements on plasma densities.

During Phase I, feasibility studies and design plans on plasma diagnostics will be completed.

During Phase II, plasma diagnostics will be demonstrated.

DNA92-021 TITLE: SCARS II Augmentation

CATEGORY: Exploratory Development

OBJECTIVE: Improve coverage and survivability of nuclear command and control by design, development and demonstration of a Status, Control, Alerting and Reporting System, Stage II (SCARS II) Augmentation Terminal.

DESCRIPTION: DNA is assisting SHAPE to improve the coverage and survivability of the SCARS II. SCARS II is the message carrier dedicated to nuclear weapons release procedures in Allied Command Europe (ACE). Earlier DNA analysis recommended enhancing these attributes of SCARS II through the design and development of terminal which is compatible with the existing SCARS II terminals. DNA is investigating two variations to accomplish these goals.

Plan A: It is anticipated the communications system will be replicated on a personal computer. A variant of the early Link Access Protocol, a form of the High-level Data-link Control protocols, and the packet layer above the LAP must be implemented. An automatic calling arrangement using Hayes-compatible modems must be implemented. A NATO cryptographic device must be controlled in the manner specified in NATO documentation.

Plan B: A SCARS “Type A” gateway is being developed under the NATO Nuclear Planning System program. This gateway will be an 80386 based PC-compatible computer. It is anticipated that an encrypted communications path would be established from the proposed SCARS II Augmentation terminal to the gateway and software developed to input SCARS messages into the gateway in such a form that the gateway could retransmit them on the SCARS II network.

During Phase I, design will be accomplished and a prototype will be built to test for compatibility.

During Phase II, a functional terminal will be produced and a man-machine interface will be developed.

DNA92-022 TITLE: Dynamic Display Device

CATEGORY: Advanced Development

OBJECTIVE: Develop the technology required to build display devices capable of presenting imagery, in the ultra-violet through infrared bands, to a sensor system.

DESCRIPTION: DNA is interested in display devices that can be used in optical effects simulators. The ability of optical sensors to properly function in the optical clutter created by a nuclear burst is a question that needs to be resolved before fielding a system. A means of simulating the nuclear background clutter is needed to test these sensors and their mitigation algorithms. Displaying the stimulated nuclear background clutter is a difficult task. A device, or devices, is needed that is capable of displaying a time-varying scene in the wave-bands of interest: ultraviolet, visible, and near-through long-wave infrared. It is expected that one device will not be able to accurately portray the nuclear scene in each of these bands, but a wide bandwidth is desired.

During Phase I, characterize the capabilities and usefulness of the proposed technology in both technical and cost terms.

During Phase II, build a display device, demonstrate its performance and determine the producibility of the display device.

DNA92-023 TITLE: Hardness Design Methodologies and Protocols

CATEGORY: Exploratory Development

OBJECTIVE: Develop Design Methodologies and protocols which provide high confidence in the nuclear survivability of advanced technology offensive and defensive systems.

DESCRIPTION: Future U.S. space-based assets and strategic defense systems will employ advanced technologies on a scale never before attempted. These systems will have very high performance requirements – sensor blinding or system upsets even in the millisecond range could adversely affect system performance and effectiveness. Protocols and methodologies are needed to ensure that hardening technologies being developed by SDIO and other defense agencies. These protocols must concurrently address approaches for ensuring high confidence hardness validation through test, modeling, and simulation. The technologies of most immediate interest are space- and ground-based optical sensors, inertial measurement units, processors, and stiffened structures.

Phase I – Identify the critical issues that must be addressed to develop a hardness validation protocol for a space- or ground-based system protocol. Develop a first-order draft protocol that addresses these issues.

Phase II – Expand the first order protocol to include risk and confidence considerations. Perform an appropriate experiment to test validity of the protocol.

DNA92-024 TITLE: Nuclear Weapon Effects Data Fusion Methodologies

CATEGORY: Exploratory Development

OBJECTIVE: Develop the data management technologies needed to provide high confidence assessments of weapon and system survivability.

DESCRIPTION: DNA urgently needs data management tools and methodologies to provide more accurate, higher confidence assessments of the survivability of critical grounds and space-based systems. There are too few underground nuclear test to develop the statistical base needed to perform survivability assessments employing classical mathematical approaches. Above ground test facilities cannot replicate the complete spectral output of nuclear events, and cannot support testing to full scale. Current simulation tools do not fully exploit existing models, or data to provide the highest confidence assessments. However, there is a large array of test, model and simulation data which could be applied to survivability assessments if application tools were available. New methods are needed that facilitate the application of all relevant data, models, and simulations in nuclear survivability assessments.

Phase I – Research will assess current DNA approaches for performing nuclear survivability assessments, and will identify weaknesses in data management and fusion techniques.

Phase II – State of the art knowledge-based and/or artificial intelligence techniques will be developed to enable the more powerful application of existing data to nuclear survivability assessments.

DNA92-025 TITLE: Conventional Weapon Effects

CATEGORY: Exploratory Development

OBJECTIVE: Better understand the interaction of conventional weapons with structures, improve the capability of structure hardness assessment, and develop countermeasure concepts.

DESCRIPTION: Improved understanding of conventional weapon interaction with structures is needed to support offensive and defensive warfare requirements. Included is the requirement for a better understanding of the structure penetration and failure mechanisms, and improved designs of hardened facilities to resist conventional weapon effects. Improved methods are needed for analysis and model testing of structures to penetration, internal damage, and collapse damage levels. Models are required for standard materials and for advanced materials as they become available. Additionally, improved methods of causing penetration, internal damage, and structure damage are needed.

During Phase I, the research will demonstrate the feasibility of the proposed methodology or design concept.

During Phase II, the research concept developed in Phase I will be further developed and demonstrated through small scale testing.