NAVY

PROPOSAL SUBMISSION

The responsibility for the implementation, administration, and management of the Navy SBIR program is with the Office of the Chief of Naval Research. The Navy SBIR program manager is Mr. Vincent D. Schaper. Inquiries of general nature may be brought to the Navy SBIR program manager's attention and should be addressed to:

Office of the Chief of Naval Research
Attn: Mr. Vincent D. Schaper, Navy SBIR Program Manager
800 North Quincy Street (BCT #1, Room 934)
Arlington, VA 22217-5000
202-696-4286

The Navy has identified 213 technical topics to which small R&D businesses may respond. A brief description of each topic is included along with the address of each originating office. This information is contained on the ensuing pages.

SBIR proposals shall not be submitted to the above address and must be received by the cognizant activities listed on the following pages in order to be considered during the selection process.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals on Navy Topics

Phase I proposal (5 copies) should be addressed to:

Topics #N89-001 through N89-008

Mail/Handcarry Address:

Office of Naval Research
Attn: ONR Code 1111MA, Rm. 607
SBIR Program, Topic No. N89-___
800 North Quincy Street, BCT #1
Arlington, VA 22217-5000

Topics #N89-009 through N89-015

Mail/Handcarry Address:

Office of Naval Technology
Attn: ONT Code 20T, Rm. 502
SBIR Program, Topic No. N89-___
800 North Quincy Street, BCT #1
Arlington, VA 22217-5000

Topic #N89-016

Mail Address:

Commanding Officer
MCRDAC, SBIR Program
Amphibious Warfare Technology Directorate
Quantico, VA 22134-5080

Topics #N89-017 through N89-059

Mail Address:

Commander
Space and Naval Warfare Systems Command
Department of the Navy
Attn: SPAWAR 10D, SBIR Program, Topic No. N89-___
Washington, DC 20363-5100

Topics #N89-060 through N89-067

Mail Address:

Commander
Naval Supply Systems Command
Department of the Navy
Attn: Code PML-5505, SBIR Program, Topic No. N89-___
Washington, DC 20376-5000

Topics #N89-068 through N89-070

Mail Address:

Commanding Officer
Naval Medical Research & Development Command
Attn: Naval Medical Command, National Capital Region
SBIR Program, Topic No. N89-___
Bethesda, MD 20814-5044

Topics #N89-071 through N89-083

Mail Address

Headquarters, Naval Air Systems Command
Department of the Navy
Attn: Code AIR-9303D, SBIR Program, Topic No. N89-___
Washington, DC 20361-9301

Topics #N89-084 through N89-128

Mail Address

Commander
Naval Sea Systems Command
Department of the Navy
Attn: Code CET-4, SBIR Program, Topic No. N89-___
Washington, DC 20362-5101

Topics #N89-129 through N89-163

Mail Address

Commander
Naval Surface Warfare Center
White Oak Laboratory
Attn: Code S-02, SBIR Program, Topic No. N89-___
Silver Spring, MD 20903-5000

Topics #N89-164 through N89-165

Mail Address

Commander
Naval Surface Weapons Center
Dahlgren Laboratory
Attn: Code S12, SBIR Program, Topic No. N89-___
Dahlgren, VA 22443-5000

Topic #N89-166

Mail Address

Commanding Officer
Naval Weapons Support Center
Attn: Code 6053, SBIR Program, Topic No. N89-___
Crane, IN 47522-5060

Topics #N89-167 through N89-171

Mail Address
Commander
Naval Weapons Center
Attn: Code 005, SBIR Program, Topic No. N89-___
China Lake, CA 93555-6001

Topics #N89-172 through N89-176

Mail Address

Commander
Naval Air Development Center
Attn: Code 094, SBIR Program, Topic No. N89-___
Warminister, PA 18974-5000

Topics #N89-177 through N89-178

Mail Address

Commercial Acquisition Department
Naval Underwater Systems Center
Shaws Cove Office Park, Bldg. #4
Howard Street
New London, CT 06320-5594
Attn: Code 911, SBIR Program, Topic No. N89-___

Topics #N89-179 through N89-180

Mail Address

Commanding Officer
Naval Air Engineering Center
Attn: Code 073, SBIR Program, Topic No. N89-___
Lakehurst, NJ 08733-5000

Topics #N89-181 through N89-184

Mail Address

Commander
Pacific Missile Test Center
Attn: Code 3154, SBIR Program, Topic No. N89-___
Point Mugu, CA 93042-5000

Topics #N89-185 through N89-186

Mail Address

Commander
Naval Training Systems Center
Attn: Code 6, SBIR Program, Topic No. N89-___
Orlando, FL 32813-7100

Topics #N89-187 through N89-189

Mail Address

Commanding Officer
Naval Coastal Systems Center
Attn: Code 401, SBIR Program, Topic No. N89-___
Panama City, FL 32407

Topics #N89-190 through N89-191

Mail Address

Commanding Officer
Naval Civil Engineering Laboratory
Bldg. #560
Attn: Code L03B, SBIR Program, Topic No. N89-___
Maritime Road & Market Street
Port Hueneme, CA

Topics #N89-192 through N89-199

Mail Address

Commanding Officer
Naval Air Propulsion Center
Attn: Code PE1A, SBIR Program, Topic No. N89-___
1440 Parkway Avenue
Trenton, NJ

Topics #N89-200 through N89-209

Mail Address

Commander
Naval Ocean Systems Center
Attn: Code 0141, SBIR Program, Topic No. N89-___
San Diego, CA

Topic #N89-210

Mail Address

Commander
David Taylor Naval Ship
Research & Development Center
Attn: Code 011.4, SBIR Program, Topic No. N89-___
Bethesda, MD 20084-5000

Topics #N89-211 through N89-213

Mail Address

Commander
Naval Air Test Center
Attn: Code CT22, SBIR Program, Topic No. N89-___
Patuxent River, MD 20670

OFFICE OF NAVAL RESEARCH

N89-001 TITLE: Language Based Software Environments

CATEGORY: Research

DESCRIPTION: Language based software development environments can improve productivity by making effective use of knowledge specific to the particular language being used, be it a programming language, a specific language, or mathematical logic. Techniques for generating language-based environments from formal specifications have been developed in the research community. Prototypes exist that demonstrate the viability of the various approaches for creating such systems. But no fully engineered products exist. Because an environment generator is a tool-building tool, considerable leverage would be obtained by perfecting such a system. In particular, one efficient implementation of an environment generator has the potential to lead to efficient environments for a multitude of languages. The introduction of Ada into military systems and the special environments for system development will cause for the foreseeable future, a mixture of CMS-3 and Ada developments to maintain fleet software. Multilingual environments are guaranteed to exist in some form that maintain the independence of each. Integration of tools to a higher level of utility by using language-specific information is a worthwhile goal.

N89-002 TITLE: Autonomous Marine Instrumentation Platforms

CATEGORY: Research

DESCRIPTION: The objective of this task is to develop innovative methods for deploying and operating autonomous, in-situ oceanographic instrumentation packages to measure surface and near-surface (up to 20m depth) physical, biological, and/or chemical parameters. Measured quantities of interest will include high wavenumber surface wave spectra, near-surface profiles of steady and fluctuating velocities together with surface and subsurface concentrations of chemical species and bubble populations. The proposed platform motions in order to reference all fluctuations to an appropriate (local) inertial frame.

N89-003 TITLE: Acoustic Classification with Parallel-Processing Networks

CATEGORY: Research

DESCRIPTION: The objective of this task is to develop a prototype system utilizing parallel-processing networks that interface with a human operator whose objective is to determine the source of a non-speech acoustic signal from it's transient characteristics. This size of the signal set should be at least 20 sounds. The exploitation of artificial neural network or neuro-computer systems is encouraged. The development of connectionist models of this task is of interest. Studies should lead to an understanding of how users interact effectively with concurrent informational flows, the conditions that significantly influences that process, and the allocation of decision-making between the user and this automatic processor.

N89-004 TITLE: Advanced Biosensors

CATEGORY: Research

DESCRIPTION: Biological systems have the inherent ability to sense and respond selectively to small concentrations of specific chemical species. Examples include: mammalian olfaction processes, insect pheromone detection, and ion channel gating in membranes. Recent advances in molecular recognition, biocatalysis, and the ability to isolate and reconstitute cell components (e.g., ion channels, receptors) into artificial host materials offer an opportunity to develop sensing elements that have many of the capabilities of biological systems. The objective of this program is to develop highly selective and sensitive sensors, which exploit these new developments by coupling the selective chemistry with optical, electrochemical and other amplification schemes. Ultimately, these biomimetic

sensors could be used to detect substances of abuse, hostile agents, and naturally occurring substances, e.g., neurotransmitters.

N89-005 TITLE: Novel Growth Techniques for Large Area SIC Substrates

CATEGORY: Research

DESCRIPTION: Investigation of novel growth/deposition techniques to provide Beta-SIC high performance device-quality thin films on crystalline insulator substrates. State-of-the-art growth techniques for Beta-SIC are limited in size and prone to high density stacking faults. The projected research effort will address suitable substrates with or without intermediate layers to achieve proper coordination number and reduce crystalline defects at the interface and their propagation throughout the films. The resulting layers over 75 to 100-mm diameter substrates will be characterized for their physical properties; e.g., electron and hole mobilities, crystalline perfection and their use for high performance (radiation tolerant, high temperature) microwave and millimeter wave devices.

N89-006 TITLE: Novel Approaches to the Synthesis of Fluorodinitromethane and Fluorodinitroetnanol

CATEGORY: Research

DESCRIPTION: A number of compounds containing the fluorodinitromethyl group are used as energetic plasticizers and polymers in high performance explosive compositions. The use of these materials is restricted by their high cost. Increased benefits from the high-energy content and excellent stability of these materials could be realized for a wider range of Navy munitions if their cost could be reduced. For these reasons, novel synthesis methods for the key precursors, f luorodinitromethane and 2,2,2- fluorodinitroetnanol, are sought which are not based on nitroform or 2,2-dinitropropanediol as starting materials. Alternatively, the novel methods may derive from nitroform or 2,2- dinitropropanediol if improved production methods for these materials are being proposed also as an integral part of the project.

N89-007 TITLE: Production and Coating of Pure Boron Powders

CATEGORY: Research

DESCRIPTION: Develop processing chemistry to synthesize pure boron powder coated with protective metal films for ultimate use in high-energy propellants and underwater explosives. Boron particle diameters in the range of 0.5 to 50 microns are desired that are coated with protective metallic films of magnesium, titanium or zirconium. The protective metallic coatings must be applied to the particles prior to exposure to air or water to prevent boron oxide formation on the surface during subsequent handling and in early stages of combustion. The protective coating thickness must be consistent with the particular diameter so that the combustion energy is not reduced by more than about 10% from that of pure boron. The process should lend itself to full-scale production of coated pure particles with a high integrity of surface coating and uniform research and development purposes to optimize, improve and control the reactivity, burning rate and combustion efficiency of boron- containing energetic propellants and explosives.

N89-008 TITLE: Novel Acoustic Damping Materials

CATEGORY: Research

DESCRIPTION: There is a need to improve materials having a high damping capacity combined with good mechanical properties, suitable for structural uses. Of primary interest are novel directionally isotropic metal matrix composite materials (i.e., not containing aligned reinforcing fibers), which can potentially provide rapid attenuation at vibrational frequencies from 1 to 1000 Hz. Also of interest are materials that are active over a broad temperature

range, at room temperature and above. Advanced processing approaches to produce novel microstructures and/or unusual metal/ceramic or metal/organic mixtures are encouraged.

OFFICE OF NAVAL TECHNOLOGY

N89-009 TITLE: Deception Methods for Rule-Based Decision Aids in Adversarial Environment

CATEGORY: Exploratory Development

DESCRIPTION: Automatic aids for situation assessment, for planning and for information fusion contain symbolic, principally rule-based, inference methods. A primary aspect of military situations is the use of deception in local and global strategies. Deception, if it is done well, produces logically consistent events and stimuli to the sensors of an adversary. This logical consistency, although fictitious, produces inference in decision aids which are the basis for a response based on "apparent truth." The need exists for methods to manage the inference process in order that the multiple hypothesis can be retained in the computations without an unacceptable overhead burden. Evidential reasoning and computational structures are key dimensions of the problem, with an added dimension being that of observation noise. Proposal should address methods for including deception patterns in decision aids when in the presence of observation noise and computational constraints.

N89-010 TITLE: Microwave Monolithic Integrated Circuits (MMIC) Passive Components

CATEGORY: Exploratory Development

DESCRIPTION: MMIC operating at "L" band need filters and isolators that are high performance, yet compatible with MMIC technology. Isolators can be made using cascade amplifiers. These circuits can provide isolations in excess of 50 db at "l" band, but noise figures and compression points are limitations. Low compression power implies the use of the isolator at low input power levels where the noise figure needs to be low. Novel MMIC techniques are needed to generate a non-reciprocal transfer function with low noise figures and high power compression points. Filters can be designed using lumped element approaches, spiral inductors and Metal-Insulator-Metal (MIM) capacitors, and the gate-to-source capacitance of a single gate MESFET can be utilized to tune the filter response moderately. The design limitation on these filters is low "Q". Techniques are needed to improve the Q-factors of these elements. Active techniques are required to generate large inductors as are used in low-frequency gyrator circuits.

N89-011 TITLE: Single Crystal Titanium Carbide

CATEGORY: Exploratory Development

DESCRIPTION: Develop a reproducible, high yield process for production of single crystal titanium carbide ingots of controlled composition and orientation. Ingots should be 2 inches in diameter and 12 inches long with large, pure single crystal regions from which uniform wafers can be sliced in high yield. Composition should be chosen to provide good lattice matching with silicon carbide, for which this titanium carbide will be a substrate.

N89-012 TITLE: Expert System for Joining Composite Materials

CATEGORY: Exploratory Development

DESCRIPTION: A wide variety of composite material joining procedures and techniques have been used and tested. However, many design engineers do not have easy access to this wealth of information. As a consequence, the designer of a composite structure or component may not make the optimum joining procedure decision during the design stages. This leads to inefficient designs, and to costly problems in the fabrication and production stages. It is

desired to have an expert system developed to assist designers in the optimum selection of composite material joining techniques. Such a system must incorporate an extensive database of composite material joining details and procedures and be capable of developing an optimum, or near optimum, joining design and procedure for the user. The system should operate in a desktop computer environment and have the ability to provide alphanumeric data, as well as design drawings and other graphical information to the user.

N89-013 TITLE: Helium Dewar System for Superconducting Sensors

CATEGORY: Exploratory Development

DESCRIPTION: Requirements exist for the development of a helium dewar that will have a substantially improved performance over those currently used for prototype development. Need dictates that the dewar be extremely efficient in terms of space, thermal leakage, and weight. Phase I of this effort requires a study of new technologies and techniques to be used in construction of miniaturized dewars, including the possibility of incorporating a closed-cycle refrigerator. At a minimum, the topics to be addressed will include thermal efficiency, hold time, magnetic signature, and antislosh baffling and size. A dewar is then to be designed based upon the initial study with the capability of cooling a sensor system with physical characteristics that will be provided by the funding agency. In Phase II, the resulting dewar will be constructed and evaluated.

N89-014 TITLE: Detection of Acoustic Non-Gaussian Signals

CATEGORY: Exploratory Development

DESCRIPTION: Methods of passive acoustic signal processing have generally assumed either a known signal or a Gaussian signal embedded in Guassian noise. In the era where radiated ship noise is being dramatically reduced, investigations of maximum likelihood or other “optimum” methods for detection of less traditional, non-Gaussian signals in Gaussian noise are important tasks. A few statistical theories have been advanced, but not applied to real acoustic operational data to determine the transition potential of the theories. Approaches to this problem may be principally ad hoc and dependent upon reasonable models of the signal and signal plus noise processes. Evaluations of the methods advanced according to suitably defined measures of effectiveness should form the focus of work proposed within this topic.

N89-015 TITLE: Torpedo Detection System

CATEGORY: Exploratory Development

DESCRIPTION: Develop non-acoustic means of detecting and localizing torpedoes using shipboard sensors. System shall be capable of operating on current US ships without restricting operating environments or tactics. The system shall be capable of detecting and localizing torpedoes operating against surface ships from all the angles on the bow and against all classes of torpedoes.

MARINE CORPS

N89-016 TITLE: Sealed Tube Technology for Metal Vapor Lasers

CATEGORY: Exploratory Development

DESCRIPTION: A requirement exists for the development of a sealed laser tube for a Copper Vapor Laser (CVL). A sealed type CVL would substantially improve performance over current state-of-the-art CVL’s by eliminating the flow-through buffer gas system consisting of compressed gas and a vaccum pump, as well as increasing the operation times, as periodic tube breakdown for copper replacement would be eliminated. Phase I of this effort

requires a study (and possible demonstration) of new technologies and techniques required for the fabrication of a sealed tube. At a minimum, this shall address the technology required to seal ceramics to dissimilar materials (e.g., alumina to niobium to sapphire) with vacuum seals capable of high temperature (1500 C) operation. Based on the study results, a CVL would be made available for this purpose. In Phase II, the resulting tube is to be fabricated and evaluated.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N89-017 TITLE: Warfare Systems Architectures

CATEGORY: Exploratory Development

DESCRIPTION: Naval warfare strategies and systems acquisitions are undergoing deliberate change in the Navy. Stand-alone systems, interoperability issues and adverse programming actions are a few of the reasons giving rise to these deliberations. The Navy is presently examining a top-down approach to R&D and acquisition decisions, guided by Top Level Warfare Requirements (TLWRs). The conceptual framework of a Warfare Systems Architect and Engineer (WSA&E) has been formed to relate the Navy's warfare strategies and systems acquisitions. The architecture level focuses on TLWR compliance. Rigorous mission analysis, force level perspectives, and systems architectures are the end products. The systems engineering level is aimed at programs. The architectures are systems engineered, wherein they are translated into program level guidance across platform and warfare mission areas. Performance specs, controlled interface drawings and test specs are established. The purpose of this task is to seek innovative assistance at the architectural level. The systems architectures address 12 warfare mission areas: Command (communications), C2, Strike Warfare (STW), Anti-Surface Warfare (ASUW), Amphibious Warfare (AMW), Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), Mine Warfare (MIW), Electronic Warfare (EW), Special Warfare (SW), Space, and Logistics. The force structures to implement these warfare missions include the Carrier Battle Force (CVBF), Battleship Battle Group (BBBG), Amphibious Task Force (ATF), Area ASW Force, and SLOC Protection Force. Proposals should identify a single mission area; multiple proposals may be submitted. The architectural process involves four steps: (1) Functional decomposition of the mission entails decomposing the mission into tiers, establishing Required Operational Functions, devising functional flow diagrams, and building a complete database. (2) Physical analysis of the current force (e.g., complete understanding of the platforms, systems interdependencies and Battle Force C2 requirements); allocating ROFs to platforms; composing a baseline warfare systems architecture; establishing functional shortfalls of the baseline architecture and adding FYDP programs. (3) Performance examines the architecture vs. TLWR models and war-gaming, and establishes performance shortfalls. Identify shortfall resolutions, such as systems upgrades, notional platforms, etc. This step is reiterated and refined. (4) Architecture Options establish WSA&E products, which include Force Level Architectures, TLWR compliant options such as costs, performance schedule, risk, technology, payoff.

N89-018 TITLE: Advanced Systems and Concepts for Future Naval Warfare

CATEGORY: Exploratory Development

DESCRIPTION: Throughout the history of military conflict innovative technology in the hands of resourceful leadership has proved to be an unequaled force multiplier. This task seeks new ideas in high payoff, high-risk technologies, systems, systems architectures, and warfare concepts addressing Naval Battle Force Warfare in the years 2000 and beyond. The Battle Force must be capable of mission execution and defense in a multiplicity of warfare areas (e.g., AAW, ASW, ASUW, MIW, C3I, etc.) involving a multiplicity of subsurface, surface, aerospace, and space platforms. The end products being sought are detailed assessments of 1) the advanced systems and architectures supportive of Navy mission areas, 2) the warfare concept and operational advantages offered the Battle Force, 3) the new existing technologies required, 4) projected costs, and 5) risks. Phase I proposals should outline a clear methodology to achieve these goals. Imaginative, realistic ideas are encouraged. Offerors may submit as many proposals as deemed appropriate to cover their varied ideas for advanced systems and concepts of future Naval Warfare. Multiple contract awards to a single offeror and awards to more than one offeror are contemplated.

N89-019 TITLE: Expert System for Development of Request for Proposal Package

CATEGORY: Exploratory Development

DESCRIPTION: Development of Request for Proposal packages is generally a manual process involving integration of inputs from program managers, contracting officers, and other various government managers. Since the packages often include standard language for statements of work, provisions and clauses, the efficiency for developing the packages could be improved by automating these sections. In addition, automation should improve the efficiency of package development and reduce the number of omissions and errors by incorporating internal automated checklists. The Navy has a requirement for development of an expert system to accommodate development of Request for Proposal packages using standard language, as well as providing the user flexibility for tailoring various sections of the package.

N89-020 TITLE: Using Differential Global Positioning System for Truth Reference

CATEGORY: Engineering Development

DESCRIPTION: The need for precise truth reference system exists for harbor navigation, rescue and salvage, and very precise tactical applications. A design approach and systems demonstration for a differential Global Positioning System for this purpose should be investigated. The use of non-development item technology with Navy standard 3S Global Positioning System equipment would be the focus of the study. This study would investigate potential cost and other advantages associated with the proposed configurations. Possibilities also exist for sensor calibration for equipment operating within the common grid system.

N89-021 TITLE: Jamming Techniques Against Frequency Hopping Signals

CATEGORY: Advanced Development

DESCRIPTION: Timely generation of effective jamming against frequency hopping signals allows only a short time to measure the target signal parameters. Since measurement precision is inversely proportional to time, certain target signal parameters will not be measured to the precision required to generate the best jamming signal. It is the lack of precision that encourages the selecting of wideband jamming waveforms in order to be sure of covering the target signal (s). Wide-band jamming waveforms, in general, require more power than narrow-band waveforms to provide the needed jamming to signal ratio at the target receiver in a naval battle group scenario. An investigation is desired to develop jamming waveforms that do not require precise knowledge of signal parameters nor unduly high power, and that will provide effective jamming of specific modifications and signal types with their associated receivers. The investigation will be analytical and experimental (at a NAVOCEANSYSCEN Laboratory). The work will be done at the SECRET level.

N89-022 TITLE: Stochastic Time Attributed Petri Network (STAPN) Modeling of C3 Networks

CATEGORY: Exploratory Development

DESCRIPTION: There is a Navy need for the capability to assess the performance of future Anti-Submarine Warfare (ASW) Command, Control and Communications (C3) architectures and, through the incorporation of advanced organizational and data/information management concepts, assess their ability to improve war-fighting effectiveness. This task involves developing a technique for modeling Naval C3 networks, which will allow the analysis of network performance and comparison of alternative C3 architectures. The technique should allow for the characterization and display of the C3 flow in Naval Command Structures. It should include parameters associated with the decomposition of warfare functions (in the mission domain), command functions (in the organization domain), and the system functions (in the resource domain). A set of representative scenarios should be established, spanning the range of military conflict from limited crisis to global war, to test each architecture, and measures of

effectiveness (MOEs) for performance comparisons should be developed. These MOEs should include command as well as communication capabilities. This technique should also include the development of data dictionaries containing baseline functional decompositions of Naval staffs, warfare areas, and ASW platforms. The technique should be compatible with the ASW Test Bed Model specifications and should allow for the creation and assessment of hypothetical systems and operating concepts.

N89-023 TITLE: Anti-Submarine Warfare (ASW) Command, Control, Communications and Intelligence (C3I) Model Development

CATEGORY: Exploratory Development

DESCRIPTION: The Naval Warfare Systems Architect needs a means of structuring Battle Force/Battle Group (BF/BG) Architecture, as well as assessing the war-fighting capability of current and future architecture. Additionally, the Composite Warfare Commander needs a means of determining the performance of his C3I systems. The objective of this is to develop an event-driven, variable time step ASW Monte Carlo C3 model. The model shall consist or at least the following principal sub-models: Data- Fusion – fuse ASW data from organic and non organic sources; Resources Allocation—ASW resource allocation and prioritization, including man, weapons and sensors; Communications—model time late, alternative network paths and connectivity, network countermeasures and degraded modes of operation; Input Message Processing—simulate message processing; Track correlation—correlation of track file with sensor (s); Target Classification—target ranking and weapon assignment; Engagement simulate encounter results; and Data Acquisition and Database Management—simulate data acquisition and management. The model must be high fidelity. Sub-models must run in a parallel, time synchronous, near real time mode. The model outputs shall be usable measures of effectiveness. The end result of this task will be: a literature search and requirements analysis, and model development risk assessment; and a top-level development of the physics of the model. Phase II, if required will consist of: complete development of the physics of the model; and application of top-down structured design to model development, model coding, model runs and fidelity demonstration and model documentation.

N89-024 TITLE: Effects of Compiler and Run-Time System Features on Future Combat Systems Designs

CATEGORY: Exploratory Development

DESCRIPTION: There has been considerable work undertaken in the development of Ada tools, compilers, and environments. The primary intent of Ada was for use as the language for combat systems. However, the ability to use Ada in these real-time embedded systems is just now being explored. There is a need to examine the run-time support required by combat systems using Ada. The purpose of this effort is to evaluate one or more combat systems under development and to identify the run-time support required if the system were to use Ada. The run-time support includes the Ada run-time executive, debugger tools, hardware, and any underlying operating systems. It is important to identify the areas in which run-time support is expected to be deficient. The Department of Defense (DOD) requires guidance for development of comprehensive and efficient run-time systems that can support actual combat systems.

N89-025 TITLE: Improve Electronic Warfare (EW) Response Time

CATEGORY: Advanced Development

DESCRIPTION: Modern communications are going more to wideband techniques, and modern usage of single channel techniques is becoming less predictive of frequencies for use. These factors lead to the need to perform an instantaneous broadband search and rapid processing of the search data in order to detect and identify signals of

interest with sufficient speed to perform countermeasures before the signal ends or changes frequency. There are many noise sources of interference and many signals not of interest that, along with the signals of interest, provide a highly complex output from a wideband receiver. Techniques are sought that can recognize patterns and associated signals at various Radio Frequencies (RFs), in time, to a particular transmission (an RF hopper) and to do so for multiple simultaneous transmissions in the noisy and busy environment with sufficient speed and accuracy to drive a jammer (follower jammer against a hopper). New and fresh approaches are sought, such as neuronets or expert systems. Work will be at the SECRET level.

N89-026 TITLE: Standard Software Environment for Local Area Network (LAN) Integration

CATEGORY: Exploratory Development

DESCRIPTION: In the near future, communication among elements of shipboard combat systems will be supported by high-speed fiber optic Local Area Networks (LANs). LANs permit a high degree of interconnectivity between all elements of the combat system and provide the flexibility to implement future changes without expensive and disruptive hardware modifications to input-output (I-O) channels or unit-to-unit cabling. The intended flexibility cannot be realized, however, if extensive software changes need to be made whenever a combat system element is to be adapted from one application to another. What is needed is a novel and innovative approach to standardization of the ISO/OSI level 6 Presentation Layer in a manner which would insulate the Level 7 Applications Programs from the lower level protocols which are network dependent.

N89-027 TITLE: Frequency Agile Laser Protective Devices

CATEGORY: Exploratory Development

DESCRIPTION: With the increasing development of lasers throughout the visible spectrum, there is a need for a single filter that will protect the eyes of personnel against all laser wavelengths. Such a frequency agile laser protective device must also provide good daytime and nighttime visibility and not pose other hazards to personnel. In essence, the ideal device must obstruct hazardous levels of laser radiation and allow viewing of light at safe levels for all wavelengths in order to see surroundings, indicator lights, and other visual aids, obstacles, etc. This device must understand all Navy Standard environmental testing.

N89-028 TITLE: Software Development System Safety Analysis

CATEGORY: Advanced Development

DESCRIPTION: With the trend of software control of weapons, aircraft, and command and control systems, the potential for a software error causing a catastrophe increases. There is a need for software hazards analysis techniques that can be applied both to program design languages, written code and interfaces between hardware and software. While a survey of existing methods is necessary for background, original work building on state-of-the-art is the desired product.

N89-029 TITLE: Analysis of Xenon-Chloride Laser Gas Contamination Mechanism

CATEGORY: Advanced Development

DESCRIPTION: The purpose of this task is to contribute to xenon-chloride laser lifetime and performance by identifying and analyzing the dynamic reactions which result in lasing medium contamination during the operation of xenon-chloride lasers. This task is important for ensuring that xenon-chloride laser transmitters with sufficient performance, lifetime, and reliability will be available for use in the satellite laser communications program. The

task will include, but will not be limited to evaluation of potential reactions that could occur within and between these materials given the environmental conditions associated with laser hot standby and operation, estimation of the rates of reaction and the likelihood that these reactions would occur, analysis of the effects of by-products and products on the laser and laser performance (ultra violet etc.), and recommendation of alternative materials or techniques to control, prevent, or mitigate the effects of gas contamination.

N89-030 TITLE: Cesium Cell Optimization for Satellite Laser Communications Applications

CATEGORY: Engineering Development

DESCRIPTION: Many factors affect the response, sensitivity, lifetime, and line of width of cesium cells. Experience has indicated that currently obtainable cesium cells are not satisfactory for use in satellite laser communication applications. The purpose of this task is to identify those factors which affect the performance of cesium cells, analyze their impact on cells intended for use in satellite laser communication hardware, and optimize cell designs for use in laser transmitters and receivers. The task includes, but is not limited to, investigation of the effects of temperature buffer gas mixture, buffer gas pressure, materials selection, temperature profile, and device geometry on cesium cell performance. Researchers shall also address cesium cell manufacturing techniques and the development of quality assurance standards and methodology sufficient to ensure the production of reliable cesium cells with consistent performance characteristics.

N89-031 TITLE: Development of All-Sapphire Raman Cells

CATEGORY: Advanced Development

DESCRIPTION: Window Raman Cells, containing lead vapor in the temperature range of 1300’C to 1350’C are used in the satellite laser communications program as an optical frequency conversion device. Production of tightly sealed optical windows which demonstrate long calendar life is a topic of continuing interest. One proposed sealing method would employ an all-sapphire tube in which the windows are fused into the cell body. (This eliminates the need to use frits as seals, which by their nature contain undesired impurities.) The objective of this task is to develop a process that yields fused sapphire cells of the desired size and with windows of the desired optical quality.

N89-032 TITLE: Information Processing Enhancements for the Satellite Laser Communications Systems

CATEGORY: Exploratory Development

DESCRIPTION: Identify and evaluate the performance of candidate techniques for increasing communications throughput, transmitter lifetime, and system connectivity by reducing the number of optical pulses required to convey a given message while maximizing the probability of it’s successful receipt. Methods to be evaluated will include, but will not be limited to, source coding, channel coding, and adaptive filtering techniques. The studies will also address the effects of spot shape, spot power distribution, spot size, environmental factors, and time delay revisiting on total system performance. All techniques and/or processes to be investigated must be applicable to a pulse position modulation scheme, be compatible with the existing transmitter/receiver design, and be incorporated before the laser transmitter or after the optical detector.

N89-033 TITLE: Long-Term Xenon Chloride Laser Gas Processing

CATEGORY: Research

DESCRIPTION: The satellite laser communications program requires development of xenon-chloride (XeCL) lasers that can support operation in space for three to seven years. Current testing indicates that after a period of operation, a buildup of contaminates within the laser gas reduces laser output power by altering the laser gas mix and by condensation/deposition on the laser pressure vessel optical windows. This task will propose and experimentally

verify the efficacy of various gas processing techniques that might be employed in space to minimize the levels of contaminants within the laser. Potential methods include the use of electrostatic precipitators, getters (particularly calcium getters), and cryogenics.

N89-034 TITLE: Effects of High Temperature on Optical Components And Sealing Compounds

CATEGORY: Exploratory Development

DESCRIPTION: Window Raman Cells, containing lead vapor at temperatures of 1300'C to 1350'C, are used in the satellite laser communications program as an optical frequency conversion device. Production of tightly sealed optical windows which demonstrate long calendar life is a topic of continuing interest. Concerns exists regarding long-term changes in the crystalline structure of the frits (seals), which may affect cell integrity, as well as the windows themselves, which may affect beam quality of optical output. In addition, migration of frit component materials onto the windows degrades long-life optical damage thresholds. This task will determine the long-life performance of various high temperature frits and optical windows (including, but not limited to fused quartz and sapphire) in an environment which simulates the interior of an operating lead vapor Raman cell.

Note: For topics N89-35 to N89-47, the Navy SBIR Communication Support System (CSS) information package is available upon request from the Defense Technical Information Center.

N89-035 TITLE: Techniques for Reconnecting Partitioned Networks

CATEGORY: Advanced Development

DESCRIPTION: As the Navy extends the range of its communication networks by the use of repeaters, it will become necessary to develop techniques for reconnecting networks which have become partitioned due to loss of repeating nodes. A typical example would be where an aircraft that functions as a repeater for a dispersed line-of-sight network suddenly lost. In this case, the network is divided into small isolated networks. These small networks could be reconnected using High Frequency as an inter-network gateway. The issue is to develop protocols which support reconnections that have minimum impact on the users (host computers). The reconnection processes should be transparent to the users. This effort is to develop techniques and simulate performance of reconnection systems.

N89-036 TITLE: Dynamic Inter-Network Gateway Algorithms

CATEGORY: Advanced Development

DESCRIPTION: This effort is to develop inter-network gateways that can be dynamically selected to support the use of multiple Radio Frequency (RF) networks for delivery of Navy Traffic. The Navy presently has a mix of RF networks such as High Frequency (HF), Ultra-High Frequency (UHF), Line of Sight, Joint Tactical Information Data Systems, Ultra-High Frequency (UHF) Satellite Communications, etc. All ships do not support all networks A typical example would be the transmission from shore on UHF Satellite Communications of a message destined for a ship that supports only and HF network. In this case, any ship that supports both HF and UHF Satellite Communications could function as an inter-network gateway. The question is, if multiple ships can act as the gateway, which one should be selected. The issue is how much network topology knowledge must be shared between the HF and UHF Satellite Communications networks in order to select a gateway which can most efficiently deliver the required traffic. Overhead for transmitting topology knowledge must also be minimized, particularly as the number of potential networks grows. The system must be sufficiently fast to incorporate aircraft as potential gateways and reconfigurations in case of ship failure. This effort is to develop algorithms and simulate performance of internet gateways.

N89-037 TITLE: Addressing Techniques for Navy Traffic in a Multimedia Environment

CATEGORY: Engineering Development

DESCRIPTION: As the Navy converts to multimedia networking using the International Standards Organization (ISO) layered architecture, it will be necessary to develop addressing formats that support Navy traffic types without imposing a heavy burden on communication resources. Navy Traffic types include a variety of point-to-point, multicast and broadcast circuits. For example, the delivery of a broadcast message using multiple point-to-point transmissions is a waste of communications resources. A common address for all intended recipients would be a better approach, given that all users have prior knowledge that they should receive the message. The purpose of this effort is to examine all Navy Traffic types and operational scenarios to determine how users could be more efficiently addressed. Names must be converted to network addresses. Group addressing for multicast or conference nets should be identified. Addressing should be accomplished within the ISO model, particularly the Internet protocol.

N89-038 TITLE: Analytical Tools for Communication Support Systems

CATEGORY: Engineering Development

DESCRIPTION: The communication support system is a vital part of the Navy's Command and Control System in that it provides message, voice, and data communications among platforms, sites, and warfare systems. A related effort which will impact the Communication Support System in the future is the Unified Network Technology Program. Unified Network Technology has as its objectives increased survivability of naval tactical communication efficiency via dynamic multi-network management. The multi-network environment includes high frequency radio, line-of-sight radio, satellite links, and intra-site local area networks. Traffic includes both digital data and voice. The development of analytical tools such as computer simulation are required in order to support improvements in network management algorithms and the extrapolation test results to larger networks.

N89-039 TITLE: Communications Resource Management Algorithms

CATEGORY: Advanced Development

DESCRIPTION: The normal process of establishing navy communications lines is manual and time consuming. This task is to develop techniques which will automatically set up reliable communication links. Links to be considered are high frequency, ultra-high frequency, ultra-high frequency line-of-sight, and ultra-high frequency satellite communications. Setup should include frequency tuning, channel probing for quality, and organization of links into networks. Line-of-sight, Extended Line-of-sight, and Beyond Line-of-sight links should be addressed. Techniques for link quality monitoring should also be investigated.

N89-040 TITLE: Database Management Techniques for Navy Message Addresses

CATEGORY: Engineering Development

DESCRIPTION: As the Navy transitions from fixed dedicated communication links to the dynamic management of a pool communication links, it will be necessary to develop a computer-based phone book. User addresses must be converted to network addresses at a speed that matches the user request for service rate. The phonebook must also be updated as new users enter the network. The purpose of this effort is to develop database management systems that address the following issues: 1) Addressing formats. Identify methods for converting names to network addresses. Names include various groups of users, single users, and broadcast users. For example, a group of users may be formed to support a common activity such that a single network address can be used in lieu of transmitting many individual user addresses. 2) Search speed. User transmissions may be short with a need for rapid transmission. Since each user request will require a database search for addressing, the speed of search will be critical. 3) New user network entry. The entry of a new user into the network must be accomplished with a minimum

of network overhead. The issue is would it be more efficient to maintain a large database of potential users such that a user needs to transmit only a short message or should the users transmit a complete network address? The new user entry must be rapid to support the transmission of time-critical data.

N89-041 TITLE: Protocol Development for Secure Voice Network Management

CATEGORY: Advanced Development

DESCRIPTION: As Navy voice circuits are transitioned from existing switching systems which are manually set up, to voice on a Local Area Network (LAN) with dial-up capabilities, it will be necessary to develop protocols and addressing for secure voice network management. Since voice and data will share the same 2.4K bps circuits, it will be necessary to develop protocols that switch between data and voice on demand. Network management for half duplex circuits should also be identified. Addressing must consider both point-to-point and conference calls. Radio frequency media to support voice should be high frequency, ultra-high frequency, line-of-sight, and joint tactical information data system, all with repeaters and satellite communications circuits. This effort is to develop both addressing and network protocols for automatic management of Naval voice circuits.

N89-042 TITLE: Graphic Displays for Multimedia Network Management

CATEGORY: Advanced Development

DESCRIPTION: As Navy Communication Systems are integrated into a pool of resources connected via a Local Area Network and are dynamically controlled, it becomes impossible for Naval personnel to determine overall communication system status. To alleviate this problem it will be necessary to develop network monitoring techniques and graphics displays that are useful to Naval personnel. Display information should include items such as connectivity, traffic loading on each circuit, some indication of circuit reliability, past history on each circuit, ability to detect spoofing, etc. Connectivity information presents some unique challenges in that network topology does not necessarily imply ship graphic development. This may cause some difficulty to ship personnel in trying to correct system failures. Areas to investigate would be the use of Naval Tactical Data System data in forming the network display or deployment. The purpose of this effort is to identify network information that needs monitoring and to develop graphics displays that can be used for status evaluation by Navy personnel.

N89-043 TITLE: Mixed Media Loading Analysis for Local Area Networks

CATEGORY: Advanced Development

DESCRIPTION: In order that future Navy communication system architectures have the capability to pool communication links for use by all users, it will be necessary to connect links and users via a Local Area Network. This LAN must carry mixed data types (i.e., voice, messages, imagery data, computer data, etc.). Each user will have different delivery criteria and will place different demands on LAN performance. Different data types will tolerate different delays. This effort is to investigate various LAN and to determine performance versus mixture of Navy traffic types. In support of developing interface standards, it will be necessary to define standard traffic formats that encompass all Navy traffic types. This includes voice, data, messages, and imaging data. The model must include speed of delivery, acknowledgement time, user population, reliability delivery requirements, etc.

N89-044 TITLE: Multimedia Dynamic Control Algorithms

CATEGORY: Advanced Development

DESCRIPTION: The future Navy communication system architecture will change from fixed dedicated links to a pool of links to be shared by all users. The issue is how is link selection determined on a dynamic basis? What rules should be used to select high frequency over ultra-high frequency satellite communications? The selection criteria

must consider connectivity, time delay bandwidth, traffic loading, priority, etc. The cost functions used for link selection must also be stable with platform motion/destruction and not vulnerable to spoofing or jamming. The issue of confidence in link selection must also be addressed. Are we 90% confident that the link is 30% reliable, or 30% confident that the link is 90% reliable? How should these confidence factors be used in link selections? The purpose of this effort is to develop cost function/algorithms for dynamic link selection and demonstrate performance through simulations.

N89-045 TITLE: Multimedia Management Algorithms for Long Haul Naval Traffic

CATEGORY: Exploratory Development

DESCRIPTION: Future Navy Communication systems, in which users are attached to local networks and utilize internet gateways for extended coverage, will need the capability to acquire/distribute global information for long haul connectivity. The issue is how much global information must each user maintain. For example, a task force may maintain global information on it's own forces but have no information on other remote tasks. Should a central location, such as shore site, be responsible for maintaining global information with queries from the task force? Does the need to send local global data to a centralized database consume a large percentage of communication resources? The purpose of this effort is to investigate techniques for developing, disseminating, and maintaining global information sufficient to support Naval operations without a large overhead burden on communication resources.

N89-046 TITLE: Multinet Controller Hardware/Software Architectures

CATEGORY: Engineering Development

DESCRIPTION: In order to manage multimedia circuits and multiusers dynamically, it will be necessary to develop a multinet controller. The multinet controller must also include a database of user addresses and display capability for monitoring network status. The multinet controller will also contain the communication plan for circuit setup. The multinet controller will not pass actual traffic. Its function is to setup circuits based on user service requests. It must also have the capability to monitor all traffic flow and link network status. Performing these functions in real time could be a heavy processing load. The purpose of this task is to investigate hardware and software configurations for a multinet controller. Hardware should be based on commercial back plane buses such as VME, and make a maximum use of existing VME- compatible processors. Software should investigate the use of real time operating systems and must support Ada.

N89-047 TITLE: Network Protocols for UHF Multiuser Traffic

CATEGORY: Engineering Development

DESCRIPTION: Typical network protocols used in Navy Ultra-High Frequency (UHF) Satellite Communications circuits are tailored to a specific user. Each link controller needs to support only one type of traffic. As the Navy transitions to an architecture in which communication links are treated as a pool of resources to be shared between all users, each link must have network protocols that can support all types of Navy traffic (voice, data, message, image, etc.). This effort is to develop network protocols that can support multiple user traffic in both point-to-point, multicast and broadcast modes. Protocols which dynamically change in response to user requests are to be considered. The emphasis is an efficient use of channel capacity and minimal time to reconfigure protocols as traffic type changes. Protocols must be tested to verify performance.

N89-048 TITLE: Computer-Aided System Engineering in Support of Multi-Warfare System Development

CATEGORY: Advanced Development

DESCRIPTION: The Space and Naval Warfare Systems Command (SPAWAR) has identified a need to apply computer-aided system engineering (CASE) tools and methodologies to support warfare architecture and systems engineering analysis. The complex interactions or multiple warfare, equipment, and platform architectures and systems requires the use of tools and methods to help keep requirements, capabilities, and interfaces clearly defined and coherently connected. Further, in order to respond promptly to Navy information requirements, SPAWAR must be able to rapidly reconfigure system connectivities and parameters, have confidence that all required interfaces are matched properly, and that the connectivities and performance numbers make sense. Given the complexity of the modern battle force, a CASE tool is mandatory. Required effort will be to enter warfare mission area architectures and plans into the CASE tool and build the required battle forces. From this level, an attempt will be made to expand the tools to lower levels in direct support of the Battle Force Systems Engineering Plan (BFSEP), Warfare System Performance Specifications (WSPS), and the Warfare System Controlled Interface Document (WSCID). Methods to ensure configuration management, regular review and update of systems parameters and how to handle required future capabilities will be defined. Practice in exercising the CASE tool, as well as mapping a strategy for sustained use, will be required. Given the proliferation of different CASE tools with dissimilar capabilities, the last step of this effort will be to examine the ability to perform CASE tool integration across different tools and their respective databases.

N89-049 TITLE: Distributed Real-Time Operating System with Task Migration

CATEGORY: Exploratory Development

DESCRIPTION: In a Local Area Network (LAN) connected shipboard combat system, critical tasks should be able to migrate from one central processing unit (CPU) to another CPU (via the LAN) upon CPU failure. CPU's must export critical state variables to redundant locations in order for a new CPU to take over a failing CPU's task and rapidly and accurately converge to the current state of the combat environment. Novel and innovative concepts are required for exporting real-time state variables with concurrent requirement of avoiding redundant database(s) corruption due to the presence of erroneous state variables from a failing CPU.

N89-050 TITLE: Analysis of the Reconfiguration of Local Area Networks

CATEGORY: Exploratory Development

DESCRIPTION: The Navy has selected two commercial Local Area Network (LAN) standards, IEEE 802.5 and ANSI X3T9.5 FDDI, as the protocol core of the SAFENET-I and SAFENET-II LAN standards. Both of these LAN's use token-passing as an access control mechanism, both use counter-rotating rings wit station bypassing. Reconfiguration following failure can involve station bypassing, cable switching or loopback. The length of time required to detect a failure, exchange data to effect reconfiguration, and restart the token is of concern to system designers with time-critical applications. Flexible evaluation tools (e.g., simulation models) are needed having the capability to fine-tune the evolving reconfiguration time as a function of the failure extent over a broad range of network sizes.

N89-051 TITLE: Shipboard Electromagnetic Emissions Management for Electronic Warfare and Communications

CATEGORY: Exploratory Development

DESCRIPTION: The management of active shipboard emissions will enhance battle forces' war-fighting capabilities through improved systems operation and reduced vulnerability to enemy attack. Emissions management should prevent the simultaneous active use of electromagnetically incompatible systems (e.g., radar and radio), optimize the use of available communications bandwidth, and prompt the transitions between the complete restriction of emissions (total EMCON) and active use of electronic warfare (EW) and/or communications equipment. Assuming that all shipboard active emissions can be enabled/disabled by netted emissions management software, an operations analysis will be used to establish criteria for automatically prioritizing conflicting requests

for emissions and to change priorities of those requests in queue as the situation demands. The criteria will accommodate simultaneous operations in multiple warfare mission areas (e.g., anti-air and anti-submarine). They must be responsive to rules of engagement, levels of conflict, and conditions of readiness as determined by higher authority. Upon completion of the criteria, a flow diagram for an implementing master algorithm will be prepared. The functions in that algorithm will be partitioned by the implementing command location to minimize the load on communications and to assure that human interfaces exist to provide for command by exception.

N89-052 TITLE: Active Sonar Range Doppler Normalization for Long Continuous Wave (CW) Transmission

CATEGORY: Exploratory Development

DESCRIPTION: Good range-rate or Doppler resolution can be obtained in active sonar by using Continuous Wave (CW) transmission. Since range-rate discrimination, especially near zero Doppler, is becoming increasingly important for future ling-range sonar systems, it is likely that these systems will make extensive use of CW waveforms. Unfortunately, CW transmissions generate high reverberation levels, and the spectral character of these is confused by source speed, surface and bottom scattering characteristics, and off-axis clutter returns entering the system through beamforming sidelobes. For CW waveforms to live up to reverberant background level must be found that can effectively handle this wide range of range-Doppler reverberation parameters. A rapidly converging adaptive approach which determines the range-Doppler structure over multiple passes is one possibility.

N89-053 TITLE: Characterization of Ownship Doppler and Transmission Channel Parameters by Means of Clutter Measurements

CATEGORY: Exploratory Development

DESCRIPTION: Future use of active sonar systems in the Anti-Submarine Warfare (ASW) mission places great importance upon being able to distinguish targets from clutter using range-rate discrimination. Fine resolution of range-rate differences depends on one’s ability to eliminate the effect of ownership motion from the received signals. Especially at low speed, present methods of estimating ownship speed are limited, in that the percentage error is typically large compared to requirements. Even the NAVSTAR Global Positioning System can only determine platform velocity down to 0.2 knot. Measurements on the clutter returns of active sonar search pulses can potentially provide the needed information, since the majority of this clutter originates from bottom-fixed features. Thus, by measuring clutter range-rates as a function of beam pointing direction, it is possible in principle to derive a good estimate of ownship motion. Similarly, for long-range active sonar, it is important to characterize multipath parameters of the transmission channel to and from a particular target range, and again, this should be determinable from the clutter returns. The purpose of this task would consist of developing and evaluating candidate algorithms for deriving the information described above from the clutter signals.

N89-054 TITLE: Color Display of Acoustic Data

CATEGORY: Exploratory Development

DESCRIPTION: This task would explore and evaluate more effective ways of using color cathode ray tube (CRT) display systems for enhancing the presentation of processed acoustic data to an operator. For passive acoustic signals, possible uses of color include the combined display of data processed with different parameters, such as integration time, frequency band, or processing bandwidth. For active signals, color might be used for presentation of high resolution Doppler information, comparison of autodetect clusters with raw data, and overlay of information from various parts of complex active waveform.

N89-055 TITLE: Communication and Database Architectures to Support Remote Ship and Shore Users

CATEGORY: Exploratory Development

DESCRIPTION: Existing land-based computer-to-computer communication systems support the use of large computer complexes by a variety of remote users. Distant users may perform database interrogation functions and/or execute complex programs not otherwise available to them while using only minimal communications capacity and local computer resources. Similar direct access by naval shipboard or remote shore users to remote processing and database functions could support a variety of useful functions in the logistics, surveillance, maintenance, oceanographic, and planning areas. This research and development task would develop requirements for such a capability and propose candidate computer and communication architectures to support remote query requirements for distant shore facilities and ships at sea.

N89-056 TITLE: Data Compression for Acoustic Surveillance Data

CATEGORY: Exploratory Development

DESCRIPTION: As future undersea surveillance systems evolve toward increasing use of active acoustics and multi-sensor correlation, there is a commensurate increase in the need to transmit a wide variety of acoustic surveillance data over digital networks and to store larger quantities of this information in digital form. Data compression techniques are sought to permit efficient transmission of both active and passive acoustic data (including LOFABGRAMS) over digital links of limited capacity, while retaining an ability to reconstruct the underlying sonar/acoustic scenario classification clues. Required capability of the technique includes a spectral dynamic range of 60db and ambiguity surface sidelobe fidelity which does not increase –30 db sidelobes more than 1 db. Although many data compression techniques in all their generality have been widely studied, previous search and analysis of prior results should be reviewed to determine the degree of their applicability to the present problem.

N89-057 TITLE: High Data Rate Satellite Communications

CATEGORY: Exploratory Development

DESCRIPTION: The objective of this task is to perform appropriate analysis and architectural studies of alternative concepts to maximize communication rates between surface and shore nodes using Ultra-High Frequency UHF satellite communications. The areas of investigation would likely include multiplexing techniques, adaptive shipboard antenna arrays, advanced modulation schemes, and optimum satellite channel bandwidth assignments. Throughput improvement of a factor of 3 or 4 is required (i.e., to rates of 100 kilobits/second or above) rather than incremental gains of a few percent. This degree of throughput improvement could have a dramatic impact upon shipboard terminal size, since one piece of equipment operating at a high data rate potentially could replace multiple pieces of equipment that operated at individually lower data rates.

N89-058 TITLE: High Resolution Active Sonar Waveforms

CATEGORY: Exploratory Development

DESCRIPTION: This task would focus on the development and testing of high resolution active sonar waveforms, such as Costas sequences, designed to enhance the simultaneous display of target highlights and Doppler. The effort would include a demonstration of corresponding processing algorithms for both initial detection and high-resolution information extraction.

N89-059 TITLE: Information Processing and Distribution for the Integrated Undersea Surveillance System

CATEGORY: Exploratory Development

DESCRIPTION: The Integrated Undersea Surveillance System (IUSS) is a network of sensors and processing centers dedicated to wide area Anti-Submarine Warfare surveillance in both peace and war. The objective of this task is to develop a communications networking concept for the IUSS shore facilities viable through the entire spectrum of conflict ranging from peace to all-out conventional warfare. This would cover both communication media (e.g., communication satellites or landlines) and information handling approaches (e.g., raw data transfer, contact reporting, packetizing, "sparsing," etc.) for local area, wide area, and global networking. Although conventional techniques are currently available to provide surveillance information to the fleet, new networking schemes are needed having the capability to effectively link all the players under stressed conditions.

NAVAL SUPPLY SYSTEMS COMMAND

N89-060 TITLE: Automated Electronic Parts Packaging and Handling System

CATEGORY: Exploratory Development

DESCRIPTION: Electronic repair parts are packaged in a number of ways, none of which are compatible with an automated parts storage and retrieval system. Therefore, the packaging does not meet the needs of a repair operation. This Phase I project is for the feasibility and preliminary design of a standard component package and an automated parts storage retrieval system compatible with automated parts loading equipment; bar coded for automatic reading; provide Electro-Static Discharge (ESD) protection; provide part in pin orientation, placement, and protection; be easily separable into individualized packages; and be compatible with an individualized automated component storage and retrieval system. The automated parts storage and retrieval system must accept the component package; read the part on entry; reject the part on read error; store up to 25,000 parts; occupy no more than 80 cu. ft.; return the part upon command; and present the part for manual or automated equipment removal. The Phase I effort shall investigate existing equipments for applicability or extent of modification and provide a development cost analysis.

N89-061 TITLE: Liquid Cooling Vest

CATEGORY: Advanced Development

DESCRIPTION: The Navy requires a liquid cooling vest that, with minimal power, is capable of extracting significant metabolic heat (approximately 350 watts) from the torso of an individual. The vest shall operate by circulating either cool water, or a mixture of polypropylene glycol and water, through the vest and shall be ergonomically designed in order to provide freedom of movement in both the standing and seated positions. The vest will be worn in shipboard spaces where environmental temperatures are 130'F dry bulb, 50% RH. The vest will be subject to radiant heat loads from metal broiler surfaces and must have a fire-retardant covering. The contractor should have the capability, either in house or through sub-contract, to evaluate the performance of the designed vest against other commercially-available vests, in order to prove its superior performance. The vest should be designed with considerations for minimal coolant flow resistance to minimize the power needed to operate the vest. Vest pressure must not exceed 5 psi and the operable flow must not require more than 0.4 gpm. Appropriate insulation shall be provided to prevent the excessive absorption of environmental heat. To prevent local skin injury, the minimum coolant temperature should be specified in order to maintain chest temperature above 65'F. The vest should be easily interfaced with liquid circulator through the use of appropriate fittings. Acceptable methods of performance evaluation are through either a properly executed thermal manikin evaluation of human physiological testing.

N89-062 TITLE: Expert System for Circuit Board Assembly

CATEGORY: Exploratory Development

DESCRIPTION: Automated assembly of printed circuit boards (PCBs) has resulted in labor savings, reduction of network costs, reduced work-in-process and improved product quality. One of the commonly used electronic assembly methods in industry is component insertion. A second automated process involves component part retrieval from a storage carousel (AS/RS) for the purpose of kitting parts necessary for subsequent automated PCB assemblies. Kitting is advantageous for small batch size- high diverse part mix assemblies; whereas, magazines are used for production-line oriented work. There are three primary considerations required for optimizing the scheduling of component insertions: (1) the assignment of components to the feeder magazines or kits (i.e., component assignments), (2) the determination of insertion sequence on the board (i.e., table tour), and (3) the determination of the retrieval sequence (i.e., magazine feeder sequence). A second set of optimal insertion sequence needs to be devised for a kitted set of component parts which would be more applicable to the Navy's Rapid Acquisition of Manufactured Parts (RAMP) Program. The purpose of this project is the development an expert system that optimizes the placement and insertion sequence of electronic part components for a circuit card assembly using kitted parts. An interface would be developed with vendor driven numeric control (NC) codes. Consideration for this system would include the type of insertion/assembly method (i.e., kitted parts use), type and size of a component part (e.g., DIP, axial, radial, straight pin, surface mount, etc.), and type of board (e.g., single or double sided, lead through devices or surface mounted devices or both). This project should demonstrate a direct time/cost benefit to the automatic insertion/placement for a variety of components.

N89-063 TITLE: Dynamic Real Time Radio Frequency Tag Network

CATEGORY: Advanced Development

DESCRIPTION: Radio frequency tags and readers have a given transmission distance. Movement of a tag beyond the transmission scope of the radio frequency tag reader, disrupts the communication, thus the tag and the material to which it is attached is "lost" to the system. Purpose of this project is the dynamic real-time and reader system which can communicate over a dynamically configurable radio frequency network in order to preserve communications regardless of the separation distance between the tag and the reader. Current radio frequency tag system costs would be reduced dramatically due to lower transmission distance requirements and lower numbers of readers to cover a given geographic area adequately. Two trips to Washington DC, as well as one trip to the Naval Supply Center, Charleston and one trip to the Aberdeen Proving Grounds, Maryland, are required in the course of the project.

N89-064 TITLE: Radio Frequency Tag Triangulation System

CATEGORY: Advanced Development

DESCRIPTION: Current radio frequency tag systems have the ability to identify only that a tag exists in the tag reader's sphere of influence. When all tags are grouped together, no determination can be made as to where in the group a particular tag which is being queried is located. Purpose of this project is the development of a radio frequency tag reader that can triangulate on a given radio frequency tag and visually display the exact location of the requested tag. The visual display would be similar to the air traffic controller displays utilized for aircraft position monitoring, but portable. The display would show (in map format) all tags, highlighting the requested tag, including distance from the reader direction, and directional relationship to other tags. Benefits would include the ability to locate radio frequency tags in groups without the need for time-consuming visual secondary inspection. Two trips to Washington DC, as well as one to the Naval Supply Center, Charleston and one trip to the Red River Army Depot, are required in the course of the project.

N89-065 TITLE: Clothing System for Static Electricity Control

CATEGORY: Exploratory Development

DESCRIPTION: The Navy has a need for materials/clothing for the control of static electricity (SE) build-up on military/personnel operating in dry-cold or dry-temperate environments while handling explosive-sensitive ordnance

and SE-sensitive semiconductor equipment. This would be accomplished through provision of a fire retardant clothing system that will control the dissipation rate of electrical energy, thereby eliminating the potential dangerous static electrical discharge. At the end of Phase I, the contractor a) will be expected to process at least two viable approaches towards development of a suitable material/clothing ensemble and grounding treatments, and b) will submit prototype materials and test data demonstrating the extent of SE control.

N89-066 TITLE: Lightweight Cold Weather Safety Boot

CATEGORY: Advanced Development

DESCRIPTION: The Navy requires a breathable, lightweight, cold weather safety boot that will enable personnel to function in wet-cold or dry-cold environments ranging from –10'F to 50'F. The boot should be similar in design (including the sole pattern) to Boots, Cold Weather, Insulated Rubber, MIL-B-41816, Type I, Class 2, but be approximately 25% lighter in weight. The toe of the boot must be capable of providing a minimum of 75 foot-pounds of impact protection and 2500 pounds of compression resistance when tested in accordance to ANSI Z41.1. A size 10R boot must provide a total clo value of not less than 1.9 and a water vapor permeability index of 0.3 to 0.4 minimum. Testing for thermal conductivity and water vapor permeability will be the responsibility of the Navy. The outsoles and heels shall conform to MIL-S-22777 Grade A. A boot shall not absorb more than 15% water after being immersed in a bath of water for 24 hours. Also, no leakage shall be observed when flexed in water on the Army Natick Dynamic Footwear Flex Tester after 100,000 flexes, drying to a constant weight at 150'F and reflexed 100,000 times. The wide variety of commercially available WI/VP films, coatings and laminates should be investigated as a potential means of attaining the required water impermeability/water vapor permeability.

N89-067 TITLE: Portable Power Supply

CATEGORY: Exploratory Development

DESCRIPTION: The Navy requires a compact, rechargeable, portable power supply that is capable of delivering 5 watts at 12V DC over a 6-hour period. The power supply will be used in a portable personal cooling system where space and weight minimization are critical. Ideally, the battery should occupy a space no longer than 5.25" x 2" x 2.25" in a backpack configuration. The power supply must conform to appropriate military specifications for batteries. A companion recharger, with built-in overcharge protection, is required to operate from a ship compatible 155V AC, 60-Hz power source. The contractor should have the capability either in-house or through subcontract, to evaluate and confirm the superior performance for the power supply against other systems. To enable the device to be economically produced and be logically feasible for Navy use, the contractor should utilize commercially available state-of-the-art devices. Devices that have an energy density greater than nickel cadium (16 W-hr/lb) or sealed lead acid (12 W-hr/lb) batteries should be examined. Lithium silver oxide and nickel hydrogen systems should be investigated.

NAVAL MEDICAL RESEARCH & DEVELOPMENT COMMAND

N89-068 TITLE: Preparation and Analysis of Pure Campylobacter Jejuni and Aeromonas Hydrophila Antigenic Protein Fractions

CATEGORY: Exploratory Development

DESCRIPTION: Grow liter amounts of specific Campylobacter Jejuni and Aeromonas Hydrophila bacterial strains and prepare protein fractions for immunologic analysis. The methods to be used for preparation and purification can include but need not be limited to molecular sizing chromatography, ion exchange chromatography, differential solubility in salt solutions, and preparation gel electrophoresis. Additionally, the separation of non-denatured proteins from sonicates of these organisms by gel electrophoresis followed by Western Blct analysis with available antisera would be desirable.

N89-069 TITLE: Development of Non-toxic, Metabolizable Cryopreservative for Human Red Blood Cell Freezing

CATEGORY: Exploratory Development

DESCRIPTION: Development and testing of cryopreservatives for human red blood cell freezing, preservation and storage is required with the specific properties that permit immediate transfusion of post-thawed red cells into recipients without wash-out of the cryopreservative. This necessitates the use of non-toxic cryopreservative that is metabolized or harmlessly excreted, as well as is able to retard or eliminate the osmotic uptake of fluid into the red cell that presently rapidly occurs with FDA-approved cryopreservatives if post-thaw wash-out prior to transfusion is not performed.

N89-070 TITLE: Physician's Encounter Data Management Computer

CATEGORY: Advanced Development

DESCRIPTION: A need exists to provide advanced computer and information technology to support Navy Health Care Providers at the patients bedside and in hospital or clinic offices. A primary application lies in the use of lightweight, portable computers with requisite communications and artificial intelligence capabilities to perform a wide range of functions, including recording of medical histories, physical examinations, and progress notes; entering and reviewing clinical findings; generating correspondence; planning and scheduling and writing orders. Proposals should provide a vehicle to 1) evaluate current information technology and applications, 2) document requirements of Navy Health Care Providers 3) conceptualize a prototype system to meet identified requirements

NAVAL AIR SYSTEMS COMMAND

N89-071 TITLE: Harpoon Employment Training on the Zenith-Z248

CATEGORY: Engineering Development

DESCRIPTION: The Zenith-Z248 (Z-248) is the DoD standard desktop computer (contract number F19630-86-D-0002). Since the Harpoon Weapon System is an integral asset in Anti-Surface Warfare, (ASW) a need exists for a trainer that simulates the concepts and performance of Harpoon employment for all the Harpoon platforms. A training tool is to be designed to take full advantage of the Z-248's Z86 architecture and state-of-the-art Harpoon simulation.

N89-072 TITLE: S-3B Viking/Harpoon Engagement Trainer

CATEGORY: Advanced Development

DESCRIPTION: The sophisticated nature of the Harpoon cruise missile requires an in-depth understanding of the cruise missile concepts, over-the-horizon targeting, degradation of missile performance in wide range of environments, and a tactical understanding of the aforementioned topics as they pertain to the S-3B Viking aircraft. A desktop computer-based trainer is to be designed and developed to address the complexities of the Harpoon operations in the VS community. The trainer should take full advantage of Navy standard tactical desktop computer technologies.

N89-073 TITLE: Harpoon Captive Carry Simulator

CATEGORY: Advanced Development

DESCRIPTION: Trainer shapes are used to conduct simulated firings. In the case of the Harpoon cruise missile, firing commands are sent to the training missile and stored on media. A facility is needed to replay a simulated Harpoon launch from the P-3C aircraft on a desktop computer. The effort should employ a cost-effective approach for maximizing current Harpoon simulation technologies and providing the VP community with a means of reconstructing simulated Harpoon launch upon immediate return from flight.

N89-074 TITLE: A-6E Intruder/Harpoon Engagement Trainer

CATEGORY: Advanced Development

DESCRIPTION: The sophisticated nature of the Harpoon cruise missile requires an in depth understanding of cruise missile concepts, over-the-horizon targeting, degradation of missile performance in a wide range of environments and a tactical understanding of the aforementioned topics as they pertain to the A-6E Intruder aircraft. A desktop computer-based trainer is to be designed and developed to address the complexities of Harpoon operations in the VA community. The trainer should take full advantage of Navy standard tactical desktop computer technologies.

N89-075 TITLE: Conducting Polymers

CATEGORY: Exploratory Development

DESCRIPTION: Future Naval airframes will incorporate large percentages of nonmetallic, largely resin-matrix composite materials. It is desirable that these materials be capable of at least a moderate level of electrical conductivity. Innovative development is required to investigate new polymeric materials or materials processing techniques that result in intrinsic conductivity. In addition to materials that conduct electronically, fast-ion or superionic conductors may be considered as candidates for development. Tailorable conductivity within the basic materials system, either by varying chemistry or processing, is highly desirable from the standpoint of matching properties with other material components. In addition to conductive materials that have applications in structural components as resins for fibers, materials that may be utilized as adhesives or sealants are of interest. Proposed projects should include a strong engineering basis for evaluation and result in a testable material or materials system that can be reasonably considered as applicable to Navy aircraft or missiles following advanced development and demonstration.

N89-076 TITLE: Nondestructive Evaluation of Composites

CATEGORY: Research

DESCRIPTION: Resin-matrix composite materials are sometimes subject to the formation of numerous internal voids, either highly dispersed or in local aggregates or layers. Conventional nondestructive evaluation (NDE) techniques, although generally capable of detecting porosity, often cannot evaluate the distribution of porosity or its mechanical significance. Innovative research is needed in NDE techniques that have the potential for industrial or military application in this area. In particular, consideration should be given to the detection, location, distribution, and significance of void aggregates in resin-matrix composites. Mechanical and physical testing of candidate resin systems in conjunction with appropriate NDE is desirable as part of the determination of void significance. The resin systems of interest include both single-and multi-phase epoxies and bismaleimides.

N89-077 TITLE: Chaotic/Fractal Processing and Display Methods

CATEGORY: Exploratory Development

DESCRIPTION: Since the discovery of chaos there has been an increased interest in this new area of non-linear dynamical theory which has provided new analysis tools to aid in data characterization. Theorists claim that chaos is not totally random but is actually deterministic in nature or in a “chaotic” state. Researchers involved in the analysis of chaotic signals have developed tools by which measured signals can be tested and characterized as stochastic or deterministically chaotic. However, because of the dynamic nature of this technology, it is difficult to assess the extent and value of chaos research to date. The purpose of this effort is to assess the current status of chaotic/fractal research and to identify and develop those techniques with potential acoustic processing and display applications. An initial survey of the field of chaos technology should include identification of specific chaotic signal processing and potential display techniques along with simple proof-of-concept demonstrations of these techniques. A subset of these techniques should be refined and applied to the problem of broadband acoustic signal analysis and display methods with the end product being a software package that incorporates these techniques in an automated signal recognition paradigm.

N89-078 TITLE: Electromagnetic Fluxgate Sensor

CATEGORY: Advanced Development

DESCRIPTION: The Navy is in need of a highly accurate and reliable electromagnetic fluxgate sensor. Current Navy magnetic compasses and corresponding sensors are severely limited. Gyro drift requirements are expensive to maintain. Purpose of this project is the development of a fluxgate that will meet the Navy’s requirements and will be 1553 data bus compatible. It should be compatible with the Standard Attitude Heading Reference System, the proposed New Technology Compass, and other fluxgate- dependent navigation systems.

N89-079 TITLE: Amphibious Air Traffic Control Direct Aircraft Identity Readout (AATC DAIR)

CATEGORY: Engineering Development

DESCRIPTION: Amphibious Air Traffic Control Direct Aircraft Identity Readout (AATC DAIR) intrasystem data rates to and from display consoles exceed present fiber optic (FO) (SAFENET1) capabilities of four megabits per second. Purpose of the project is to consider converting AATC DAIR consoles to SMART micro processor-controlled displays with a resulting factor of ten data rate reduction and display update enhancements. Conversion should include integration of FO circuits to preclude requirements for external box; signal data converter (SDC)-Display and SDC-Computer interface circuitry. Modification would convert AATC-DAIR to a prime candidate for a local area network FO system. An additional advantage to the use of FO system interfaces is the reduction in shipboard weight requirements.

N89-080 TITLE: High-Speed Tracker Algorithms Study

CATEGORY: Advanced Development

DESCRIPTION: Design and document detailed computerized simulation methods to compare the performance of the following High-Speed Tracking Algorithms:

1. Adaptive Alpha, Beta Filters
2. Variable Alpha, Beta Filters
3. Extended Kalman Filters

The performance parameters shall include:

a. Target position and velocity accuracy and resolution

b. Tracker tenacity during target maneuvers

c. False track initiation rate (clear and noisy areas)

The study should also address advantages and disadvantages of each method for use in high-speed tracking.

N89-081 TITLE: Advanced Ceramic Cutting Tools for Titanium Alloys

CATEGORY: Advanced Development

DESCRIPTION: Titanium Alloys are used extensively in Navy aircraft in both airframe and turbine engine applications. While carbides have been used for machining titanium, they are less than optimum and contain cobalt (a strategic metal) as a binder. The program objective is to reduce dependency on cobalt imports as well as reducing the cost of machining titanium. In the case of machining titanium alloys, the cutting tool behavior is governed by its solubility and reactivity with titanium. The failure mechanism is not a wear type phenomenon. The methodology for this program would be: a) investigate ceramic alternatives to carbide cutting tools, b) evaluate ceramic cutting tool limiting due to the reactivity and solubility of titanium into the cutting tools.

N89-082 TITLE: High Density Electronic Packing Concepts

CATEGORY: Exploratory Development

DESCRIPTION: The Naval Air Systems Command is interested in the development of novel concepts for packaging of high-density electronics for computers and signal processors. The intent is to utilize high-speed parallel to serial conversion for the elimination of expensive high-density multipin connectors that are currently used for parallel data transmission. Approaches include guided wave optics, free space optics, and/or superconductor devices and transmission lines. All proposed concepts should have the potential of meeting the severe aircraft environment.

N89-083 TITLE: Novel High Torque DC Motors

CATEGORY: Exploratory Development

DESCRIPTION: The Naval Air System is interested in the design and development of novel DC motor concepts. The motor should be capable of developing high torque and horsepower for driving aircraft and missile control surfaces. Very high efficiency and minimum weight and volume are essential, as is operation in the severe aircraft environment. Novel materials, (e.g., rare earth magnetics, superconductors, and conductive polymers, as well as composite casings) are of particular interest, as is innovative design.

NAVAL SEA SYSTEMS COMMAND

N89-084 TITLE: Ship Manning Requirements Planning Knowledge Based Systems

CATEGORY: Advanced Development

DESCRIPTION: Officer manpower requirements are calculated for each new ship and submarine design, and for each upgrade. In addition, feasibility studies are conducted on an iterative basis, as requested. Each year, ship-manning studies must be updated, based on the ship Required Operations Capabilities/Projected Operational Environment (ROC/POE) Instruction. Planning requirements for ship manning is a complex task, but is governed by a fairly clear set of documented rules. Knowledge-based systems (software packages) can be used to automate and replace the trained personnel in narrow fields of expertise. The objective of this project is to automate the ship manning requirements planning process, based on ship Required Operations Capabilities/Projected Operational

Environment (ROC/POE) Instructions and other guidance. The expert system shall be developed using Guru and must run on a VAX VMS operating system. Phase I should yield a prototype expert system to perform early officer manning estimates. Phase II is expected to fully automate ship-manning requirements planning functions.

N89-085 TITLE: Transient Acoustic Analysis

CATEGORY: Advanced Development

DESCRIPTION: Improved methods are needed for separation and identification of short duration noise sources that occur simultaneously or near simultaneously. Sources include broad-band, narrow-band, and combinations of broad-band and narrow-band noise with different sources located at varying distances from each other. Proposals should address innovative methods for analyzing acoustic data to process, separate, and identify short duration events rapidly and efficiently.

N89-086 TITLE: Fiber Reinforcement Ceramic Coatings

CATEGORY: Advanced Development

DESCRIPTION: The problem encountered in this application of ceramic thermal barrier coatings to gas turbine airfoils and diesel engine components is coating spallation. A major factor in this coating spallation is the inability of the coating to withstand the range of mechanical and thermally induced stresses caused by changes in engine power. The objective of this program is to assess the advantages of ceramic fiber and/or whisker reinforced thermal barrier coatings in providing coating integrity in these applications. Coatings with ceramic fiber and/or whisker reinforcement should be compared to coatings without reinforcement under simulated thermal cycle conditions. The project should include fracture analysis results, coating and powder characterization, and identification of ceramic fiber and/or whisker data plasma spray parameters.

N89-087 TITLE: Shipboard Tank and Void Inspection

CATEGORY: Exploratory Development

DESCRIPTION: A major cost driver during ship availabilities is repair to ship tanks and voids. A need exists to identify required repair work inside of Navy ship tanks and enclosures while the ship is operational; that is, prior to the planned availability. Repair work is currently determined while the ship is already undergoing a planned availability and requires cleaning and gas freeing the tanks prior to any inspection. Tanks may be compensated (flooded with seawater s fuel is used or uncompensated). Inspections include identification of side, top, and bottom corrosion, failed paint systems, failed welds and seams, deteriorated piping, deteriorated electrical stuffing tubes, damaged sounding tubes, ladders, and tank level indicators. A study is required to determine alternative inspection methods that do not require cleaning and gas freeing the tanks. Methods must be capable of being accomplished by senior Navy enlisted personnel. The study should be structured towards an operational demonstration.

N89-088 TITLE: Linear Motor Current Collectors

CATEGORY: Exploratory Development

DESCRIPTION: Linear electrical motors are being considered for various Naval applications. Linear motor designs being considered include DC brush commutated machines operating in seawater. The feasibility of operating electrical current collectors in seawater must be determined and demonstrated. The current collector (brush) system will operate at sliding velocities of up to 20 meters per second and carry 10,000 amperes of electrical current for a time duration of 3 seconds. Damage to the motor commutator is critical and must be kept to a minimum. Required brush operating life must be 1000 seconds or 300 motor operations at 10,000 amperes. In addition, the brush system will be exposed to seawater on a continuous basis and the effect on overall life and performance must be

determined. Since size of the brush system will have a major impact upon motor size, the brushes should operate at the highest possible current density consistent with the above requirements.

N89-089 TITLE: Magnetic Silencing

CATEGORY: Exploratory Development

DESCRIPTION: The Navy requires closed loop magnetic signature reduction systems for the numerous field generating mechanical subsystems aboard minesweepers. Each mechanical system must have dedicated signature reduction instrumentation, all of which must work in concert to reduce the total signature of the minesweeper below levels detectable by magnetic influence mines. A total system of closed loop signature reduction instrumentation must include such elements as: (a) magnetic sensors, (b) feedback and control electronics, and (c) power supplies and magnetic coils. The studies will involve the design, fabrication, and evaluation of an appropriate system, which should consist of a minimum of two three-axis signature reduction instruments working in proximity to one another.

N89-090 TITLE: Digestible Plastic Films

CATEGORY: Exploratory Development

DESCRIPTION: Develop a substitute material for conventional plastic trash can liners that, when shredded, or otherwise reduced in particle size, poses not health threat to marine life if ingested. Ingestion of plastic wastes in the ocean has been attributed as a major cause of death to sea turtles, marine birds, fish, and marine mammals. The substitute material must retain the desirable properties of polyethylene trash bags (tensile strength, wet strength, bacteria barrier, etc.) for at least two weeks after it is used. Other applications for this product are possible. The product of this research effort shall be a prototype plastic film and test results report.

N89-091 TITLE: Development of Seawater Spray Nozzles for Gas Quenching

CATEGORY: Engineering Development

DESCRIPTION: There are potential Navy applications for seawater spray nozzles that can provide a continuous stream of fine droplets to cool hot exhaust gases effectively. Nozzles currently available are not capable of maintaining a fine droplet distribution over an extended period of time or under conditions of intermittent operation due to partial clogging of the orifice. The investigations should include investigation of the factors causing clogging and the development of a nonclogging design that will maintain a droplet size distribution with Sauter mean diameter of approximately 100 microns at a nominal nozzle flow of 2 gallons per minute.

N89-092 TITLE: Cleaning of Ship Coatings

CATEGORY: Advanced Development

DESCRIPTION: Numerous environmental and safety restrictions exist regarding the removal, handling, and disposal of coatings used to protect Navy ships' hull systems. Handling of antifouling coatings is of special interest. Concepts are required that have the potential for removal of ship coatings at rates in excess of 600 square feet per hour per mil of thickness; that do not damage the substrate materials; that are usable in a shipyard drydock environment; and that will not create products that are hazardous to both the environment and the personnel.

N89-093 TITLE: Computational Modeling of 3-D Unsteady Flow

CATEGORY: Research

DESCRIPTION: The highly three-dimensional (3-D) geometry of flowpaths in modern marine gas turbines causes very complex flow fields within the machine. The impact of these complex flow fields on the pressure losses is not well understood. This project is specifically directed at obtaining a better understanding of the flow through 2-D and 3-D sections of exhaust diffusers in advanced marine gas turbines. The contractor shall develop a user-friendly computer code for turbulent, separated and recirculated flows in conical exhaust diffusers with dump-type collector boxes. Software should be compatible with the VAX 11700 series computer preferably in VAX-VMS language.

N89-094 TITLE: Identification of Ignition Criteria for Low Vulnerability Ammunition (LOVA) Propellants

CATEGORY: Exploratory Development

DESCRIPTION: Low vulnerability Ammunition (LOVA) gun propellants are designed to resist ignition from thermal threats, and as a result are inherently more difficult to ignite than conventional propellants. In order to overcome the ignition problems, the chemical and physical environments that enhance the ignition of these propellants must be identified. Once these criteria have been described, an igniter system and material can be designed that meet these requirements. Develop a test procedure that will isolate and identify the chemical and physical environments that improve the ignition behavior of LOVA gun propellants. With the results of the designed tests, described and igniter material and system that will improve the ignition reliability of LOVA propellant in a gun system.

N89-095 TITLE: Integral Dielectric/Heat Sink for Electronic Devices

CATEGORY: Exploratory Development

DESCRIPTION: Electronic devices with increasing power output levels are required in every Navy weapon and platform system. Many such devices consist of a printed circuit board (PCB) bonded to a metal heat sink to remove heat from the board. There is potential for significantly improving the reliability of the device by eliminating the bond between the PCB and the heat sink. The goal of this topic is to demonstrate that a dielectric material can be fabricated with sufficient thermal conductivity to eliminate the need for a separate heat sink in the device. Concepts including monolithic materials such as aluminum nitride and/or novel composite designs should be considered. Beryllium oxide is suggested as the standard for comparison with new material concepts.

N89-096 TITLE: Reinforced Intermetallic Materials

CATEGORY: Exploratory Development

DESCRIPTION: Supersonic/hypersonic tactical missiles such as Standard Missile Upgrade are designed with fins and other external structural components that must operate at temperatures in the range of 2,000’F to 3,200’F. Few materials retain structural integrity in this temperature range. The family of intermetallics (aluminides, beryllides) hold some promise, and should benefit from fiber reinforcement that could provide structural stability at high temperatures combined with toughness during component fabrication and prelaunch handling. Proposals are sought with a demonstrated capability to fabricate intermetallic compounds, combined with an approach/work plan for demonstrating that reinforced intermetallic composites can be fabricated. Preliminary test data, sufficient to indicate the quality of the composites, should be provided to support implementation of Phase II effort.

N89-097 TITLE: Polymer Matrix Composite Heat Sinks for Electronic Devices

CATEGORY: Exploratory Development

DESCRIPTION: The Navy is currently supporting development of a Standard Electronic Module (SEM) as part of the Standard Hardware Acquisition and Reliability Program. In order to meet new design specifications, heat sinks will be required that have a thermal expansion in the range of 2.8 ppm/’F, and thermal conductivity of at least 250

W/M'K. These combined properties are not presently achievable in polymer matrix composites. Novel approaches are sought such as conductive polymers and/or metallic additions to the composite, which will meet these goals. The new heat sink should be amendable to standard polymer matrix processing.

N89-098 TITLE: Neural Net Software Applications

CATEGORY: Exploratory Development

DESCRIPTION: Knowledge-Based Systems are powerful software tools that can be used to solve complex problems in narrow areas of expertise. A user of a present day expert system can say he or she is 70% sure that a rule applies, but he or she cannot say that only 70% of the rule is correct. A neutral network can deal with the latter case. The neutral network implements this with a concept called "nearest neighbor classifier" of patterns, with the rules being interpreted as variations of patterns. Neural nets learn by example and by experience, and can recognize relationships between data that have no apparent correlation. Neutral network software can increase the power of knowledge-based systems by helping the system "learn" faster and with less human programming. This form of machine learning should make it much easier to develop expert systems in the future. The purpose of the project is to evaluate the level of maturity of currently available neural network software and demonstrate potential applications within the Navy where the best payback can be expected, such as front-ending expert systems. In addition, a detailed plan of actions should be identified for the design, development, and implementation of selected applications for use within the Navy. Phase II is to develop selected application packages, user assistance and documentation, and provide the necessary interfaces with the existing NAVSEA information resources. The offeror must be thoroughly familiar with both expert systems and neural nets.

N89-099 TITLE: Application of Fiber-Optic Local Area Networks (LANs) To Shipboard Voice Systems

CATEGORY: Engineering Development

DESCRIPTION: Innovative concepts are sought for the development of fiber-optic Local Area Network (LAN) based shipboard voice communication systems that would have the following attributes: (a) modular growth capability; (b) all fiber-optic interfaces; (c) both tactical and administrative voice traffic capability; (d) external interface (radio) capability; (e) high circuit availability (e.g., multiple-vendor open architecture using commercial/military standards).

N89-100 TITLE: Non-Acoustic Sensor and Guidance for Underwater Vehicles

CATEGORY: Exploratory Development

DESCRIPTION: The use of sound in sensor, guidance, and control applications in underwater vehicles limits capability growth by the inherent slow speed of sound in water and the physical effects of the ocean environment on sound propagation. Capability is needed to accomplish these functions using non-acoustic means. The objective of this effort is to explore and ultimately develop non-acoustic sensor capabilities along with the associated guidance and control for application in small, high-speed underwater vehicles.

N89-101 TITLE: Acoustically Damped Torpedo Propellers

CATEGORY: Advanced Development

DESCRIPTION: Torpedo propellers operate in a nonuniform flow and are subjected to time-varying water-induced forces. The interaction of these flow induced forces upon the propeller produce noise. If the marine propeller were constructed of damped materials, with improved damping properties, the level of the noise would be reduced. Many materials with good damping properties have been investigated, but most have insufficient strength and are very difficult to machine into a propeller shape. Proposals are solicited for the construction of a simplified test propeller

of a material with inherent good damping. The propeller will be approximately 9 inches in diameter and consist of four blades. The design will be supplied to the contractor. The studies should specify the material candidates along with the manufacturing technology rationale.

N89-102 TITLE: Measurement of Temperature and Pressure in an Underwater Explosion Bubble

CATEGORY: Exploratory Development

DESCRIPTION: There is currently a very strong interest in the use of metalized underwater explosives, but uncertainties exist about the timing of the reaction of the metal and the extent to which it contributes to explosive performance. The goal of this project is the development of a method that determines both the temperature and pressure of the explosive product gases as a function of time. The temperature can be expected to be as high as about 2,500'K and the pressure as high as 100 kilobars. Temporal resolution of 1 msec or better is desirable.

N89-103 TITLE: Expert System Application to a Commanding Officer's Cognitive Process

CATEGORY: Advanced Development

DESCRIPTION: Through all phases of an Anti-Submarine Warfare (ASW) engagement, the commanding officer (CO) is burdened with critical, time-dependent decisions. Data may be scarce or nonexistent, and current actions may depend on previous actions or events for a successful mission. A requirement exists to replicate the cognitive process of a CO by an expert system. A prototype software system built upon ASW mission phases is desired for possible implementation in future combat systems.

N89-104 TITLE: Intermittent Contact Evaluation

CATEGORY: Advanced Development

DESCRIPTION: There exists a need for the capability to evaluate sporadic sonar contact over long periods of time, such as 24 or 48 hours. A difficult problem faced by the Commanding Officer is the assessment of intermittent contacts, such that a number of related contacts can be converted into solid contact on the target of interest. A prototype evaluation technique or system is desired in order to demonstrate concept feasibility.

N89-105 TITLE: Underwater Range Data Display Upgrade

CATEGORY: Engineering Development

DESCRIPTION: Present displays of real-time range tracking data are done on color CRTs using separate X, Y (plan), and Z (depth) plots. This requires the viewer to integrate the two plots mentally in order to visualize the true picture. A three-dimensional (3-D) projection system would eliminate this process, making the situation clearer and more meaningful to the viewer. Offerors shall perform a literature search to determine the state of the art and the feasibility of applying holographic underwater range tracking data. It is envisioned that a satisfactory holographic display range tracking would initially be projected in a volume no larger than 3 x 3 x 5 feet in a dimly lit room. Computer-generated symbols for ships, submarines, torpedoes, aircraft, and other tracked objects (participants) would be displayed in 3-D in various colors. Variable persistence wake tails indicating speed and direction of previous motion would be appended to chosen symbols. The deliverance report should list"

1. All entries found in the literature search.
2. The state of the art of real-time 3-D data displays using holographic projection.
3. Techniques used for projecting holographic images.
4. Present image intensity in holographic displays.
5. Interfacing of computer-driven data to holographic projection systems.

6. Feasibility and cost estimate of applying holographic projection to display range tracking data. The feasibility and cost requirements, interfacing and software development, and integration requirements.

N89-106 TITLE: Detection of Bottom Deployed Mines

CATEGORY: Engineering Development

DESCRIPTION: There is a need to determine the optimum frequencies for use in a mine detection and classification sonar system. The optimum frequency will be not only a function of the degree of resolution required, but also will be a function of the size of the mine, the range desired, the scattering strength of the mine, and the bottom conditions. The purpose of this task is to conduct an experimental evaluation using various broadband sonar set operating at multiple frequencies and using various canister sizes as targets to determine empirically a matrix of trade-offs with respect to range, frequency, aperture, resolution, pulse length, and pulse shape. The deliverable product of this task is a final report describing the actions taken and the results, as well as a recommendation for follow-on action.

N89-107 TITLE: Technology for Development of a Mine Avoidance Submarine-Tethered Remote Operating Vehicle

CATEGORY: Engineering Development

DESCRIPTION: There is a need for a Remote Operating Vehicle (ROV) that will operate from and forward of a submarine to ensure an essentially safe path through a mine field. The ROV will consist of a sonar transducer and hydrophone array operating at multiple frequencies in order to provide long-range search, medium-range detection, and short-range classification capabilities. The ROV will be tethered forward of the submarine at a predetermined distance to detect and classify mines and relay the information by cable to a display aboard the submarine, thereby allowing time to maneuver. The coverage of the sonar set will be 180 degrees forward of the ship, with the capability of side-scan for 270 degrees coverage. The system will operate narrow-band for high resolution, and will provide a display of range, height-above-bottom, and three-dimensional imaging. The ROV will also be stored on the submarine when not in use. This task is to address a conceptual design. A subsequent task will be to prototype a complete system for evaluation at a Navy facility. The deliverable product of this task is a final report describing the actions taken and the results, as well as a recommendation for follow-on action.

N89-108 TITLE: Monolithic Composite Periscope Fairing

CATEGORY: Advanced Development

DESCRIPTION: Conduct an engineering feasibility study to investigate and recommend materials and compatible processes to replace existing periscope fairing assemblies with one-piece construction, water-resistant composites. The concept should be adaptable to various hydrodynamic shapes. The fabrication process shall be dimensionally controlled to eliminate final machining. The structure should demonstrate improved impact resistance and superior water absorption capabilities over and above conventional fiberglass.

N89-109 TITLE: Materials for Underwater Explosion Shock Wave Attenuation

CATEGORY: Advanced Development

DESCRIPTION: Conduct feasibility studies of using plastic materials and processes that lend themselves to the manufacture of closed-cell foams with high air volume, in the range 75% to 85%, to attenuate the shock wave produced by an underwater explosion.

N89-110 TITLE: High-Strength, Lightweight Torpedo Hulls

CATEGORY: Advanced Development

DESCRIPTION: Submarine-launched torpedoes currently use either cast or forged aluminum hull sections. Relatively thick hulls are required in order to withstand the hydrostatic forces encountered during deep-depth operations, and dynamic forces developed during shipboard testing. The thick hulls contribute significantly to the overall torpedo weight. Hull sections made of alternative materials are desired. The materials must have higher strength/weight and/or stiffness/weight ratios than the existing design, and must be competitive in manufacturing costs. The hull sections must be 21 inches in external diameter and no less than 19 inches in internal diameter. Penetrations for cables, access covers, etc., are required. Nonpermanent end joints are also required to permit torpedo disassembly.

N89-111 TITLE: Encoded Acoustic Transponder

CATEGORY: Engineering Development

DESCRIPTION: The loss of practice torpedoes and the compromising of weapon systems due to their recovery by foreign governments is of concern to the Navy. Improved systems are needed to ensure location and recovery of all losses. The desired device is an end-of-run locator which would respond only to an encoded acoustic message. This would prevent unauthorized personnel from locating lost torpedoes. Such a device would be applicable to all torpedoes and potentially to other systems. A detailed definition of system requirements and development of a high-level system specification is desired during Phase I.

N89-112 TITLE: Prelaunch/Postlaunch Torpedo Communications

CATEGORY: Exploratory Development

DESCRIPTION: Innovative concepts are desired which would provide an improvement over existing submarine-to-torpedo prelaunch and postlaunch communication systems. The existing prelaunch communication mechanism is via an umbilical cable ("A-cable"). The umbilical has a large 65-pin connector that is attached to the torpedo tube breech door and a smaller connector that is attached to the torpedo with shear screws. In addition to occasional electrical short circuits when the torpedo tube is flooded, excess time is required to complete all connections with the tube. Postlaunch operation involves: a) two-way communication via a single conductor guidance wire with seawater return; b) guidance wire payout concurrently from both shipboard and torpedo wire coils; and c) limiting of ship speed and maneuverability to avoid guidance wire fouling with either the ship's propeller or the towed array. Two solutions to these problems have been conceived but not developed:

1. Prelaunch communications via matching transformers.
2. Postlaunch communications via a short-range acoustic data link between two transponders which remain in close proximity after being deployed by the ship and torpedo.

Offerors are not limited to the above concepts and may address either the prelaunch issue, the postlaunch issue, or both. If both issues are addressed, separate proposals should be submitted.

N89-113 TITLE: Analysis of Electronic Warfare (EW) Programs to Support Mission Areas

CATEGORY: Management and Support

DESCRIPTION: The Assistant Chief of Naval Operations for Naval Warfare (OP-07) is directing the development of stand-alone Top Level Warfare Requirements (TLWRs) for Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), and Strike Warfare (SW). These will be followed by TLWRs for other major mission areas. As there will be no TLWR specifically addressing Electronic Warfare (EW), the requirement

exists to ensure that each Warfare TLWR includes EW architectures that effectively and efficiently interface with and provide improved combat next-generation EW systems requirements. This effort will include work sessions with both operational and technical experts, translate this knowledge by means of multi-attribute utility analysis, relative comparison techniques, computer models, cost-benefit analysis and other TLWRs and which support Program Objective Memorandum (POM)/Special Procurement Program (SPP)/Five Year Defense Program (FYDP) and other current and planned EW equipment performance and to provide recommendations for achieving required performance capabilities. Deliverables under this project shall include a listing of all EW programs prioritized by performance benefit and life-cycle cost; and cost/benefit curves depicting recommended order of procurement for specific EW equipments/capabilities.

N89-114 TITLE: Research Leading to a Low-Cost Traveling Wave Tube (TWT)

CATEGORY: Exploratory Development

DESCRIPTION: Present traveling wave tube (TWT) technology is labor intensive with high failure rates in manufacture. A second generation TWT, with a simplified design, capable of being produced with greater automation is required for expendable applications. Research would focus on demonstration and validation of designs and fabrication techniques that will lead to a second generation I/J band pulsed, low-cost, expendable TWT. Design to price goal is $2500.

N89-115 TITLE: Transportable RF Simulator for Electronic Support Measure (ESM)

CATEGORY: Engineering Development

DESCRIPTION: The Navy needs a transportable, programmable device capable of simulating a realistic electromagnetic signal environment at RF in the 2-18 GHz band for ESM system training and testing applications. The Navy is currently using a portable device known as the Training and Maintenance System (TRAMS) to train ESM operators in a simulated threat radar environment of up to 150 signals. A major drawback is that the system produces only a baseband video output with digital signal information. In order to fully test ESM receiver front ends, it would be desirable to add a radio frequency (RF) capability to the TRAMS (e.g., VCOs, synthesizer, etc.).

N89-116 TITLE: Passive Ranging Algorithm Using Electro-Optic Data

CATEGORY: Engineering Development

DESCRIPTION: An algorithm is required for passively ranging ships and other floating objects of interest using and electro-optic sensor. Many current passive electro-optic sensors do not readily provide range to objects that are being viewed. There is a requirement for a ranging algorithm that will operate on the output parameters of a scanning electro-optic system. Many of the classic ranging techniques are not applicable since they require multiple apertures, require resolution greater than that available from electro-optical systems utilizing discreet detector elements, or assume ideal conditions such as a stable platform, nonmaneuvering targets, or high signal-to-noise ratios. The contractor will 1.) compare existing passive ranging techniques or propose new techniques; 2.) analyze the most promising techniques, to include the effects of optical aberrations, detector element size and geometry, stabilization, uncertainties in the vertical reference, objects of unknown size, geometry, as well as maneuvering of both the ship platform and the viewed object; 3.) perform a computer simulation of the algorithm(s) to determine the effectiveness of the algorithm under diverse operating conditions; and 4.) prepare a computer software block diagram demonstrating an implementation methodology of the algorithm in a general-purpose computer.

N89-117 TITLE: Advanced Technology Applications for Electronic Support Measure (ESM) Receivers

CATEGORY: Advanced Development

DESCRIPTION: Current shipboard Electronic Support Measure (ESM) receivers were developed to detect conventional range tracking pulse radars. Advances in radar technology (spread spectrum, low power, very short, and very long pulsewidths, frequency agility) and emitter density and electromagnetic interference (EI) problems drive new requirements for future receiver designs. An in-depth study is required that addresses the trade-offs and affordability of various receiver architectures, considering the availability of advanced technologies such as MIMIC, GaAs, DRFM LSI modules, acosto-optic, microscan/compressive techniques, and azimuth-frequency mapping. Study shall evaluate technical risks, performance gain, EMI immunity, signal management, and cost factors. Phase II shall include the brassboard development of critical elements in the receiver architecture.

N89-118 TITLE: Research in Support of an Improved Traveling Wave Tube with Extended Shelf Life

CATEGORY: Advanced Development

DESCRIPTION: Present traveling wave tubes (TWTs) were designed for immediate use in applications requiring frequent radiation of the tube. When stored for long periods of time or when not energized regularly, their vacuum envelopes degrade, leading to tube failure. Design/manufacturing improvements are required leading to a tube that is capable of prolonged shelf life (greater than 5 years) without the need for periodic degassing of the vacuum envelope.

N89-119 TITLE: Direction of Arrival (DOA) Sorting Antenna Array

CATEGORY: Advanced Development

DESCRIPTION: Radar Pulse Sorting in Electronic Support Measure (ESM) systems is often done using only frequency, pulse repetition interval, and pulse width as sorting parameters. Direction of arrival (DOA) is another signal parameter than can be used when monopulse techniques are employed to allow each pulse to be tagged with DOA. However, multipath can significantly degrade the accuracy of the measured DOA. Purpose of the project is to develop an antenna array that will provide radar pulse-to-pulse (monopulse) direction of arrival pulse sorting in a near sea surface, severe multipath environment. The array must fit into a package less than 8 inches in diameter and cover the SHF and EHF bands.

N89-120 TITLE: Tactics Development for Coordinated Usage of Onboard/Offboard Electronic Warfare (EW) Systems

CATEGORY: Exploratory Development

DESCRIPTION: Various onboard and offboard EW systems (Electronic Support Measures (ESM), AECM, DECM, and Decoys) have been developed for shipboard use in naval warfare. Generally, these systems are employed as stand-alone methods by single ships for anti-ship missile defense (ASMD) and counter-targeting (false targets, confusion, deception) purposes. Few (if any) tactics are available to warfare commanders that provide guidelines for coordinated employment of all EW assets available in multi-ship scenarios or which provide the tactical commander the most effective utilization of assets throughout each phase of the engagement. The requirement exists for a two-phased analysis that would determine technical feasibility and approach for coordinated multi-ship cooperative countermeasures. Phase I would include threat analysis (performance and vulnerabilities) and analysis of friendly-force capabilities. The objective of this phase is to identify deficiencies in current capabilities and provide preliminary recommendations of proposed cooperative tactics. Phase II results would provide detailed recommendations for employment of coordinated tactics, including trade-off analysis of technical risk/performance and cost/schedule impacts. This study should include (but not be limited to) combination of techniques such as false target generation, cooperative “blinking,” blip enhancement, AECM (ownship/multi-ship/offboard helo), DECM/Decoy Integration (DDI), Ship Automated Decoy Integration (SADI), and counter-ARM techniques.

N89-121 TITLE: Functional Recognition of Radar Signals

CATEGORY: Exploratory Development

DESCRIPTION: The Navy requires a functional radar signal recognition capability to enhance radar threat warning capabilities aboard submarines. Increasing computer capability and years of building databases have led the Navy to providing a submarine Commanding Officer with specific emitter and platform identification to make threat/non-threat determinations. Prior to computer-based systems, Electronic Support Measure (ESM) operations were trained to identify radar emitters using a ser of "thumb" rules to report the emitter type (function). This process has not been mechanized in our computer-based systems. These "thumb" rules need translation into algorithms for Navy systems so that an emitter is identified and reported by function. To meet the functional radar signal recognition requirements of the Navy, the contractor should:

1. Identify all functional recognition categories and determine the ranges of each parameter in the category.
2. Determine the impact of any parameter not measured by the system on functional recognition and identify possible solutions.
3. Define threat in terms of radar function and develop a decision tree for contact reporting.

N89-122 TITLE: Develop Database of Potential Electronic Warfare (EW) Non-Developmental Items

CATEGORY: Advanced Development

DESCRIPTION: A requirement exists to develop a computerized list (PC compatible) of Electronic Warfare Directorate applicable Non-Developmental Items (EWNDI) with sources, major characteristics (e.g., voltage, frequency, environmental capability), and available data (e.g., test, storage, reliability). This effort should include state-of-the-art hardware with the following examples of EWNDI: high-voltage power supplies, thermal batteries and seawater batteries, and lithium batteries, traveling wave tubes, delay lines (optical), photo diodes, transmission components etc. The purpose of this list, whose extent is currently unknown, is for use in Government Requests for Proposals and to provide cost-effective alternatives to design and development in future contracts.

N89-123 TITLE: Quantitative Lubricating Oil Debris Monitoring and Analysis

CATEGORY: Advanced Development

DESCRIPTION: With the development of new, technically advanced gas turbine engines and high-speed diesel engines, the need to monitor critical parameters such as lubricating oil system debris is a necessity. Oil debris monitoring is now an established technique used throughout the aircraft industry to detect incipient failures of oil-wetted components in gas turbine engines. Oil-wetted components wear and fail by the removal of material from their load bearing surfaces. Figures available for gas turbine engines state that approximately 30% of all engine failures are caused by metal particulate contamination in lubricating oil systems. Quantitative debris monitoring permits the early detection of lubricating oil system particulate contamination and impending component failures. Spectrographic oil analysis is the most widely used and accurate oil monitoring and analysis method. Because these spectrographic analyzers are large in size and very expensive, only a few laboratories have them. As a result, oil samples must be transported long distances in order to accurately monitor oil chemistry, thus limiting the timeliness of the information received. Proposals should address the development of a portable spectrographic lubricating oil analyzer that could be located conveniently onboard a ship or carried from ship to ship. Proposals should address development feasibility, design, installation, testing, and implementation, as well as contain a plan of action and milestones to complete the task.

N89-124 TITLE: MK 6 Life Raft Improvements

CATEGORY: Engineering Development

DESCRIPTION: Operational requirements of US Navy Ships dictate improvements to the existing MK 6 life rafts. Life rafts, as a lifesaving device, must have extremely high reliability requirements. Current MK 6 life raft design experiences nominal inflation failures caused by inadequate containment of the life rafts to take rough treatment during transportation and stowage and inherent inflation system design shortfalls. Proposals are sought on the following:

- **a.** Improved methods to encapsulate the life rafts.
- **b.** Provide a completely reliable inflation system.
- **c.** Reduce cost of and improve recertification program.

Phase I will be a design study detailing the improvements. Phase II will require fabrication of a prototype for a sea testing. Although an existing life raft can be provided as a test platform and as the core around which the improvements are designed, a completely new life raft design developed as a result of this study could also be considered.

N89-125 TITLE: Shipboard Composites

CATEGORY: Exploratory Development

DESCRIPTION: The Navy currently uses machinery foundations and other ship components made of various steels which require high level of maintenance in order to control corrosion. These components also contribute to the overall weight of the ship. Modern materials such as glass-reinforced plastic (GRP) and graphite composites offer properties such as strength-to-weight ratios and resistance to corrosion which could make them attractive alternatives to steel for use in some shipboard applications. Proposals are solicited for applications of composites to shipboard use. The proposed effort would produce a system concept definition including a trade-off study of proposed materials and a comparison with those currently in use in order to define requirements, limitations, advantages, and disadvantages of each in the marine engineering environment. Also included would be a survey of potential applications for these composites in the shipboard environment.

N89-126 TITLE: Docking Blocks Technology

CATEGORY: Engineering Development

DESCRIPTION: Docking blocks used in drydocking US Navy ships are presently constructed of wood (and also, at times, steel and concrete). The blocks must be custom cut and fitted for each docking. Also, the proper wood is difficult to obtain, it’s properties vary widely, and it’s condition after extended use is difficult to judge. A dependable, cost-effective alternative to the present blocking system is needed. The Phase I effort would include identifying existing methodology and requirements and developing approaches for designing and testing alternatives. Phase II would implement the development and testing of one or more innovative blocking systems.

N89-127 TITLE: Low-Frequency Vibration and Acoustic Measurements

CATEGORY: Engineering Development

DESCRIPTION: Provide technical analysis for the development of a measurement standard for the extremely low-level frequency measurement range: 2 Hz to 10 Hz vibration, with applied acceleration to 10g at +-1.5% uncertainty and 20 Hz to 50 Hz acoustic signals with +-0.2 db uncertainty, in the presence of high sea-noise levels. Vibration measurements are extremely critical to ship silencing and failure prediction systems aboard submarines (such as the SSN-21) and surface ships. Isolation from unwanted vibrations is required for ship silencing inertial navigation instruments, ultraprecision machining operations, and pointing and tracking systems. The TRIDENT SSBN 76 Class Vibration/Noise Monitoring System is an example. Systems such as this support ship silencing programs, assess the effectiveness of noise isolator designs and define acoustic noise sources in underwater weapon systems. These

systems usually employ accelerometers that depend directly on calibration sources and standard accelerometers to simulate/calibrate vibration modes. The requirement is to achieve the best sensitivity and lowest uncertainties attainable. Underwater weapon system test facilities utilize acoustic transducers and hydrophones to performance test hull designs, torpedo launch tube designs and missile target simulators. They are also used in Navy range operations where submarine and weapon structure-borne and airborne noise sources are monitored for noise signature analysis and noise reduction projects. Measurements are required to reach the lowest possible levels to achieve effective noise reduction results. Transducer and hydrophone calibration is at the heart of system improvements. Current techniques and equipment are inadequate and limit program accomplishments. Improved methods and systems are needed for more accurate measurement of wider acoustic bandwidths, sound pressure, acoustic intensity, and radiated sound power. Calibration methods and systems are nonexistent for sound intensity (sound pressure x particle velocity) transducers and reference sound sources used for sound power comparison measurements.

N89-128 TITLE: Database Architecture for Battle Force Tactical Training

CATEGORY: Advanced Development

DESCRIPTION: The ability to generate an accurate and plausible scenario for Battle Force tactical training is dependent on the quality and quantity of data from which to select. There are numerous databases in use today that support the unique requirements of individual training systems. To fully support battle force tactical training, a scenario author should have a means to access all of these existing databases. Since these databases are in different programming languages, in different levels of detail and serve different purposes, a means to assimilate, translate, and correlate them is required. This requirement is to design an architecture that will support combining and collating the variety of data currently available. This architecture should also permit addition of new data as it becomes available. The architecture should utilize a higher order language (HOL) and commercially available computers and peripherals.

NAVAL SURFACE WEAPONS CENTER/WHITE OAK LABORATORY

N89-129 TITLE: Biodegradation of Heavy Hydrocarbons

CATEGORY: Exploratory Development

DESCRIPTION: Some eight bacteria have been isolated which utilize asphalt-20 as a substrate. The interaction has been studied. It appears that the interaction with the substrate is complex; it involves the production of a surfactant and possibly an enzyme. The thrust of this topic is twofold: the production of the surfactant should be enhanced and the possible enzymatic interaction clarified.

N89-130 TITLE: Laser Optical Detection of Dynamic In-Plane Mechanical Displacements

CATEGORY: Exploratory Development

DESCRIPTION: Conventional optical interferometry has been shown to be suitable for the detection of the out-of-plane displacement of ultrasonic waves propagating in solids. In thin plates the in-plane displacements characterize the modes bearing useful information on the elastic stiffness properties. Proposals are sought for optical techniques and fiber-optical devices for detection of such displacements in carbon and metallic composites. Considerations should be given to the effects of material surface conditions (e.g., highly absorbing, specularly reflecting, diffusely scattering), bandwidth, and signal-to-noise problems associated with measuring small displacements in a non-ideal environment.

N89-131 TITLE: Shock-Resistant Circuit Breakers

CATEGORY: Engineering Development

DESCRIPTION: Circuit Breakers with improved resistance to high impact shock are of interest for use in 120 volt, 50 ampere (max) circuits. The shock environment is a broad spectrum of frequencies. Variants of design and/or new concepts leading to improved performance are sought. Technologies may include conventional designs augmented by magnetic, shape memory alloy, spring force, mechanical, or other components. A successful device will preclude unintended opening of the breaker due to shock without inhibiting normal actuation of the breaker. Simplicity of concept is preferred. The Naval Surface Warfare Center (NSWC) will perform shock tests on prototype devices at no charge to the successful proposers.

N89-132 TITLE: Synthesis and Characterization of High Purity Explosive Compounds

CATEGORY: Advanced Development

DESCRIPTION: A need exists for a supply of individual samples of a wide range of nitrodiphenylamino-N-nitroso compounds of optimal purity and of detailed structures characterization by chromatographic behavior (HPLC, g.c.), nuclear magnetic resonance spectroscopy (1H, 13C, and 15N), FTIR high resolution, mass spectrometry and UV-vis spectra. Specifically, mono, di, tri and tetranitrodiphenylamine-N-nitroso compounds are desired. Standardized procedures should be established for region-selective nitration of diphenylamine and optimal conditions for N-nitrosation of nitrated diphenylamine samples. Longer term goals will focus on the course and kinetics of thermal decomposition of representative members of the mono, di, tri, and tetranitrodiphenyl amine-N-nitroso derivatives. Another desirable goal is the synthesis of 13C enriched analogs of several of the key compounds.

N89-133 TITLE: Non-Carbon Based Energetic Systems

CATEGORY: Research

DESCRIPTION: The overall objective of this proposed project will be to provide the basic knowledge and understanding required to achieve high energy-density performance combined with a high degree of insensitivity in new non-carbon based energetic material systems. The object of this project is to devise a method of estimating heats of formation for organic compounds containing boron, nitrogen, phosphorous, fluoride, oxygen and/or hydrogen. The end result of the project should include or make possible the derivation of bond energies for single or multiple bonds between the aforementioned elements. The effort may include, but is not limited to, the compilation of heats of formation in the scientific literature and the calorimetric determination of heats of formation of model borazine and phosphazene compounds.

N89-134 TITLE: Evaluation of X-ray Microtomography for Energetic Materials Characterization

CATEGORY: Research

DESCRIPTION: Recent progress in three-dimensional X-ray microtomography (e.g., Science 237, 1439, 18 Sept 1987) suggests that the technique holds considerable promise for the characterization of explosives and solid propellants in terms of filler particle size distributions, size distributions of voids produced during manufacture or service life, mixing inhomogeneities and particle composition. The proposed evaluation should try to establish the capabilities of this technique with both the synchrotron and the laboratory X-rays sources for particle size distribution measurement (resolution and accuracy), for particle and homogeneity mapping, for particle composition determination and for void sizing and mapping. Actual demonstration of capabilities on inert propellant or explosive simulants is highly desirable. (Inert simulants can be supplied by the Naval Surface Warfare Center (NSWC).

N89-135 TITLE: Radiation Transport Codes for Mini-Supercomputers

CATEGORY: Exploratory Development

DESCRIPTION: Radiation transport programs are presently computer limited, for example, in predicting fields from 100 weapons stored aboard an aircraft carrier, or in transporting a particle beam through the atmosphere and predicting it's reactions with a missile structure. As a result, the complexity of the physical model and the number of different situations studied fall short of what is needed. Radiation transport physics lends itself to efficient modeling on parallel processor machines. The desired result is the statistical combination of many independent events, and locating the events in three dimensions (four if time-dependent), and it can benefit greatly from the fast attached processors. Therefore, programs designed for these machines will find immediate use in solving radiation transport problems. Computer programs that predict weapon nuclear radiation amounts and their effects on shipboard personnel or systems are needed. These codes should make use of the new parallel processors such as Digital's Polestar or Weitek's XL-8000.

N89-136 TITLE: Development of Bulk-Density A1203 Thin Films

CATEGORY: Exploratory Development

DESCRIPTION: The Navy has a need in a variety of applications to fabricate thin A1203 films which have the density of the bulk material (3.97 gm/cm3) and are uniform in thickness. A request for proposals is made for development of a technique for which a thin film can be produced having thickness between 100 and 1000 nm. Films of this type shall be manufactured and delivered to the Naval Surface Warfare Center (NSWC). The linear thickness of each film shall also be provided. Film densities will be verified at NSWC. Substrate materials should consist of low atomic number elements, preferably carbon or silicon.

N89-137 TITLE: Non-Lethal Anti-Swimmer System

CATEGORY: Exploratory Development

DESCRIPTION: A requirement exists for the design, development, and demonstration of a non-lethal anti-swimmer device/weapon capable of deterring a casual underwater swimmer from entering an area of restricted water. Since the device would be used against a swimmer during peacetime and possibly in a foreign harbor, the device can render only temporary discomfort, causing the swimmer to surface and to promptly leave the restricted area. The device would not cause any permanent or temporary damage to the swimmer. The device must be effective to greater than 200 yards and portable, less than 50 pounds.

N89-138 TITLE: Holographic Optical Element Fabrication

CATEGORY: Exploratory Development

DESCRIPTION: Holographic Optical Elements provide a means of reducing the size and weight of optical signal processing systems for use in such applications as missile seekers and other airborne weapon systems. Simple, economical, integrated, computer-aided design, and fabrication systems are required to allow practical experimentation and development of widespread application of holographic optical elements as replacements for conventional optical elements.

N89-139 TITLE: Shock Hardened on-Board Data Acquisition System

CATEGORY: Exploratory Development

DESCRIPTION: Develop a compact, rugged, 12-channel minimum, on-board digital data acquisition system, capable of measuring and recording shock experiences associated with weapon delivery and use. Shock experiences to be measured will include: bomb rack ejection, parachute or fin opening, water entry, bottom impact, target impact, counter mine, etc. The system shall be self-contained, packaged as small as possible, and may be of modular design. Each module must contain at least four data channels and typically by 2-1/2 inches maximum dimension. The system shall be powered from internal batteries, and capable of one month of data storage. The system shall measure and store data of appropriate amplitude from analog devices at programmable sampling rates up to 10 kHz data for 400 ms or 200 Hz data of equivalent duration. The data shall consist of 12 bit words of A/D data. Each data channel shall have separate triggering criteria which are software selectable and include such parameters as threshold level, filtered level, and integrated record level. Elapsed time to enable criteria and capture of reference baseline (pre-trigger data capture) shall also be provided. The system shall survive and operate after exposure (25 or more times) to all re-test test, and post-test environments (vibration, shock, temperature, humidity, pressure) associated with its use. Pre-test setup and post-test data retrieval shall be compatible with an IBM PC-AT or equivalent computer. Design considerations shall include possible expansions/use of this system as an on-board vibration and temperature digital data acquisition system.

N89-140 TITLE: Maneuvering Re-entry Body Packaging and Synthesis Computer Program

CATEGORY: Exploratory Development

DESCRIPTION: Future missions of the Navy's Submarine Launched Ballistic Missiles may require the development of new maneuvering re-entry bodies. The required aerodynamic performance is a major factor in determining the external shape of the body. Both size and shape of the body are determined in part by the internal components that must be packaged within the body. A computer program is desired that will aid in developing the size and shape of a maneuvering re-entry body for specified required performance and specified internal components to be packaged. It is desired to determine the optimized size and shape for one of several pertinent criteria.

N89-141 TITLE: Software Reliability Indicators in the Requirements and Design Phase

CATEGORY: Advanced Development

DESCRIPTION: This task will involve the investigation of software metrics and indictors of software reliability that can be applied in the early stages of a program's development. Specifically targeted is the requirements and design phase. The task will involve investigating proposed approaches in the literature, developing new approaches or modifying existing ones for application in a software environment that develops both real-time fire control system software, and supporting general-purpose software such as trajectory simulations. The task will also entail developing a PC-based implementation of the tool and the demonstration of the use of that tool.

N89-142 TITLE: Improved Computer-Aided Software Engineering Technology for Embedded Computer Systems

CATEGORY: Advanced Development

DESCRIPTION: Even though today's Computer-Aided Software Engineering (CASE) products have brought some improvements to the software development process, they have deficiencies which limit their effectiveness. Some of these deficiencies are: poor user interface, documentation inadequacies, methodology constraints, and administration difficulties. Innovative ideas that could alleviate these deficiencies are requested. Proposals must identify the deficiencies to be addressed, supply supporting rationale, and provide a plan capable of producing strong results indicating that such deficiencies can be resolved. Proposer must demonstrate experience in manufacturing CASE tools and developing real-time embedded software.

N89-143 TITLE: Infrared Radiometry of Dynamic Targets

CATEGORY: Exploratory Development

DESCRIPTION: Respondents should propose a task to design and develop radiometers to measure the infrared signature of test targets. The Navy has a continuing problem in verifying the infrared signature of test targets moving at speeds corresponding to Mach numbers from 0.5 to 4.0. These test targets include missile, towed bodies, drones, and aircraft. Often the targets are augmented with directionally dependent sources and their signature is influenced by orientation, flight dynamics, range and weather. Both point and resolvable targets are important and continuous data collection is required.

N89-144 TITLE: Bistatic ASW Operations in the Year 2000

CATEGORY: Engineering Development

DESCRIPTION: This Anti-Submarine Warfare (ASW) study will consider planned developments in surface ship sonars and offboard sensors while using threat projections for the year 2000. Summary error analysis will be performed to consider the effects on bistatic detection, classification, and localization for such factors as sensor placement, uncertainty, sensor insertion, time lates, target characteristics, sensor type, source usage, range, environment, and algorithm selection. The sensitivity of detection algorithms to long-range signal propagation and target scattering characteristics is of particular interest and shall be considered in detail. Study conclusions should address the overall usefulness of bistatic systems to future ASW prosecutions and my include recommendations for innovative source and sensor designs. (Clearance Required to SECRET level).

N89-145 TITLE: Automated Signal Processing of Sonar Sensor Data

CATEGORY: Engineering Development

DESCRIPTION: There is an increasing need for automation of Naval Ship Systems in order to assist operators in complex decision-making processes. Needs are for automated expert system, real-time signal processors of active high frequency (30-600 kHz) sonar data as related to an obstacle avoidance system and passive low to mid-frequency sonar data for application in a threat detection system. These systems must use the data from the sonar for detection, tracking and basic classification of the target in a realistic signal-to-noise ratio environment. An artificial intelligence/expert system approach with emphasis on fault tolerance to the control of the sensor processor and a low false alarm rate are primary concerns. Also a high reliability is required with a high Mean Time Between Failures (MTBF).

N89-146 TITLE: Fabrication of Continuously Reinforced Carbide and Boride Ceramics

CATEGORY: Exploratory Development

DESCRIPTION: Refractory ceramics, such as the carbides and borides of zirconium and hafnium, have been explored for use in high-temperature environments, such as rocket nozzles. Success has been limited due to the limited thermal stress resistance of such materials. The use of continuous fiber reinforcement has been shown to dramatically improve structural properties in brittle materials. The fabrication of continuously reinforced carbides and borides with chemical vapor infiltration (CVI) methods has been attempted, but has shown limited success. Metal halides produced surface coatings, but little in-depth ceramic deposition. Innovative methods of fabricating continuously reinforced carbides and borides are desired. The method must be capable of preserving the structural integrity of the fibers, provide compositional control of the matrix, and be demonstrable for parts of one-quarter inch thickness or greater. One possible approach would be the development of zirconium and/or nafnium based organo-metallic compounds for CVI processing of fiber preforms.

N89-147 TITLE: Polyurethane Foam Propellant Containers and Coolant Sleeves

CATEGORY: Exploratory Development

DESCRIPTION: Polyurethane foam wear reducing jackets have been used with the large caliber Navy guns since the mid-1960's. The formulation, based on Canadian Patent No. 742,908 was also used to make propellant containers with the intention of replacing the cloth charge bags. The current formulation, still based on this technology from the mid-1960's contains castor oil, a natural product whose characteristics and availability are not consistent, and 2,4 tolylene disocyanate (TDI), a toxic reagent. Utilizing state-of-the-art polymer and materials technologies, candidate replacements for the castor oil and the TDI will be identified. Also, methodologies for imparting electrical conductivity to a level effective for static charge dissipation will be identified. Materials will be formulated and evaluated in terms of cost, processibility and physical characteristics relevant to functional performance.

N89-148 TITLE: Reaction Efficiency of Aluminum in Explosives

CATEGORY: Research

DESCRIPTION: The use of metals in explosives offer a means of increasing the available energy and hence, for some applications, the performance of the explosive. Although aluminum is used in many explosive formulations, there is very little data to indicate whether there is preferred oxidant for aluminum that would increase the efficiency of the aluminum oxidation. The goal of this project is to generate data that will indicate whether the efficiency of aluminum oxidation can be improved by controlling the oxidant species. The techniques used might include but are not limited to, detonation calorimetry and cylinder tests. Oxidants to be considered should include both oxygen- and fluorine-containing species.

N89-149 TITLE: Software Intensive Systems Reverse Engineering

CATEGORY: Exploratory Development

DESCRIPTION: The innovation sought in this topic is a methodology and computer-assisted implementation of the techniques to capture the specification from actual, existing, functionally correct software-intensive systems. The capture should use all relevant, available information from all sources, such as code and documentation to perform the specification recapture. Particular attention should focus on the source language (such as CMS-2), the language that will capture the specification, the ability to forward engineering to a new language (such as Ada) and the new systems with emphasis on parallel and distributed architectures. This methodology/tool should be applicable to design as well as later life-cycle management.

N89-150 TITLE: Non-Aqueous Battery

CATEGORY: Research

DESCRIPTION: The performance of magnesium batteries is limited by negative effects related to the presence of water. These are (a) voltage delay caused by anodic films, and (b) parasitic reactions of magnesium with water forming hydrogen gas, thereby reducing the energy density. To eliminate these negative characteristics of aqeous batteries, it is proposed to explore the potential of water-free magnesium anode electrochemical systems, which will provide the following advantages: (a) gasless, no hydrogen formation, (b) no anodic protective coating needed (eliminates one cause of voltage delay), (c) elimination of parasitic magnesium/water reaction and anode lass, and (d) elimination of magnesium hydroxide films, which also cause voltage delay. Research aimed at eliminating magnesium battery corrosion problems is sought. Respondents should describe the electrochemistry of their approach and should perform studies or experiments to indicate the likelihood of success in a Phase II continuation.

N89-151 TITLE: Catalytic Metallo Macromolecules

CATEGORY: Research

DESCRIPTION: Several new catalytic materials, including a variety of metallo phthalocyanines, porphorins, tetrazanulenes, etc., have been developed that dramatically enhance the capacity and rate capabilities of lithium-thionyl chloride batteries. This catalytic process is not understood. The proposer should be able synthesize a variety of inexpensive metallo macromolecules, stable and preferably insoluable in LiA1C14-SOC12 battery electrolyte. Research to indicate the probability of one or more of these successfully improving battery performance will be conducted and reported.

N89-152 TITLE: Safety Aspects of Lithium Rechargeable Batteries Utilizing SO2-Based Electrolytes

CATEGORY: Exploratory Development

DESCRIPTION: The Navy wishes to develop rechargeable batteries utilizing lithium anodes in the potentially high-power, high-energy, SO2-based electrolyte. The goal of this effort is to elucidate aspects of cell performance impacting on safety during normal, nonabusive cell cycling. The proposer should define approaches to overcome safety problems and should perform or plan tests to confirm his solution.

N89-153 TITLE: Dual Band Infrared Discrimination Techniques

CATEGORY: Exploratory Development

DESCRIPTION: Shipborne infrared search and track (IRST) systems are needed to fulfill the Navy's requirements for air threat detection and designation in the short-range Anti-Air Warfare (AAW) defense scenario. The pressing technical problem in IRST development is that of automatic target declaration in the presence of sea and sky background clutter. Present IRSTs operate only in a single spectral band in either the 3-5 micrometer or 8-12 micrometer region. This effort would investigate the performance improvement to be realized by utilizing both spectral bands. Tasks to be preformed include (1) an analysis of the detection capability of each band in the presence of clutter, (2) a comparison between bands of performance under various meteorological conditions, and (3) development of dual band target performance. The final product would be signal and data processing algorithms for optimal dual band IRST operation. It should be understood that the dual band algorithms must involve the most suitable sub-band in the 3-5m band in combination with the most suitable sub-band in the 8-12m band.

N89-154 TITLE: Dual Band Infrared Discrimination Techniques

CATEGORY: Exploratory Development

DESCRIPTION: The productivity advantages of using computer-aided diagrammatic vice textual language for software design has been demonstrated experimentally. A fundamental question that arises is whether or not the "direct use" of diagrammatic language in the later stages of software development would further increase productivity. By direct use is meant the automated production of executable code from design and implementation level diagrams in such a manner that the developers are not exposed to a conventional text language. The primary data needed to resolve this question are development time, level of effort, and quality of the final, tested computer programs for diagrammatic versus textual methods.

N89-155 TITLE: Hierarchical Computer Architectures

CATEGORY: Advanced Development

DESCRIPTION: In recent years a number of special-purpose parallel computer architectures have been developed for various computer time-intensive classes of problems. Examples include array processors, associative processors and data machines. Yet very little has been done to address the need of a broad class of problems involving hierarchical decomposition, including tree search, dynamic programming, game theory, etc. There is a need for inexpensive parallel architectures involving hierarchal processor and memory organization at the level of hundreds to thousands of CPUs using standard bus interfaces, e.g., MULTIBUS II.

N89-156 TITLE: Fiber Optic Sonar Dome Pressure Transducer

CATEGORY: Exploratory Development

DESCRIPTION: Surface vessels require that sea water pressure in the sonar dome be monitored accurately. A fiber optic pressure sensor with a range of 0-100 psig that is accurate in all types of shipboard environments (shock, vibration, thermal) over long periods of time without recalibration and is perfectly lead insensitive (immune to cable bending effects) is required. The signal conditioner used with this sensor would also be capable of transmitting the pressure data digitally via fiber optics to remote displays located throughout the ship. System must utilize 9/125 single-mode fiber at 1300rm.

N89-157 TITLE: A High Order Meta Model for Systems Development

CATEGORY: Advanced Development

DESCRIPTION: The manager, faced with the task of developing a complete information system, such as combat system or a weapons subsystem, from recognition of need to deployment, finds that the system model undergoes significant metamorphosis as it progresses through the life cycle phases. However, it is obvious that all of the specifications are about the same system and the same components (data, operations on the data, and the control placed over the operations). There is therefore a desire to identify more generalized abstractions that would allow the mapping of local views of the components as they progress through the life cycle. This work would examine some of the existing models used in various life cycle phases, publicized documentation standards (e.g., 2167A), and analogous models in other disciplines to formulate a “higher order” entity relationship attribute model. A model is required that captures the essence of the various models into a higher level unified form from which the others could be derived.

N89-158 TITLE: Standardization of Programming and Instructions for Information Systems Users

CATEGORY: Advanced Development

DESCRIPTION: Tools for development of information systems, such as combat systems and their embedded subsystems, include the linguistic culture that the tool developers thought was ideal for the purpose. However, the vocabulary embedded in the tool is often foreign to the users of the tool. The advent of the Entity Relationship Attribute (ERA) model has made the structure of the culture more understandable to the end users. This still does not solve the problem of having an ”alien” culture or vocabulary with which the user must deal. An ideal culture would be gleaned from examining the statements, specifications, or conversations that the user has with his/her peers about the system. Using techniques of library information storage and retrieval, the user’s vocabulary can be extracted from such textual material, and the familiar culture defined. The user can then begin to define his/her systems in the very familiar and appropriate vocabulary which as been formalized in this culture. The required work involves examining the tools and the techniques available for the extraction and definition of cultures and providing an appropriate approach.

N89-159 TITLE: Automated Integrated Navigational System

CATEGORY: Engineering Development

DESCRIPTION: There is an increasing need for automation for Naval ship systems in the area of integration of navigational sensors and devices. An artificial intelligence/expert system type of control and integration of a Correlation Velocity Log (VCL) and altimeter, Ring Laser Gyro (RLG) keel depth sensor, orientation sensors (yaw, pitch, roll), and Global Positioning System (GPS) or an equivalent update is desired. The system must interface with a controller for navigation of an underwater vehicle in real time. Fault tolerance and reliability with a high Mean Time Between Failures (MTBF) are primary concerns.

N89-160 TITLE: Artificial Intelligence Based Target Recognition

CATEGORY: Exploratory Development

DESCRIPTION: Target recognition is one of they key components of an autonomous weapon system. This system is intended to remove man from the process of target acquisition and recognition. One approach to the development of a hybrid image understanding system may include one or more neural networks for feature extraction and recognition. An alternative would be a knowledge-based approach to image interpretation using semantic, context, and problem domain. These techniques, or their combinations, could greatly increase the probability of detecting features or targets from the sensory data. Emphasis should be placed on those techniques which will result in a real-time target recognition system.

N89-161 TITLE: Photodetectors for Optical Signal Processing

CATEGORY: Exploratory Development

DESCRIPTION: Ultra-high speed optical signal processing systems still require a photodetector such as a CCD array at the image plane to sense and record the output. This creates a bottleneck at the optical interface. Major improvements in two-dimensional output detectors are necessary in terms of spatial sampling, resolution, temporal sampling, dynamic range, geometric fidelity, and processing and storage techniques for reducing output data rates. Offerors should consider a systems approach which includes the detector array and an integrated digitized or data transformation and buffering system.

N89-162 TITLE: Nonlinear Transforms for Optical Signal Processing

CATEGORY: Exploratory Development

DESCRIPTION: Optical systems provide true parallelism and thus great speed advantages over electronic systems in a great number of signal processing applications. Linear operations such as correlation, convolution and fast Fourier transform processing are relatively easy to implement. Many signal processing techniques required to support radar and sonar applications require nonlinear transforms, such as the log function, as part of their operation. New concepts and techniques for nonlinear optical processing are required in order to perform nonlinear transforms such as the log function in real time.

N89-163 TITLE: High Performance Modulators for Optical Signal Processing

CATEGORY: Advanced Development

DESCRIPTION: Optical signal processing allows processing of radar and sonar data in real-time. This is accomplished through the use of devices that can convert an electrical signal instantaneously into a spatial modulation of an optical signal for processing with standard Fournier optics. The most useful devices are the acousto-optic modulator, which converts data from the temporal domain to the spatial domain, and the electronically addressed spatial light modulator, which performs incoherent to coherent signal conversion. New high performance acousto-optic modulators that combine large bandwidths with high diffraction efficiencies are required. New

electronically addressed spatial light modulators that provide good resolution, high contrast and high update rates are required.

N89-164 TITLE: Concepts for Advanced Deep-Strike Cruise Missile Damage Assessment

CATEGORY: Exploratory Development

DESCRIPTION: Emerging capabilities for cruise missiles to attack land targets at very long ranges pose a significant damage assessment problem. Among the potential approaches to this problem are various over-the-horizon communications from the missiles, imagery techniques, and fly-out-and-look. Concepts are being sought that represent new approaches to this problem or feasible implementations of existing capabilities. Proposals should include concepts for managing the data flowing back into the Battle Group and associating this data with particular missiles, as well as the hardware that collects the data.

N89-165 TITLE: Advanced Deep-Strike Cruise Missile Autonomous Target-Scene Interpretation and Decision Making

CATEGORY: Exploratory Development

DESCRIPTION: Emerging capabilities for cruise missiles to attack land targets at very long ranges pose a targeting problem for movable or relocating targets. Long times of flight and intelligence senescence result in a significant possibility that the desired targets will not be in the anticipated location, either within or not present in the sensor field of view. Concepts are being sought that provide a capability in the missile to assess the scene and decide what to do next. If the target is missing, the subsequent action might be to proceed to a secondary target. If the target has moved but is still in the scene, proceed to it if possible even though it may have to fly around and come back – or determine that the next target is more achievable. There could be other possibilities.

NAVAL WEAPON SUPPORT CENTER

N89-166 TITLE: Reformation of Reclaimed PBX Materials

CATEGORY: Exploratory Development

DESCRIPTION: Ordance reclamation activities yield particles of plastic bonded explosives approximately 1/8 cu. in. in size and smaller. There are usually broken down into a family of explosives for use in the surface mining industry. Fillers could be added to bring their detonation velocities and pressures down to more usable values. Drilling of bore holes for explosives is a considerable cost in surface mining and in the diameter of the hole required could be reduced by using a more powerful explosive, great savings would result. This would create a market for the thousands of pounds of explosive ingredients which are excess to the Navy's present needs. The feasibility of using existing computer programs to calculate the theoretical pressures and velocities of various washed out PBX materials and fillers must be shown. Technological requirements for lab scale testing (to follow) must be identified.

NAVAL WEAPONS CENTER

N89-167 TITLE: Friction Welding Ceramics to Metals

CATEGORY: Exploratory Development

DESCRIPTION: Develop friction welding parameters and materials interface combinations for a variety of ceramic-to-metal friction welds. Evaluate the potential for scale up to 10-inch diameter tubular joints. Determine suitable

mechanical test specimen geometries. Test methods and mechanical properties of the friction welded ceramic-to-metal combinations.

N89-168 TITLE: Low Noise Millimeter Wave Receiver

CATEGORY: Advanced Development

DESCRIPTION: The need to see through battlefield obscurants and fog are axiomatic. Man Infrared and Electro-optical imaging systems are hampered under these conditions. Imaging in the millimeter wavelengths would provide a useful adjunct to these systems when their operation is degraded due to the above factors. In passive millimeter wave imaging systems low noise receivers need to be employed. The receiver needs to fulfill the dual requirement of high contrast sensitivity and high sampling rates in order to provide near time imagery. The frequency regions of interest are 35 GHz and 94 GHz with a bandwidth of approximately 2 GHz. Performance characteristics of 3.0 db or less double sideband noise figure, a total gain of 65 db, and a long term gain stability better than 1 part in 4000 are required. Compactness and rugged construction are also important for measurement activities involving field testing. Possible implementations could involve cooled, cooled quasi-optical, or superconductor device technologies.

N89-169 TITLE: Superconducting Millimeter Wave Mixer

CATEGORY: Advanced Development

DESCRIPTION: Many new systems are being proposed that operate in the millimeter wave area. A major obstacle in the development of these systems is the lack of low noise components, mainly the mixers used in the front end of heterodyned receivers. Current room temperature mixers have a conversion loss of 5.5 db or more, while cooled units (20 K) suffer a loss of 2.4 db or greater. A mixer is desired that has less than 2 db of conversion loss or preferably conversion gain. It should be similar in size compared to standard millimeter wave mixers, should not require cooling in liquid helium, and should operate from less than 10mW of local cecillator power. The frequency bands of interest are 35 GHz and 94 GHz. It is also desirable that the mixer be usable outside of a laboratory environment.

N89-170 TITLE: Improvements in Single-Crystal Diamond Tools

CATEGORY: Advanced Development

DESCRIPTION: Special mounted, ground and polished single crystal tools are extensively used in ultraprecision machining of optical surfaces, special mechanical components, and magnetic memory substrates. The quality of the cutting edge of the diamond tool is critical to the durability of the edge in actual use and the quality of the resultant finished surface. By combining a tool fabrication effort with an evaluation program using the Naval Weapons Center Diamond Turning Facility, a functional evaluation of tools under actual use is possible. This solicitation requests proposals in the area of selection and crystallographic orientation of the diamond crystal and processes for finishing of the tool edge. Important parameters are the tool nose roundness accuracy, and the tool edge sharpness, as follows:

1. Tool nose radius shall be in a range from 0.030 to 0.125 inches, with a maximum departure from roundness of no more than 5 microinches;
2. The cutting edge shall be free from chips and flaws when examined at 10000X in a low scanning electron microscope.

A performance goal is that the tools to be developed shall be capable of machining high phosphorous (>12%) electroless nickel with no edge damage when observed as described in item 2., above.

N89-171 TITLE: IC Design Hardware/Software Communication Protocols

CATEGORY: Engineering Development

DESCRIPTION:

1. The vendor must identify and develop communication protocols for interfacing between currently available integrated circuit (IC) design hardware and software (sometimes referred to as an "executive system").
2. Deliverables to be (a) Report and (b) hardware/software to translate between the different protocols.

Examples of IC Design Hardware/Software:

Workstations: Daisy, Mentor, Valid
Computers: PC-AT, MicroVax (VMS), Sun
Software: Dracula, Merlyn, MP2D, Hilo, Helix
Data Formats: Calm GDS-II, CIF, Appicon, EDIF, VHDL, Gerber
File Transfer: RS-232C, IEEE 488, Ethernet, TCP/IP
Plotter Interfaces: HP, Versatec, Calcomp
Printer Interfaces: Dot Matrix, ElectroStatic, Ink Jet, Laser
Tester Interfaces: Sentry, GenRad, Taiketa-Raiken, Tektronix, HiLevel, Cadic

NAVAL AIR DEVELOPMENT CENTER

N89-172 TITLE: Long Range Stand-off Miniature Surveillance System For Navy Helicopters

CATEGORY: Exploratory Development

DESCRIPTION: As a result of recent US Navy involvement in the Persion Gulf, the need for a long range stand-off miniature electro-optic imaging surveillance sensor for use abroad US helicopters exists. The system would operate during the day and provide real time imagery onboard the helicopter at distances outside of the threat umbrella. In response to this need a number of contractors have responded with various types of equipment and concepts. A number of systems have been flight tested by the Navy. To date none of the systems proposed by the contractors have met the Navy needs. Since different contractors were involved, using a wide variety of equipment and concepts, it is apparent that a sensor system is not available for fleet operations. Also, there were other laboratory and flight demonstrations being conducted by contractors at civilian facilities. These efforts also have failed to define a system. The objective of this study will be to identify the technical approach required to design a miniature sensor for a Navy helicopter that will provide a ground resolution of three feet or less from a slant range of 60,000 feet. The research shall be directed at investigating the latest mathematical models that can simulate performance for different ranges, aircraft operating conditions as well as atmospheric conditions. In addition the study shall investigate the latest state-of-the-art in stabilization (low-friction bearings, gyros, etc.), optics (reflective, refractive, etc.) sensors (CCD, videcon tubes, etc.) and cost. Weight and size shall be restricted to 100 lbs and 3 cubic feet, respectively. If the study identifies a technical approach, Phase II will be undertaken to develop a miniature sensor system that can provide the required imagery.

N89-173 TITLE: Smart Part

CATEGORY: Advanced Development

DESCRIPTION: A requirement exists to develop a real time automatic system for tracking the life cycle location history of aircraft structural parts. Ideally, the structural part should contain an imbedded or adhesive-mounted small (dime-sized) source device which, when externally excited/activated, would emit an identifying signal, unique to the part capable of being permanently recorded. Since component parts are interchanged from aircraft to aircraft, the source device should be completely self-contained and maintenance free, preferably requiring no power

requirements or external wire connections/disconnections when the structural parts are changed. When aircraft power is turned on, it should cause all the source devices, peculiar to the aircraft, to be activated and emit signals which can be recorded concurrently with time/date/aircraft serial number information as a permanent parts location history to enable the Navy to automatically track which structural components parts flew with what aircraft.

N89-174 TITLE: Water-Borne Resin Development for Flexible Adherent Primer

CATEGORY: Exploratory Development

DESCRIPTION: Air-pollution regulations that limit the volatile organic compounds (VOC) content of paints applied to aircraft and ground support equipment have restricted the use of traditional, solvent-based materials. In particular, the current flexible primer MIL-P-85853 only has a sole-source exempt solvent version for this problem. Since exempt solvents have other related drawbacks, it is necessary to develop new paint specifications using water-borne technologies. This specific effort is designed to develop water-borne resin that can be used in the requirements of MIL-P-85853.

N89-175 TITLE: Fiber Optic Aircraft/Stores Interface

CATEGORY: Exploratory Development/Advanced Development

DESCRIPTION: Fiber optic transmission media are essentially impervious to the effects of EMI and EMP. That means that they will not act as antenna's for the transmission nor for the reception of electronic interference due to electrical or electromagnetic signals in the environment. These electromagnetic signals are due to deliberate transmissions (jamming), natural electrical disturbance (lighting, static electricity, sun spot activity and the like) or nuclear generated electromagnetic pulse. This feature of the optical fiber makes it an important area of investigation for military aircraft communications data bus use. It is particularly important where the bus is exposed to the environment such as an interface to a weapon external to the aircraft fuselage. The use of composites has extended the vulnerability of wire data busses to within the aircraft. MIL-STD-1760A has set aside only two connector cavities for use by fiber optic (FO) interfacing. No work has been done to determine how a fully fiber optic interface can be developed using only two cables to perform those functions required by a MIL-STD-1760 interface. The standard establishes the requirements for multiple functions to occur concurrently. These functions include release consent address lines, high bandwidth lines on which both analogue and high speed digital signals may be required to exist concurrently, and interlock. An interesting problem arises if it is desired to make the fiber line capable of carrying the motor start or release pulse. This energy currently is in the order of 100 watts for 10 milliseconds or 0.1 joules. Typically, an SMS for fighter aircraft will have nine weapons stations on the bus. This would require isolation of the optical receivers and transmitters on the bus from the high energy pulses defined above. This will require a device analogous to a radar T/R tube. Responses to this topic can take the form of 1) Identify those items which need to be developed to make a viable FO weapons interface system or 2) identification of a single critical item for development, generating a plan for the needed research to develop that item and sufficient laboratory work to verify the approach is viable. This would be followed up in Phase II by developing hardware to be integrated into a system demonstration.

N89-176 TITLE: Critical Defect Assessment for New Composite and Hybrid Materials

CATEGORY: Research

DESCRIPTION: New composite and hybrid materials may possess unique failure characteristics for which existing mechanical analysis and NDE (non-destructive evaluation) methodologies may be inappropriate. For these materials, it is necessary to establish the nature of critical defects, failure modes, and the effects of load and environment on failures. Also important will be the development of fracture toughness concepts relevant to these materials. This task will require both analytical and experimental efforts.

N89-177 TITLE: Rare-Earth Magnetostrictive Cryogenic Projector

CATEGORY: Exploratory Development

DESCRIPTION: A rare-earth magnetostrictive transducer with its driver operating at liquid nitrogen temperatures is needed as a high-power, low-frequency underwater acoustic projector. The transducer shall operate below 500 Hz with an acoustic power output exceeding 5 kw and an electroacoustic efficiency of at least 70%. A scaled-frequency prototype is considered essential to complement the design.

N89-178 TITLE: Laser Doppler Velocimeter (LDV) Measurements in Transient Impeller Flows

CATEGORY: Exploratory Development

DESCRIPTION: Most past experimental investigations of the physics of impeller flow fields have been conducted under steady state operation. Consequently, little is known about the prevailing phenomenon and associated physics of the impeller flow field during transient or start-up operation. The intent of this task is to develop a back-scatter laser Doppler velocimeter (LDV) technique and associated hardware required to measure transient impeller flow fields. The radial and tangential components of the flow are to be measured simultaneously from pump start-up to be a maximum speed of 1500 rpm. The axial component of the flow must also be measured, but can be obtained independent of the other two components. The LDV system is to use a fiber optic link to isolate the focusing and receiving lens from the remainder of the LDV system. Positioning of the measurement volume is to be accomplished through a suitable 3-axis traversing mechanism for the focusing lense. The measurement volume is to be traversed and provide the capability of making measurements over a 12 inch length in the radial direction.

NAVAL AIR ENGINEERING CENTER

N89-179 TITLE: Continuously Adjustable, Electrically Operated Control Valve

CATEGORY: Exploratory Development

DESCRIPTION: Current steam catapult technology uses fluidic amplification to control the launching of aircraft from carrier decks. In this method, the flow of hydraulic fluid through a small, controllable (electric-motor-driven) orifice is used to effect the flow rate of a much larger volume of fluid which controls the opening rate of a large rotary steam valve. The system is operated open loop, whereby the small, controlling, orifice opening is determined in advanced of launch from essentially hand-tabulated nomographs depending upon various aircraft launch factors; and once set is held fixed throughout the launch cycle. The present approach is somewhat wasteful of ships fossil fuel stores for non-nuclear class carriers, or place a minimum speed requirements on nuclear-powered vessels to assure a minimum safe level of aircraft take-off speed. It is desirable to have an electronically operated, continuously adjustable control valve to allow closed-loop operation with a suitable method of generating the thrust to safely launch 20,000 to 100,000 lb. Aircraft by accessing the aircraft's real-time acceleration/velocity and steam pressure as feedback parameters. The advanced system should effect significant reductions is maximum vessel speed requirements and aircraft stress levels leading to longer service life.

N89-180 TITLE: Remote Wind Sensing

CATEGORY: Advanced Development

DESCRIPTION: Remote wind sensors such as laser Doppler anemometry can be used to sense wind parameters about the ships structure. This system would be specialized test equipment used to map wind direction and velocities about a ship in various sea states with different ship headings. This equipment would be used to determine ship dynamic interface envelopes prior to actual flights to determine ship dynamic interface requirements. Note: This would promote greater safety and accuracy in performing dynamic interface tests and would not require test pilots to

fly in potentially hazardous conditions. Additional uses of this system would be in investigating and characterizing "burble" and its effects on carrier landings for use in developing better landing systems and control algorithms.

PACIFIC MISSILE TEST CENTER

N89-181 TITLE: Measurement of the Ultraviolet Signature of an Object

CATEGORY: Advanced Development

DESCRIPTION: Some anti-aircraft missiles use imaging trackers operating in the ultraviolet part of the spectrum. Low observability is required by aircraft to reduce deterction range and to improve aircraft self protection. Design, study, and analysis will be required in the following areas:

1. Aircraft signature characteristics in the ultraviolet, especially the effects of paint, sun angle, shape, shadows, etc.
2. Atmospheric absorption and scattering, the effects of atmosphere on target signature measurement, and methods of mathematical treatment in extrapolating measurement data to other ranges and conditions.
3. Available calibration sources for the ultraviolet and methods of performing accurate calibrations.
4. Methods of characterizing target and background signature data in the ultraviolet and presenting such data in forms useful to both humans and computers.

Determination of the degree of vulnerability of a low observable aircraft design or coating requires quantitative measurement data of ultraviolet reflections from the aircraft skin and of the background.

N89-182 TITLE: Expendable Ship Replica

CATEGORY: Advanced Development

DESCRIPTION: In-situ test and evaluation of new weapon systems, particularly smart weapons, is dependent upon the existence of accurate representation of ships to determine how the weapon responds on its final approach and attack on Navy surface ships. Old obsolete ships are currently used for this purpose. Due to the destructive power of modern weapons, fleet training, as well as test and evaluation, have depleted these assets. In addition, these older vessels do no "look like" modern ships to smart weapons. Alternative methods for replicating a ship or ships at sea is needed. Large ship-shaped Metalized balloons shall be explored as a possible answer to this problem. Areas to be addressed shall include materials, electromagnetic response (high frequency to ultraviolet) of coating materials, design, fabrication, storage, inflation, deployment, repair/reuse, station keeping, stability attachment/incorporation of simulated emitters, and propulsion potential. In conjunction with the study of the ship target as a test and evaluation asset, the concept shall also be explored for tactical applications as a decoy type ship defense. In this regard the following areas shall be addressed in addition to those indicated above: (a) methods of very rapid deployment, and (b) implications for application to an unsophisticated attack as well as sophisticated war at sea scenarios.

N89-183 TITLE: RF Digital Phase Shifter (5-Bit)

CATEGORY: Engineering Development

DESCRIPTION: 5-Bit phase shifters exist, however, they have limitations in one or more of the following: (1) modulation rates, (2) carrier suppression, (3) bandwidth, or (4) low residual output noise. An application exists which requires a 5-bit phase shifter with the following characteristics: Freq. 5.3-6.0, 8.5-9.5 and 10.0-10.5 GHz; mod rates from 10 Hz to 20 MHz (not 50%), one TTL input, internal circuitry to provide proper element drive); carrier suppression of 30db (min) with translated outputs from plus or minus 5 Hz to plus or minus 625 KHz (measured relative to translated line), insertion loss 7 db max; low residual noise output with phase shifter connected

to input of RF amplifier of 45 db gain with phase shifter, input terminated and with 20 MHz modulation applied to the phase shifter, the noise out of the amplifier of 45 db gain, with phase shifter input terminated and with 20 MHz modulation applied to the phase shifter, the noise out of the amplifier (as measured with a power meter) shall not increase moiré than 0.5 db. Device must meet MIL 3-5400 environment specification. This project is high-risk since no known manufacturer has designed such a device. It has a high potential use in a variety of countermeasures systems, and would be considered. Concept verification tests and evaluations shall be conducted as needed.

N89-184 TITLE: Altitude Measurement In High-Velocity Low-Altitude Vehicles

CATEGORY: Exploratory Development

DESCRIPTION: Develop techniques for accurately (centimeters) measuring the height above the sea surface of high velocity (greater than Mach 2.5) low altitude (less than 20 feet) vehicles. Techniques considered shall include those which require modification of the vehicle and those which can provide the altitude independent of any devices or equipment aboard the vehicle. All techniques, whether based on optics, Radio Frequency, or Acoustics will be considered. Concept verification tests and evaluations shall be conducted as needed.

NAVAL TRAINING SYSTEMS CENTER

N89-185 TITLE: Low Cost Computer Image Generator for Night Vision Simulation

CATEGORY: Exploratory Development

DESCRIPTION: Efforts are currently underway to develop low cost display systems to simulate Night Vision Goggles (NVG) for use in flight training simulators. A low cost image generator is needed to drive these displays. The Computer Image Generator (CIG) is different than the usual CIG found in simulation in that it need not be in color. The low cost generator should be capable of displaying night vision terrain for use in flight simulation. The database created for the low cost CIG should coordinate with an existing daylight database. Provisions for inputs of flight parameters, database location, and altitude are required. Since NVG viewing window can change dependent on the simulated flight, a provision for input of head attitude information must be provided. The computer system must be low cost and compatible with Naval Training System Center systems.

N89-186 TITLE: Low Cost Night Vision Goggles (NVG) for Simulation

CATEGORY: Exploratory Development

DESCRIPTION: The increased use of night vision goggles for flight has prompted the need for night vision flight training. Night vision systems used in flight have a limited field of view and do not allow for use of periphery cues when flying nap of the earth. A low cost display system that mimics operational NVG hardware for simulation training is needed. The low cost simulation NOG monochrome display should have display rates compatible with current flight simulation computer image generators and be comparable in weight when worn on the head. Field of view and viewing plan parameters should be that of operational NVGs.

NAVAL COASTAL SYSTEMS CENTER

N89-187 TITLE: Quiet Submarine Launcher Technology

CATEGORY: Exploratory Development

DESCRIPTION: This task involves the investigation and selection of the most feasible, new innovative concepts for quietly deploying countermeasure devices from submarines. Tradeoff studies shall be performed to provide the basis for the selections. In recent years, many conventional techniques such as pneumatics, springs, etc. have been investigated in an attempt to reduce the acoustic launch transient. To date, none of these techniques appear sufficiently quiet to satisfy future (year 2010) requirements. Existing countermeasure launchers employ a solid propellant gas generator to expel the 6.25-inch diameter by 106-inch long devices. The following are examples of concepts which have not been evaluated for this application and would, therefore, be appropriate for this task: flow-assisted release, gravity and buoyant release, and electromagnetic launch. Concepts which would employ a combination of two or more techniques should also be included.

N89-188 TITLE: Underwater Cryogenic Cutter

CATEGORY: Engineering Development

DESCRIPTION: Advances in cryogenic technology have facilitated sophisticated applications in the aerospace, biomedical, and related fields. An underwater cryogenic cutter would employ a liquid nitrogen delivery system with application temperatures low enough to embrittle and sever structural materials through local build-up of thermal stress. Two configurations of interest include: (1) a completely portable system light enough to be carried by a single diver, and (2) a larger, longer-duration system using topside equipment to support two divers with cutters to depths of 60 fsw.

N89-189 TITLE: Hull Potential Measurement System for Underway Ships

CATEGORY: Engineering Development

DESCRIPTION: Corrosion potential measurements on marine structures are, at best, difficult because of transient galvanic activity associated with the very process of cleaning to bare metal. Additionally, potential fields are known to respond to fluid velocities, so that measurements taken in port may not reflect a ship's condition while underway. The purpose of this task, therefore, is to develop a portable, self-contained measurement systems that can be mounted by a diver while the ship is in port and that measures electrolysis activity while the ship is underway. One system approach to be considered measures the hull potential in reference to a silver/silver-chloride immersed in the water surrounding the ship. The value obtained can be used together with known speed salinity, and water temperature to determine whether electrolysis criteria are within acceptable limits.

NAVAL CIVIL ENGINEERING LABORATORY

N89-190 TITLE: Rapid Detection of Asbestos

CATEGORY: Exploratory Development

DESCRIPTION: This study shall focus on the development of two alternative systems that rapidly determine at the work site whether or not asbestos exists in given specimens. The alternative systems will be developed to separately detect asbestos in: (1) material specimens and (2) airborne samples. The systems shall: (a) be portable, (b) make the determination of the presence of asbestos rapidly and reliably at the work site, (c) be simple to operate by persons with some training but without a specialized technical college degree, and (d) be safe to use.

N89-191 TITLE: Joint: Sealants for Concrete Airfield Pavements

CATEGORY: Advanced Development

DESCRIPTION: This study shall focus on the development of new materials for sealing joints in new pavements as well as resealing joints in existing pavements. The materials shall be resistant to: (a) jet engine effects (temperature and blast), (b) chemical (fuel, hydraulic oil, lubricants, solvents) degradation, (c) environmental (e.g., ultraviolet, moisture, freezing/thawing) degradation, and (d) mechanical (due to movement of the adjacent pavement slabs) failures (adhesion, cohesion). The continuing poor performance of currently available sealants results in the Navy expending multi-millions of dollars annually to reseal joints.

NAVAL AIR PROPULSION CENTER

N89-192 TITLE: Aircraft Engine Mixed Flow Compressor Analysis

CATEGORY: Research/Exploratory Development

DESCRIPTION: Mixed flow compressor stages have demonstrated higher pressure ration capability than axial stages at the same efficiency levels. A mixed flow stage is more rugged than an axial stage; it also enhances the foreign object debris (FOD) tolerance. The maximum pressure rise capability of a single mixed flow stage should be characterized to determine the number of axial stages that can be replaced by this technology. Several applications, such as turboprop/turboshaft and missile engines, could benefit from reduced parts and higher pressure and efficiency levels. Research is needed to thoroughly assess mixed flow compressor capabilities to determine the maximum attainable pressure ratio, efficiency levels, surge margin and variable geometry operability range.

N89-193 TITLE: Aircraft Gas Turbine Augmenter Ignition/Blowout Characterization

CATEGORY: Exploratory Development

DESCRIPTION: Aircraft Gas Turbine Augmenters have historically experienced difficulty igniting and maintaining stable combustion at high altitudes and low flight Mach numbers (i.e., upper left-hand corner of a flight envelope). Design modifications to improve ignition are usually based on empirical correlations or experience, and are generally ineffective in improving operability. The proposed program would analytically model the ignition process using computational fluid dynamics (i.e., solving the time dependent, compressible Navier-Strokes equations) and develop the methodology to design and modify augmenters for high altitude combustion. The methodology should include all known effects on ignition and blowout, including the effect of upstream vitiation and the presence of a choked nozzle downstream of the flameholder. Potential Navy payoffs will include an expansion of the upper left hand corner of the aircraft flight envelope and improved aircraft operability in this area.

N89-194 TITLE: Turbine System Design Code

CATEGORY: Exploratory Development

DESCRIPTION: This technology effort will develop the software necessary to fully analyze aircraft engine turbine component aerodynamic and heat transfer designs, to establish component performance at design point and off design. The software must be user friendly, requiring a minimum of inputs to utilize the program. The heat transfer analysis portion may be limited to the flow path portion of the turbine component but should be capable of expansion to the entire turbine system.

N89-195 TITLE: Turbulence Effects on Turbine Blade Film Cooling

CATEGORY: Exploratory Development

DESCRIPTION: High temperature gas turbine engines require efficient film cooling of turbine airfoils. Film cooling schemes designed without taking into account realistic turbine turbulence will result in ineffective cooling designs.

The objective of this effort is to understand the effects of turbulence on film cooling of turbine blades by conducting a literature search to assemble existing data and conducting appropriate tests to obtain data where none exists.

N89-196 TITLE: Lightweight Turbine Blade Attachment

CATEGORY: Exploratory Development

DESCRIPTION: Increased thrust-to-weight requirements of future gas turbine engines dictate a need to reduce the weight of turbine components. One place where this can be accomplished is the turbine blade/disk attachment area. The standard type of attachment uses a high stress dove-tail or fir tree arrangement. There is potential for significant weight reduction by changing this method. The objective of this program is to develop a feasible attachment concept that would still allow easy removal and replacement of blades while lowering the blade attachment weight. This, in turn, will lower the blade pull stress and allow a lighter disk design, further reducing the weight of the system.

N89-197 TITLE: Bearing Coating Development

CATEGORY: Exploratory Development

DESCRIPTION: Current rolling element bearing materials are susceptible to corrosion and debris damage. Additionally, bearing components generate considerable heat due to friction and viscous drag. The goal of this effort is to develop tenacious coating systems for high speed rolling element bearings which provide for wear/debris resistance, corrosion resistance, and improved friction characteristics for loss of lubrication tolerance. The proposed coating systems must be compatible with current MIL-L-23699 and MIL-L-85734 lubricants. The coating must also tolerate soak-back temperatures of at least 600’F without degradation of reaction.

N89-198 TITLE: Roller Bearing Inspection System

CATEGORY: Exploratory Development

DESCRIPTION: Current techniques for measuring dimensional tolerances of precision roller bearings are very labor-intensive and include many specialized fixtures resulting in high bearing costs for components which require 100% inspection. The goal of this effort is to develop precision non-contracting measurement techniques with high through-put capability for roller inspections. The systems developed should be applicable for a wide size range and yet maintain precision measurement throughout the range.

N89-199 TITLE: Life Prediction of Turbine Blades by Computer Modeling

CATEGORY: Engineering Development

DESCRIPTION: Engine manufactures use the same acceptance criteria for turbine blade quality from one engine design to the next without any knowledge as to the effect of type and size of casting flaw on life. Historically, they wait for field data on high time parts to tell them if the acceptance criteria is satisfactory to produce the life desired. But by waiting, the number of affected parts in the field increases as production continues and the cost of fixes are uncovered. This antiquated, trial and error approach to life prediction degrades and jeopardizes fleet readiness and safety. An interactive, computer aided design tool is needed to simulate the flying and engine running of turbine blades containing specific flaws and flaw sizes at various locations on the blades in question. Such an interactive software program would address life issues under various “what if” scenarios relating to blade design and casting flaw geometries, sizes and locations. The historic approach of building field data to assess the reasonableness of prior (e.g., assumed) design flaw acceptance criteria would be accomplished now through specific software designed to simulate these events in a computer. This computer simulation would be capable of testing a multitude of “what if” blade design and casting flaw scenarios, depicting outcomes, recording degradation or failure modes if any, and predicting life with certainty. Because such simulations would be accomplished superfast in present time, a high

degree of blade design and casting optimization could be accomplished in a very short time at a fraction of the cost for current trial and error methods. It would open significant opportunities on “how to” lower production and ownership costs and extend blade life.

NAVAL OCEAN SYSTEMS CENTER

N89-200 TITLE: Automated Specification of Testing for Software Systems

CATEGORY: Engineering Development

DESCRIPTION: In the development of complex computer software systems an increasingly large effort is spent in the testing system. In some Mission Critical Computer Systems, software testing may involve nearly as much time as software development. Testing of a large and complex system includes the development of the test plan, the test procedures, the tests, and the organizational support of the test team. After the tests are executed, the results are analyzed for correctness. Error reporting is recorded for appropriate action. New automated tools and techniques are needed to support the testing process. Included are test scenario and specification tools which operate in conjunction with the design and program specification tools, unit and component test tools which operate on the unit and component code and test analysis tools which operate on the unit and component code and test analysis tools which automate error detection. System test and test scenario tools are needed. Specialized documentation and error reporting tools would be used to assist in the support of the test organization.

N89-201 TITLE: Grid Free, Modular Large Screen Liquid Crystal (LC) Displays with Colors

CATEGORY: Exploratory Development

DESCRIPTION:

1. Undesired grid lines exists whenever the modules (he building blocks) of a Large Screen LC Panel are abutted together. The objective is to optically mask these unwanted lines, thus making a continuous, gridless, modular panel of any size possible.
2. Fiber optic microchannel plate, currently being fabricated under US Army contract for nigh vision application, are good candidates for this optical approach.
3. According to the manufacturer, it is quite feasible to fabricate these hollow fiber optic microchannel plates with a 10’ to 15’ tilt in their optical axis.
4. Superimposition of these tilted hollow fiber plates on the pixels of liquid crystal panels shall diverge the entering lights toward and above the grid lines, thus making the optical masking possible.

N89-202 TITLE: EHF Antenna Array for Surveillance Systems

CATEGORY: Exploratory Development

DESCRIPTION: New and innovative techniques are needed for implementing phased arrays for the 75-110 GHz band for surface surveillance applications. Current techniques based on conventional waveguide components, and designs, such as ferrite phase shifters, are complex and too costly for production. New approaches are needed, based on low cost components and designs, such as printed circuit techniques, that will provide low cost in production. As a proof of concept, the output of the investigation should be a laboratory model array operating from 80 to 100 GHz with electronic beam steering of at least 50’ in elevation and 80’ in azimuth.

N89-203 TITLE: Non-Scanning Optical Tracking System

CATEGORY: Exploratory Development

DESCRIPTION: A rapid and robust optical means of detecting and establishing ranges and bearings to multiple high-speed surface targets (i.e., speedboats) is needed for deployment on conventional surface platforms for purposes of target designation and tracking. Such a system shall also be used to support automatic acquisition and plotting of navigational aids and for purposes of collision avoidance on both conventional and autonomous surface vessels and robotic vehicles. Existing laser-based time-of-flight ranging systems consist of very narrow field of view optical receivers operating in conjunction with laser transmitters of even narrower illumination beam-width. While high angular resolution is thus achieved, mechanical scanning (usually employing rotating mirrors) is required to gather data over extended fields-of-view. Such systems are inherently slow, fragile, and prone to calibration errors. The many laser pulse transmissions necessary to raster scan the entire scene of interest increase probability of detection by enemy sensors. Since overall scan time is relatively long, system response is insufficient for weapons directing. In addition, the 3-D data so gathered is inherently distorted by sensor platform and/or target motion over the period of acquisition, necessitating computationally extensive coordinate transformations for restoration. Performance degrades rapidly as well in the presence of atmospheric obscurants such as fog and haze. Accordingly, an innovative and robust means of gathering high resolution optical 3-D data from a scene about the region of interest is needed for use on conventional and autonomous surface platforms and robotic vehicles, with the inherent ability to discriminate against background and foreground clutter. Such as system must provide rapid updates, without swamping the signal processor with inordinate amounts of unnecessary data, and employ no mechanical scanning. Resolution must be sufficient for fire control solutions, with maximum line-of-sight range between five and ten nautical miles.

N89-204 TITLE: Cross Section Reduction of Dish Antennas

CATEGORY: Exploratory Development

DESCRIPTION: Parabolic dish antennas are used in a number of radar tracking and fire control systems, ranging from small onboard systems for missile guidance to large shipboard systems for support of long range engagements. The radar cross section of these antennas, as seen by the target being tracked, can be quite large due to the retro-reflective nature of the antenna on boresite. The objective, here, is to devise alternate dish antenna designs that can significantly reduce this problem, or even eliminate it altogether. The Phase I effort should review and evaluate selected approaches, concluding with a detailed design proposal for a Phase II demonstration.

N89-205 TITLE: Waveform Design to Defeat Intercept Receivers

CATEGORY: Exploratory Development

DESCRIPTION: Broadband, high power radar concepts are becoming more practical as the required microwave component technologies advance. Radar designers are now being asked to include, in their waveform suite, options that either preclude detection or at least deny recognition by hostile intercept receivers. But intercept receiver design is also progressing. For the current and near term state of affairs, radar engineers need a clear understanding of how these receivers work and what problems the intercept receiver designer faces as the radar parameters vary. The task then is to: (1) survey current operational intercept receiver design, with particular emphasis on intercept ID algorithms, showing clearly how changes in radar parameters would impact the receiver effectiveness; and (2) from (1) and estimates of projected ID algorithm improvements, delineate the most effective radar waveform strategies.

N89-206 TITLE: Improved Direction Finding Techniques

CATEGORY: Advanced Development

DESCRIPTION: The need for improved direction finding (DF) techniques is vital to the implementation of advanced passive radio frequency (RF) surveillance and targeting systems. Accurate direction finding techniques compatible with sensor physical implementations/envelopes within missile launchers and aircraft pylons are required to provide for spatial processing and accurate location. The desire to achieve high accuracy utilizing short

baseline interferometer implementations as well as alternate advanced processing techniques are of major interest. The ability to achieve accurate DF/location is a necessary prerequisite for covert, passive targeting sensor systems. The identification of unique technologies such as optical processing techniques/schemes for enhanced signal processing techniques and sensor alignment requirements are critical to achieve the necessary performance. Concepts and approaches to achieve the desired level of performance should be performed.

N89-207 TITLE: Accurate Passive Ranging Techniques

CATEGORY: Advanced Development

DESCRIPTION: The need to accurately determine the location of threat radio frequency (RF) emitters while employing passive RF surveillance and targeting sensors is critical to successful performance of future Naval missions. Current passive RF technology provides techniques to achieve accurate angular measurements, while major improvements are required in techniques for achieving rapid and accurate range measurements. Emphasis should be placed upon methodologies and processing techniques to passively determine accurate range/location of threat RF sources. Implementations compatible with passive RF airborne sensor/platform applications should be emphasized. The technical approach should address the dynamic environment, the need for accurate determination of platform attitude, position, and associated rates, sensor processing schemes/techniques, computational algorithms, and any other significant considerations in achieving the desired performance.

N89-208 TITLE: Packaging of High Speed Optoelectronic Devices

CATEGORY: Exploratory Development

DESCRIPTION: There is currently a major effort within the DOD to employ fiber optic techniques to the feeding, distribution, remoting, and processing of high frequency antenna array signals. These applications are mainly due to the extremely high time-bandwidth products attainable with optical fibers. These fiber optic distribution and signal processing devices can potentially be used in systems operating in the millimeter wave frequency range (30 GHz), which is receiving increased emphasis for military applications. At present, the bandwidth of these fiber optic links is limited to about 20 GHz by the modulation bandwidths of the optical sources or external modulators, whichever is used, and the optical detectors. External optical modulators and detectors that use III-V semiconductor technology have theoretically attainable bandwidths approaching 100 Ghz. In practice, the bandwidths of these devices are usually limited by the microwave packaging. Consequently, high-speed device packaging is an extremely important issue when dealing with frequencies exceeding 30 GHz. This task requires theoretical modeling and experimental implementation of wideband millimeter wave circuits and packaging which can be used in conjunction with high-speed optoelectronic devices.

N89-209 TITLE: High Strength Optical Fibers for Air-Deployed Data Links

CATEGORY: Exploratory Development

DESCRIPTION: The recent application of optical fibers to high-speed, air-deployed data links, has developed a need for smaller diameter fibers with very high tensile strengths. During payout, the fibers are exposed to tensile and shear loads which could lead to failure. Commercial telecommunications fibers are buffered with a thick, polymeric jacket which, because of its large diameter and linear mass density, becomes a liability for high speed air deployment. To achieve the desired fiber characteristics, one must reduce the buffer thickness while increasing the glass fiber tensile strength. Thickness reduction of the buffer materials currently used in telecommunications fibers, leads to weaker fibers. These materials typically are uv-curable expoxy acrylates. It may be possible to sacrifice thickness if alternative polymers were developed which (1) can be applied and cured on-line during fiber draw, (2) have high adhesion, but are readily strippable, and (3) provide the same protection as epoxy acrylates at half the thickness.

DAVID TAYLOR RESEARCH & DEVELOPMENT CENTER

N89-210 TITLE: High Heat Flux Heat Exchanger

CATEGORY: Exploratory Development

DESCRIPTION: Advanced heat transfer surfaces for single phase heat exchangers which will yield significantly greater heat fluxes, (e.g., factor of 5 or more improvement over conventional surfaces) are required to decrease both unit size and cost. The performance characteristics of proposed concepts will be modeled analytically for the prediction of heat transfer capabilities. A small-scale demonstration model of a water-to-air heat exchanger shall be fabricated for proof of concept.

NAVAL AIR TEST CENTER

N89-211 TITLE: Infrared Scene Generation Model

CATEGORY: Engineering Development

DESCRIPTION: Models of infrared signatures are needed to simulate infrared scenarios presented by air, ground and sea threats for the test and evaluation of aircraft weapons system infrared sensors. The modeling scheme should utilize existing Compu-Scene IV and LOWTRAN software as much as possible and should provide for a generation of redefinable infrared environments for Compu-Scene IV. This would provide the capability to rapidly change the infrared scene to simulate specific threats and different modes of operation of known threats. Once the scene is generated with the proper field of view by the Compu-Scene IV software, the LOWTRAN software should calculate the atmospheric transmission losses between the aircraft's infrared sensor and the target threat. Special consideration should be given to the fact that wide field of view sensors look both horizontally and vertically through the atmosphere thus; the slant range to the receiver target varies. The dependency of transmission loss on look angle should be included in the model.

N89-212 TITLE: Dynamic Infrared Scene Projection

CATEGORY: Engineering Development

DESCRIPTION: Ground testing of forward looking infrared (FLIR) sensors determines baseline performance and is extremely effective in minimizing costly cut-and-try flight tests. There is a need to develop a thermal projection device which can dynamically simulate a high threat infrared environment. The thermal projector should be capable of taking a video computer generated image and present a corresponding thermal image to an aircraft FLIR sensor. The system must provide a high resolution image to wide field of view navigational FLIR's. The projector should also have a frame rate fast enough for the FLIR to perform as if the projected threat environment was continuous. The systems should be portable so that it can be positioned to accommodate different FLIR sensors on the same aircraft. The projector should present images in the 8-12 micron and 3-5 micron regions of the spectrum. A projector with a wider spectral bandwidth would be preferable for the testing of future infrared sensors which may use different wavelengths.

N89-213 TITLE: Multi-Mode Range Instrumentation Radar System

CATEGORY: Advanced Development

DESCRIPTION: Proposals are sought to determine the technical feasibility in developing a Multi-Mode Range Instrumentation Radar System (MRIRS). The study should establish the system performance requirements based on the flight test support required during the development, test and evaluation phases of naval airborne electronic

warfare systems. The system would be integrated with existing range instrumentation, taking advantage of those assets already available and would provide the capability to operate in the following radar modes:

- Inverse Synthetic Aperture Radar (ISAR)
- Pulse Doppler
- Pulse Compression
- Frequency Agility
- Pulse & Continuous Wave Radar
- Complex Pulse Trains

The MRIRS is required to replace obsolete single-purpose radars and to perform electronic warfare test measurements such as radar cross section (RCS), jammer-to-skin radar return ratio measurements, radar imaging, antenna patterns, sensitivity testing, chaff evaluation and would provide basic design concept. Phase II will consist of developing a prototype system in one of the electronic warfare frequency bands.