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

Send Phase I proposals (five copies of the full proposal, PLUS three copies of Appendices A and B only) by US Mail to:

Strategic Defense Initiative Organization
Attn: TNI/SBIR
Pentagon, Room 1E167
Washington, D.C. 20301-7100

For administrative help only: Call 800-937-3150

Proposals delivered by other means (commercial delivery service or hand carry) must be delivered to Room 1D110, The Pentagon, Washington, D.C. WARNING: Only persons with access to the interior of the Pentagon building can reach Room 1D110. Delivery to a Pentagon entrance is not sufficient. 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.

SDIO is a DoD project to explore the feasibility of finding and disabling a ballistic missile in flight.

Topics on the following pages broadly state SDIO's interests. SDIO seeks innovative concepts on the cutting edge of technology that might enable a defense against a mission in flight. SDIO seeks concepts for its need of lighter, faster, smarter, more reliable components. The proposer need not know details of possible SDIO systems. SDIO will also consider highly innovative technology that does not clearly fit into any specific topic.

SDIO SBIR seeks a demonstrable product that makes a leap in capability. SDIO seeks to invest seed capital, to supplement private capital, in a product with a future market potential (preferably commercial) and a measurable SDIO benefit. SDIO SBIR will not fund ordinary research or studies (including surveys, assessments, data collection, or systems studies). Nor will it further develop concepts already mature enough to compete for venture capital or government development funds.

Phase I will show the concept feasibility and the merit of a Phase II that will demonstrate a prototype or at least show proof of principle. The development must be appropriate for a small firm. Principal Investigators who are tenured faculty are not considered primarily employed by a small firm if they receive compensation from the university while performing the SBIR contract. Any waiver must be requested explicitly with a justification showing a compelling national need. SDIO expects to grant no waivers.

FY1992 TOPIC DESCRIPTIONS

SDIO92-001 TITLE: Directed Energy Concepts

DESCRIPTION: Innovative applied research in the generation and propagation of directed energy beams. Systems being considered include (but are not limited to) chemical lasers, excimer lasers, laboratory x-ray lasers, gamma ray lasers, free electron laser, and hybrid approaches. Interests include the full range of embodiments, i.e., low mass space based, ground based, and pop up systems. Included are such topics as weapon pointing, beam control, acquisition, tracking and pointing, microns technology, beam propagation through natural and disturbed environments, optics and countermeasures.

SDIO92-002 TITLE: Kinetic Energy Weapons

DESCRIPTION: Kinetic energy (KE) weapons candidates presently include a variety of ground and space based interceptors including their propulsion. Approaches are sought which extend, facilitate, or reduce the cost of the concepts. Elements of the systems include ground based launchers, divert motors/nozzles, smart projectile components, and endo/exoatmospheric guidance and control mechanisms. Technology challenges for KE systems include: the booster hard body within the plume, high performance and divert propulsion subsystems, miniature inertial navigation units, array image processing, C.G. Control algorithms, fast frame and U.V. Seekers, acquisition and track; target discrimination, seeker operational integrity, non-nuclear kill warhead performance, target acquisition in a nuclear environment, performance and survivability of electronics in nuclear environment; HVG lifetime, firing rate, projectile guidance and control and projectile launch survivability, and, common among all systems reliability; producibility, maintainability, and low cost/low mass.

SDIO92-003 TITLE: Sensors

DESCRIPTION: Sensors and their associated systems will function as the “eyes and ears” of a space based ballistic missile defense systems, 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 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 coolers, superconducting focal place detector arrays, signal and data processing algorithms, low power optical and sub-mm wave beam steering, range Doppler lidar and radar, passive focal plane imaging, 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 agile lasers for sources for space based SDIO application, new optics and optical materials. Entirely new approaches as well as approaches that expand and improve present concepts are sought.

SDIO92-004 TITLE: Nuclear Space Power

DESCRIPTION: Weapons, sensing, and communication 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 unmanned spacecraft. The power duty cycles to be considered include: hundreds of MW power for pulse applications, sustained tens of KW to one hundred of KW for electric propulsion, continuous tens to hundred KW power for house keeping, tracking, etc. This category includes auxiliary components and sub-excursions of power and burst mode power are sought. As part of Topic 92-007, innovative 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.

SDIO92-005 TITLE: Non-Nuclear Space Power and Power Conditioning

DESCRIPTION: Along the lines of Topic SDIO92-004, non-nuclear approaches are sought for high energy densities. The power duty cycles to be considered include: hundreds of MW power for burst applications, sustained tens of KW to MW power for electric propulsion, continuous of W to a few KW for house keeping, communications, etc. Specific topics include novel very long life battery concepts, chemically driven systems for burst power, advanced solar collectors and high efficiency multibandgap or thin film converters, inductive and capacitive stores, space based MHD generators, heat dissipation systems, signature control, plasma switches, and high temperature power electronics. Also, concepts and systems that improve maintainability and reliability of space power systems are sought. Very lightweight and affordable technologies are also sought.

SDIO92-006 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 operation of the spacecraft have been major factors in the determining the life cycle costs of space based assets. 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 effluent, 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 and solar power demonstration mission incorporating arc jet thrusters, SDIO seeks 10 to 30 KW arc jet thruster modules. With the advent of small surveillance satellites, low power electric propulsion is being considered for station keeping and orbit transfer; for such systems emphasis is being placed on achieving higher power densities of the integrated system. Low mass interceptors require advances in divert propulsion systems.

SDIO92-007 TITLE: Thermal Management

DESCRIPTION: The high power levels for space stations must dissipate heat. Expected power levels required for SDIO 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 years of storage of large amounts of cryogens with minimum cryogen loss and high cryogen delivery rates under condition of zero-g, concept and devices for all types of space based power cycles, nuclear and non-nuclear and can satisfy these projected space platform requirements.

SDIO92-008 TITLE: Survivability

DESCRIPTION: The Strategic Defense System elements must survive determined attacks against the system, and the natural space environments. Survivability technology is needed for threat sensing, creation of false aim points and passive hardening. Contribution s are sought in analytic methods, computer simulation/modeling, materials development and processing, component hardware, systems, design and analysis.

Threat sensors enable the defense elements to detect nuclear, laser and radio frequency weapon attacks, and to respond appropriately. Sensors which can characterize the threat according to direction of attack, and spectral characteristics are particularly noteworthy. Technologies to create false aim points are needed to operate against the threat support sensors, including radar, passive visible/IR sensors and seekers, and laser radar.

Passive hardening against the nuclear, laser, RF and pellet/debris environments is needed, in addition to hardening against the natural space environments. SDS elements have common mission critical subsystems. Sensor systems, communications antennas, altitude sensors, solar power, propulsion, structure and thermal control are all directly exposed to nuclear, laser, IR and pellet/debris in addition to the natural space environments. Materials and component designs which are intrinsically hard to these environments, and/or protective devices are needed. A key area is sensor subsystems, the components of which must survive the laser, nuclear and IR environments. Nuclear and laser hard baffle materials, and devices for protection against unknown or agile lasers and rejection of R energy of particular interest. Structures and coatings providing appropriate thermal characteristics, stability under mechanical impulses and hardness to laser and R radiation are needed. Processors capable of operating in unique nuclear environments presented by this strategic application while retaining full functionality are essential.

SDIO92-009 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 of 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.

SDIO92-010 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 of 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, neural networks, etc.
- Very high level language 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. Includes neural networks.
- Language design to develop code optimized for highly parallel processes architectures.
- Testing techniques that will provide a high level of confidence in the successful operation of concurrent, real time, distributed large scale software systems. Examples include sensitivity analysis, data flow testing, mutation testing, static concurrency analysis, and dependency analysis.
- 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.
- Software architectures for embedded computer networks that especially facilitate incremental system and software integration, hardware and software maintenance, and system evolution, without significant performance degradation.
- Hardware and software self diagnostic capabilities for monitoring the operational readiness and performance of space and ground systems incorporating embedded computer networks.

SDIO92-011 TITLE: Optical Computing and Optical Signal

DESCRIPTION: Dense 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.

SDIO92-012 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, and cost effectiveness. 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 with experimental verification. New types of miniaturized sensors, and low power actuators are needed for embedment in or attachment to space structure components for health monitoring vibration control, and real time structural performance tailoring. Innovative lightweight power conditioning and information processing techniques are also being sought.

SDIO92-013 TITLE: Structural Materials

DESCRIPTION: Many of the anticipated structural advances sough in Topic 92-012 will depend on major improvements in material properties and cost effectiveness. Space structures supporting weapons and antenna must accommodate retargeting maneuvers without detrimental jitter from vibrations and thermo-mechanical flutter. Surface launched interceptors must withstand high g loads and extreme heating without degradation.
Specific goals require advanced techniques and processes that 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 minimize fiber matrix reactions in composites exposed to high operating temperatures. Innovative tribology technologies are sought in areas such as solid and liquid lubricants, moving mechanical assemblies, low density alloys, and antiwear adhesives. Advances are sought in materials for optical systems, components, and radiation hardening. The following are sought: innovative manufacturing methods for producing high modulus, fiber reinforced glass, light metal, or thermoplastic matrix composites, innovative procedures for the production of instrumentation, sensors and software for online process monitoring and evaluation of high modulus, fiber reinforced composites during fabrication; novel approaches to modify surfaces to promote fiber/matrix adhesion in advanced composites; innovative surface modifications to promote wear resistance; innovative tooling techniques for net-net shape production of advanced composites; novel, low-to-no outgassing joining/bonding techniques for advanced composites; novel instrumentation of determination and telemetry of material properties and data from space; improved materials for low power embedded actuators capable of large displacements; and new methods for integrating instrumentation into advanced composite materials and structures. Proposals involving these as well as other space structure and material-related research and innovative technology topics are sought.

SDIO92-014 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/superlattice structures which allow the realization of unique elective properties through “band gap engineering” are sought as are 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 SDIO electronic needs are advances in high frequency transistor structures, solid state lasers, optical detectors, low dielectric constant packaging materials, tailored thermal conductivity, micro structural waveguides, multilayer capacitors, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials.

SDIO92-015 TITLE: Superconductive Materials

DESCRIPTION: Interest in these high temperature superconducting materials includes characterization, stabilization of new high TC 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 TC superconductive materials for various electronic applications, e.g. Josephson junctions and SIS mixers; bulk materials for power transmission, conditioning and storage; compact, high 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-TC superconductors but attention is also given to the more mature low TC materials as well.

The principle SDIO interest in superconductor technology is in the development and demonstration of both high temperature superconductor and low temperature devices significantly enhancing the performance of strategic defense systems. Primary emphasis in HTS technology is in components integrated with state of the art cryoelectronics for communications systems at K and V bands and radar systems in the x band. The emphasis in LTS technology is the development of high sensitivity IR detectors, digital electronics and memory enabling on FPA signal processing and operating at temperatures greater than 10 K. Efforts should address packaging and interface issues and systems integration with cryocoolers and stored cryogen.

SDIO92-016 TITLE: Surprises and Opportunities

DESCRIPTION: Since SDIO is an exploration at technology's leading edge, it recognizes that surprises and opportunities may arise from creative minds. SDIO will consider proposals in other technologies where they present an unusual opportunity for SDIO. The proposer should take special care to describe the technology and why SDIO would benefit from exploring it. Proposals should not that proposals in this topic will receive preliminary screening that may reject them as too far a field without the full technical review received by proposals in the topics already listed. This open call is for new technology, not for recycling of old ideas.