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

Submitting Proposals

Phase I Proposals (five copies of the full proposal, plus three copies of Appendices A and B only) should be sent by US mail addressed to:

Strategic Defense Initiative Organization
Attn: T/IS/SBIR
The Pentagon
Washington, DC 20301-7100

Proposals delivered by other means (commercial delivery service or hand carry) must be delivered to Room 1D110, The Pentagon, Washington DC. WARNING: Only persons with access to the interior of the Pentagon building can reach Room 1D110. Delivery to a Pentagon entrance is not sufficient. US Postal Service Express Mail is the only express service with unconditional access.

Receipt of proposals will be acknowledged only if the proposal includes a self-addressed stamped envelope and a form (like Reference B) that needs only a signature by SDIO.

Topics on the following pages are broad statements of SDI interests. SDI seeks innovative concepts on the cutting edge of technology that might enable a defense against a missile in flight. SDI seeks concepts for its general technological need of lighter, smarter, more reliable components. The proposer need not know details of possible SDI systems.

SDI SBIR seeks a demonstrable product that makes a leap in capability – components that might fit into a larger design. SDI seeks to invest seed-capital, to supplement private capital, in a product with a future market potential and a measurable SDI benefit. New algorithms and computer codes qualify if the Phase II product would be used extensively outside the firm. SDI SBIR will not fund ordinary research or studies (including technical assistance, surveys and assessments, data collection, or systems studies). Nor will it further develop already mature concepts.

Phase I will show the concept feasibility and the merit of a further investment in a Phase II that will demonstrate a prototype or at least show proof-of-principle. The concept development must be within the scale appropriate for a small firm.

SDI will invest in small firms where the Principal Investigator is primarily employed. Tenured faculty are not considered primarily employed by a small firm if they receive compensation from the university while performing the SBIR contract. Any request for waiver must be stated explicitly with a justification showing a compelling national need. SDI expects to grant no waivers.

FY1989 SBIR Topics
Strategic Defense Initiative Organization

SDIO89-001 TITLE: Directed Energy Concepts

DESCRIPTION: Innovative research in the generation and propagation of directed energy plays 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, laboratory x-ray lasers, gamma-ray lasers, and free electron lasers. Hybrid approaches are also of interest. Interests in the concepts include the full range of embodiments, i.e., low mass spaced-based ground-based, and pop-up systems. Included in the directed energy problems are such diverse topics as weapon pointing, beam control, acquisition, tracking and pointing, mirror technology, beam propagation through natural and disturbed environments, and countermeasures. Approaches are needed that either extend or improve the present concepts. Approaches that facilitate or support the evaluation of concepts are also appropriate.

SDIO89-002 TITLE: Kinetic Energy Weapons

DESCRIPTION: Kinetic Energy (KE) Weapons Systems are an integral part of candidate strategic defense systems. System candidates presently include ground-based exoatmospheric re-entry vehicle interceptors (ERIS) and space-based Interceptors (SBI), high endoatmospheric defense interceptors (HEDI) and hypervelocity guns (HVG) [electromagnetic (EM), electrothermal (ET), and hybrid systems].

Approaches are sought which extend, facilitates, or reduce the cost of the concepts. Elements of the systems include the space-based carrier vehicles (CV) or ground-based launchers, divert motors/nozzles, smart projectile components, and endo/exoatmospheric guidance and control mechanisms. Technology challenges for KE systems include: SBI acquisition of booster hardbody within the plume, high performance axial and divert propulsion sub-systems (especially very low mass divert systems), miniature inertial navigation units, array image processing, C.G. Control algorithms, fast frame and U.V. seekers, acquisition and track; ERIS target discrimination, seeker operational environments, lethality/miss distance; HEDI aero-optical effects, guidance and fuzing accuracy, shroud separation, window thermo-structural integrity, non nuclear kill warhead performance and survivability of electronics in nuclear environment; HVG lifetime, fire rate, projectile guidance and control, and projectile launch survivability; and, common among all systems, reliability, producibility, maintainability, and low cost/low mass.

SDIO89-003 TITLE: Sensors

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. Passive, active, and interactive techniques for discriminating targets from decoys and other 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 coolers (open and closed systems), superconducting focal plane detector arrays (for both the IR and sub-mm spectral regions), signal and data processing algorithms (for both conventional focal plane and interferometric imaging systems), low-power optical and sub-mm wave beam steering, range-doppler lidar and radar, passive focal plane imaging (long wavelength infrared to ultra-violet; novel information processing to maximize resolution while minimizing detector element densities) interferometry (both passive and with active illumination), gamma-ray detection, neutron detection, intermediate power frequency agile lasers for diffractive beam steering and remote laser induced emission spectroscopy, lightweight compact efficient fixed frequency radiation sources for space-based SDI application (uv-sub-mm wave). Entirely new approaches as well as approaches that expand and improve present concepts are solicited.

SDIO89-004 TITLE: Nuclear Space Power

DESCRIPTION: Weapons, sensing, and communications systems under consideration for strategic defense have diversified power requirements. Methods and processes are being considered for a wide spectrum of power and power conditioning situations. Nuclear power concepts and the associated components are of interest for both manned and unmanned spacecraft. The power duty cycles to be considered include: hundreds of MW power for pulse applications, sustained hundreds of KW to MW power for electric propulsion, continuous tens to hundreds of kw power for house keeping, tracking, etc. This category includes auxiliary 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. As part of the topic 89-007, 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.

SDIO89-005 TITLE: Non-nuclear Space Power and Power Conditioning

DESCRIPTION: Along the lines of topic SDIO89-004, non-nuclear approaches are sought. Applications in space demand high energy densities. The power duty cycles to be considered include: hundreds of MW power for burst applications, sustained hundreds of KW to MW power for house keeping, tracking, etc. Specific topics include novel battery concepts, chemically driven systems for burst power, advanced solar collectors and converters, inductive and capacitive stores, space-based MHD generators, heat dissipation system, signature control, and plasma switches. Also, concepts and systems that enhance maintainability and reliability of space power systems (e.g. insulation and cable) are sought.

SDIO89-006 TITLE: Propulsion and Logistics

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 and maintaining payloads in the desired orbit. Traditionally, the cost of space transportation and the operations of the spacecraft have been major factors in determining the life cycle costs of space-based assets. This burden on the deployment of strategic defense systems has been identified a major cost driver. Approaches leading to techniques, methods, processes, and products in support of these propulsion and logistics objectives are sought. Propulsion approaches include liquid, solid, and electric. Advancements are needed in propulsion-related areas, e.g., extending storage time of cryogenic fluids, reduction of contamination from effluents, and sensors and controls for autonomous operation. Areas of interest include the entire spectrum of space transportation and support: efficient launch systems for small technological payloads as well as full system payloads, assembly, and control systems; expendable and recoverable components; improved structures and materials; and increased propulsion efficiency. In anticipation of the SP-100 reference mission incorporating arcjet thrusters, attention is being directed at thruster modules (e.g., electrodes, insulators, ignition systems, propellant control, command and control system, thermal management system, and power conditioning unit).

SDIO89-007 TITLE: Thermal Management

DESCRIPTION: The high power levels for space stations will need effective heat dissipation. Expected power levels required for SDI space platforms will stress state-of-the-art capabilities for waste thermal energy acquisition, transport, and dissipation to space. Technology advancements are required in thermal management for both power generation systems and space platform payloads.

Some space platforms will require long-term (years) storage of large amounts of cryogens with minimum cryogen loss and high cryogen delivery rates under conditions of zero –g, microgravity and maneuvering loads. Innovations are sought for concept and devices for all types of space-based power cycles, nuclear and non-nuclear, and can satisfy these projected space platform requirements.

SDIO89-008 TITLE: Survivability

DESCRIPTION: The various components of a space-based missile defense system must survive both attack and the environment in space. Products, processes, and techniques for active and passive hardening against directed and kinetic energy devices, and natural threats such as UV/radiation damage, thermal cycling, and atomic oxygen degradation are sought. Components to be made survivable include sensors, battle management systems, power systems, and directed/kinetic energy weapon configurations. Survivable sub-components include large and small optics, electronics, structures for support 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, insulation methods, threat radiation activated optical limiters and switches, and the non-linear optical materials/techniques involved in their fabrication. Of particular interest is hardening and survivability against x-ray lasers and bright short wavelength ground-based lasers.

SDIO89-009 TITLE: 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. Innovative ideas or concepts for measurement of radiation or particle penetration, structural damage due to thermo-mechanical stress, opacities of plasma blow-off. New concepts to produce higher probability of kill-given-a-hit.

SDIO89-010 TITLE: Computer Architecture, Algorithms, and Language

DESCRIPTION: Strategic defense systems for battle management demand order-of-magnitude advances. A system must acquire and track thousands of objects with hundreds networked sensors and data processors, direct weaponry, to intercept targets, and determine the degree of kill. Areas of interest are:

- New computer architectures, which are robust, compact, and fault-tolerant, but allow for the extremely rapid processing of data. Architectures may be implemented by new designs or innovative applications of existing technologies, such as optical signal processing, systolic arrays, neutral networks, etc.

- Very high-level language (VHLL) design for both the development and testing of extremely large software systems.

- Novel numerical algorithms for enhancing the speed of data processing for sensing, discrimination, and systems control. These may be specifically tailored to a particular system, for tasks (for instance, the execution of a phase retrieval algorithm for interferometric imaging). Include neural networks.

- Language design to develop code optimized for highly parallel processed architectures.

- Testing techniques that will provide a high level of confidence in the successful operation of extremely large software systems.

- Computer network and communications security. R&D for trusted computer systems in accordance with DoD 5200.28.STD; integration of COMPUSEC with COMSEC (DoD 5200.5).

- Self-adaptive processing and simulation. Algorithms and architectures for advanced decision-making.

- Neurocomputing and Man-Machine Interface- rule-based AI and neural networks combined for decision-making flexibility and system robustness; development of decision trees and information display for highly automated, short response time, high volume scenarios.

SDIO89-011 TITLE: Optical Computing and Optical Signal Processing

DESCRIPTION: Defense computing capability is sought in all architectural variations, from all optic to hybrid computers. Specific examples of areas to be addressed include, but are not limited to, high speed multiplexing, monolithic optoelectronic transmitters, holographic methods, reconfigurable interconnects, optoelectronic circuits, and any other technology contributing to advances in intra-computer communications, optical logic gates, bistable memories, optical transistors, and power limiters. In particular, non-linear optical materials advancements and new bistable optical device configurations are of interest.

SDIO89-012 TITLE: Space Structures

DESCRIPTION: The strategic defense mission places great demands upon the design of space structures to be used for their fabrication. The requirements include structures for prime power systems, antennas, tracking and pointing systems, solar collectors, and pressure vessels. All of these present individual challenges in terms of stiffness, impact resistance, high temperature capability, deployment, etc. Most of the anticipated situations depend on major improvements in material properties, cost effectiveness, and prediction methodology. Space structures supporting weapons and antenna must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermo-mechanical 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, pointing, and vibration/noise suppression. There is also a need for novel, lightweight large optical structures that are compatible with the space environment, and for innovative optics/information processing techniques, which maximize the imaging performance that can be achieved with imperfect, temporarily unstable structures.

SDIO89-013 TITLE: Structural Materials

DESCRIPTION: Many of the anticipated structural advances sought in Topic 89-012 will depend on major improvements in material properties, cost effectiveness, and prediction methodology. Space structures supporting weapons and antenna must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermo-mechanical flutter.

Specific goals requiring advanced techniques and processes include imparting oxidation resistance and damage tolerance to 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. Tribology innovative techniques and ideas are sought in areas such as solid and liquid lubricants, moving mechanical assemblies, low density systems, components, and radiation hardening. Proposals involving these as well as other space structure and material-related research and innovative technology topics are encouraged.

SDIO89-014 TITLE: Electronic Materials

DESCRIPTION: The necessary advances in electronics for the many strategic defense applications will require advances in electronics materials. Primary emphasis lies in advancing the capability of integrated circuits, detectors, sensors, large-scale integration, radiation hardness, and all electronic components. Novel quantum-well/super lattice structures, which allow the realization of unique elective properties through “band gap engineering” are sought as new organic and polymer materials with interesting electronic characteristics. In addition, exploitation of the unique electronic properties of single crystal diamond is of considerable interest. Among the many SDI electronic needs are advances in high frequency transistor structures, solid-state lasers, optical detectors, low dielectric constant packaging materials, tailored thermal conductivity, microstructural waveguides, multilayer capacitors, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials.

SDIO89-015 TITLE: Superconductive Materials

DESCRIPTION: Recent advances in the discovery and fabrication of high-temperature superconducting materials promise to have a large pay-off for many SDI applications. Interest in these new materials includes material characterization, stabilization of new high-tech phases, and development of novel fabrication techniques for both the thin-film and bulk materials. Areas of application are also being stressed and include: novel, low-power infrared (IR) staring-array sensors, particularly those with monolithic focal plane pixel arrays and read-out electronics; high-tech superconductive materials for various electronic applications, e.g., Josephson junctions and SIS mixers; bulk gradient accelerator cavities for novel particle beam and free-electron laser design concepts; magnetic shielding of critical components from EMP effects. Note that in the applications area interest is not limited to only this new class of high-tech superconductors but attention is also given to the more mature low-tech materials as well, e.g., Niobium and Niobium Nitride.