STRATEGIC DEFENSE INITIATIVE ORGANIZATION (SDIO)
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals

Phase I proposals (5 copies) should be prepared for routine US Mail and addressed to:

Strategic Defense Initiative Organization
Attention: IST/SBIR
The Pentagon
Washington, DC 20301-7100

Since no provisions will be made to receive handcarried proposals, bidders should allow ample time for routine delivery of proposals by the US Post Office. The above address can not be used for commercial delivery services, US Post Office Express Mail, or hand carry.

Many of the concepts being addressed by SDIO involve major ground or space based systems which tax the capability of even the largest corporations. While the total systems may be beyond the capability of a small high technology bussines, many of the subsystems, components, processes, etc. fall within the scope of this solicitation. Accordingly, the prospective bidders can interpret the SDIO topics in terms of how they can contribute to the solution of the broader problems and challenges described in this solicitation. In many cases, the thrust of a topic includes establishing feasibility of concepts, enabling major advancements in capability, etc. rather than directing attention at production. For example, the deliverable from a successful Phase II effort could be a prototype which becomes an element in a demonstration program; the follow-on Phase III could be further research to perfect the approach following testing or evaluation.

Prospective bidders are advised to interpret the twelve SDIO topics in the context of its present mission, i.e., a research program to provide a sound basis for making future decisions on whether to proceed with development on specific weapons and components.

Although in the original legislation providing for the Federal SBIR Program Congress envisioned Phase I awards of approximately $50,000, the Department of Defense is authorized to exceed that amount for specific awards when adequate justification is provided. SDIO anticipates that its nominal Phase I awards will be in the $50,000 to $100,000 range. SDIO is encouraging small high technology businesses to form cooperative arrangements with university researchers by involving university researchers in both the Phase I and Phase 2 activities. Also, SDIO is receptive to arrangements whereby a small high technology business proposes to take advantage of the special facilities of other businesses, either large or small. Proposals which provide for such arrangements can include budgets up to 50% greater than the nominal budgets. Prospective bidders are cautioned that nothing in this paragraph is to contradict the instructions in Sections 1 through 7 of this document.

Strategic Defense Initiative Organization FY1986 SBIR Topics

SDIO86-001 TITLE: Directed Energy Concepts

DESCRIPTION: Innovative research in the generation and propagation of directed energy will play an important role in the determination of effective ballistic missile defense systems. Systems being considered include (but are not limited to) chemical lasers, excimer lasers, nuclear and non-nuclear driven x-ray lasers, gamma-ray lasers, free electron lasers, neutral and charged particle beams, and plasmoids. Hybrid approaches are also of interest. Interests in the concepts include the full range of embodiments, i.e., light weight space based, ground based, and pop-up systems. Included in the directed energy problems are such diverse topics as weapon pointing, beam control, mirror technology, beam propagation through natural and disturbed environments, and countermeasures. Approaches are needed that either extend or improve the present concepts. Approaches that facilities or support the evaluation of concepts are also appropriate.

SDIO86-002 TITLE: Kinetic Energy Weapons

DESCRIPTION: Along similar lines to the topic SDIO 86-1, kinetic energy systems are candidates for ballistic missile defense. Systems being considered include (but are not limited to) electromagnetic rail guns, plasma guns, and other hypervelocity projectile concepts, as well as chemically-propelled interceptors. Included in the kinetic nergy weapons area are smart projectiles development, homing devices, launcher designs, engagement tactics, hypervelocity aerocontrol/thermal protection, and countermeasures. Approaches are needed that either extend or improve the present concepts.

SDIO86-003 TITLE: Sensors for Surveillance, Acquisition, and Discrimination

DESCRIPTION: Sensors and their associated systems will function as the “eyes and ears” of a space-based ballistic missile defense system, providing early warning of attack, target identification, target tracking, and kill determination. New and innovative approaches to these requirements using unconventional techniques are encouraged across a broad band of the electromagnetic spectrum, from radar to gamma-rays. Both passive and active techniques for discriminating targets from decoys and other penetration aids are solicited. In addition to novel sensing concepts, sensor-related device technology is also needed, with the intended goal of producing either a specific product or process. Examples of some of the specific areas to be addressed are: cryogenic refrigerators, signal and optical processing, algorithms, optical beam steering, synthetic aperture lidar and radar, passive imaging (IR to UV), interferometry, beam positioning, low-signal gamma-ray detection, and frequency-scanning laser techniques for active discrimination. Approaches are needed that can extend and improve the efficiency of present concepts.

SDIO86-004 TITLE: Nuclear Space Power Concepts and Thermal Management

DESCRIPTION: Weapons, sensing, and communications systems under consideration by SDIO have diversified power requirements. Methods and processes are being considered for a wide spectrum of power, power conditioning, and thermal management conditions. Nuclear power concepts and the associated components are of interest for both manned and unmanned spacecraft. The power duty cycles to be considered include: 10’s of MW power for pulse applications, sustained MW power for electric propulsion, continuous 10’s of kW power for house keeping, tracking, etc. This category includes auziliary components and sub-systems vital to the operation of the power system. The energy conversion approaches include: thermoelectric, thermionic, and Brayton cycle. New approaches leading to controlled wide excursions of power and burst mode power are sought. Innovative high power thermal radiator concepts are needed for all types of power cycles. Also, concepts and systems that enhance safety, maintainability, and reliability of space nuclear power systems are sought.

SDIO86-005 TITLE: Non-nuclear Space Power and Power Conditioning

DESCRIPTION: Along the lines of topic SDIO86-004, non-nuclear approaches are sought. Applications in space demand high energy densities. The power duty cycles to be considered include: 10's of MW power for burst applications, sustained 10's of kW power for electric propulsion, continuous 10's of kW power for house keeping, tracking, etc. Specific topics on which proposals are sought include: Novel battery concepts, advanced solar collectors and converters, inductive and capacitive stores, MHD generators, heat dissipation systems, signature control, and plasma switches. Also, concepts and systems that enhance maintainability and reliability of space power systems are sought.

SDIO86-006 TITLE: Propulsion

DESCRIPTION: Strategic defense places unprecedented demands on all types of space transportation and propulsion systems: launch to low earth orbit, orbit transfer, orbit maneuvering, and station keeping. In particular, advancements are needed to achieve major reductions in the costs of placing payloads in the desired orbit. Both expendable and reusable systems are of interest. Processes, methods, and techniques are sought to support propulsion approaches which include: liquid, solid, transatmospheric air-breathing, electric. In addition, advancements are needed in propulsion related areas, e.g., extending storage time of cryogenic fluids, reduction of contamination from effluents, sensors and controls for autonomous operation.

SDIO86-007 TITLE: System Survivability

DESCRIPTION: The survivability of various components of a space-based missile defense system will be a key issue in the effectiveness of such a system. Of interest to the SDIO are products, processes, ad techniques for active and passive hardening against directed and kinetic energy devices. Components to be made survivable include sensors, battle managers, power systems, and directed/kinetic energy weapon configurations. Survivable sub-components include large and small optics, electronics, structures and fuel containment, and specific materials critical for shielding, maneuvering, propulsion, and targeting. In addition, to shielding, other well designed and innovative countermeasures are encouraged. Specific examples of areas to be addressed include: thermo-mechanical shock hardening, heat dissipation techniques, protective coatings, baffling techniques, materials conditioning, orientation, or deployment strategies, and insulation methods. Of particular interest is hardening and survivability in the nuclear environment.

SDIO86-008 TITLE: Target Lethality

DESCRIPTION: A major factor in determining the effectiveness of a ballistic missile defense is the lethality of the directed and kinetic energy devices against responsively hardened targets. The key questions that need to be addressed under this topic deal with the quantitative assessment of target lethality. Hence, techniques are needed to acquire, access, and query an extensive data base on the damage to basic materials, electronics, and optics due to various mechanisms. Techniques are needed to quantify laser radiation damage due to ionization, thermal deposition, and impulse shock as a function of wavelength, intensity, and pulse characteristics. This is required in order to direct future research in novel directed energy concepts. Similarly, techniques are needed to investigate and quantify damage mechanisms due to particle beam interaction with targets. In the area of kinetic energy, the effects of hypervelocity projectile impact on structural and hardened materials are of extreme interest. Finally, innovative ideas or concepts for measurement of radiation or particle penetration, structural damage due to thermo-mechanical stress, opacities of plasma blow-off, and equation-of-state data are relevant.

SDIO86-009 TITLE: Computer Architecture/Very-High-Level Language Design for Battle Management

DESCRIPTION: The battle management requirement for a ballistic missile defense system is an extremely demanding one, required order-of-magnitude advances in existing technologies. The system will be required to acquire and track thousands of objects through the use of hundreds of networked sensors and data processors, direct

weaponry to intercept targets, and determine the degree of kill. Three areas to be strongly emphasized under this solicitation are:
1. New computer architectures which are lightweight, compact, fault-tolerant, and hardened to radiation, but allow for the extremely rapid processing of data which will be required. This issue can be addressed via either new designs for computer components (e.g., optical signal processors) or innovative architectures using existing technology.
2. Very high level language (VHLL) design for both the development and testing of extremely large software systems.
3. Novel numerical algorithms to enhance the speed of data processing for sensing, discrimination and system control. Since the computer will likely be a single-purpose design, these may be specifically tailored to a particular architecture suited to the SDIO data processing task.

SDIO86-010 TITLE: Supporting Concepts for System Architecture

DESCRIPTION: As part of the Strategic Defense Initiative research program, a number of systems architecture options are presently being studied. This multiple-path approach is necessitated by the large number of missile threat interceptor concepts being considered in the program as well as by the survivability, viability, and affordability issues associated with defense systems options. While comprehensive systems architecture studies are beyond the scope of a small business, a number of supporting concepts may be investigated under the SBI program. Examples of these include: secure laser satellite networking of battle managers and sensors, deployment strategies of components in a nuclear environment.

SDIO86-011 TITLE: Space Materials and Structures

DESCRIPTION: The strategic defense mission places great demands upon the design of space structures and the materials to be used for their fabrication. The requirements include structures and materials for: prime power systems, antenna, tracking and pointing systems, solar collectors, and pressure vessels. All of which present individual challenges in terms of stiffness, impact resistance, high temperature capability, deployment, etc. Most of the anticipated situations depend on major improvements in matieral properties, cost effectiveness, and prediction methodology.

Space structures supporting weapons and antennae must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermomechanical flutter. Techniques for both passive and active control of the structural dynamic responses to environmental and operational excitations are needed. Methods are needed to predict the dynamic performance and stability characteristics of structures acting in concert with on-board distributed controllers for maneuvering, printing, and vibration/noise suppression.

Techniques are needed to obtain greatly improved understanding of structure-property relationships for advance carbon/carbon, ceramic-matrix, and metal-matrix composite materials. Specific goals required advanced techniques and processes include imparting oxidation resistance and damage tolerance to carbon/carbon composites, enhancing the static and dynamic toughness of ceramic composites and creating fatigue-resistant metal composites with order of magnitude improvements in passive vibrational damping. Methods are needed to establish the thermodynamics and kinetics basis for minimizing fiber-matrix reactions in composites exposed to high operating temperatures. Methods are needed to address the basic mechanics of failure characteristics and fatigue behavior under complex mechanical and thermal loadings.

Consistent with topics SDIO86-001, -003, and –007, advances are sought in materials for optical systems, electronic components, and radiation hardening.

Proposals involving these, as well as other, space structure and material-related research and innovative technology topics are encouraged.

SDIO86-012 TITLE: Space Transportation and Support

DESCRIPTION: The objectives of this activity include encouraging research into the areas of space transportation and support with the primary emphasis on reducing the cost of space operations. Traditionally the cost of space transportation and the operations of the spacecraft have been major factors in determining the life cycle costs of our space based assets. This burden on the deployment of Strategic Defense Systems has been confirmed by the Horse Race Contractors and was originally identified by the Defensive Technologies Study Team as a major cost driver. Areas of interest include the entire spectrum of space transportation and support: efficient launch systems, automatic design, assembly, and control systems: expendable and recoverable components; improved structures and materials; increased propulsion efficiency; and significant reduction in the manpower intensive tasks of production, assembly, checkout, operations, and control. Approaches leading to techniques, processes, and products in support of these objectives are sought.