NAVY

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR Program Manager is Mr. Vincent D. Schaper. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

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ATTN: Vincent D. Schaper
Navy SBIR Program Manger
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The Navy has identified 290 technical topics in this DOD solicitation to which small R&D businesses may respond. A brief description of each topic is included along with the address of each originating office. In addition, there are index and topic title sections which are provided for quick reference. 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.

The Navy's mission is to maintain the freedom of the open seas. To that end the Navy employs and maintain air, land and ocean going vehicles and personnel necessary to accomplish this mission. The topics on the following pages provide a portion of problems encountered by the Navy in order to fulfill its mission and are an increase over previous years.

Selection of proposals for funding is based upon technical merit and the evaluation criteria contained in the solicitation document. Because funding is limited the Navy reserves the right to limit the amount of topics funded under any topic and only those topics considered to be of superior quality will be funded.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Navy Topics

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

Administrative
SBIR Contact

Topics Nos. N91-001 through N91-010

Mail/Handcarry Address:

Office of Naval Technology
Attn: ONT Code 20T1, Room 502
SBIR Program, Topic No. N91-_____
800 N. Quincy Street, BCT #1
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Mr. Doug Harry
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Topics Nos. N91-011 through N91-015

Mail Address:

Commanding Officer
MCRDAC, SBIR Program, Topic No. N91-_____
Amphibious Warfare Technology Directorate
Quantico, VA 22134-5080

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MCRDAC, SBIR Program, Topic No. N91-_____
Amphibious Warfare Technology Directorate
Lucas Hall, Room 9
Marine Corps Base
Quantico, VA 22134-5080

Topics Nos. N91-016 through N91-062

Mail Address:

Commander
Space and Naval Warfare Systems Command
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Washington, D.C. 20363-5100

Ms. Betty Geesey
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Space and Naval Warfare Systems Command
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2511 Jefferson Davis Highway
Attn: SPAWAR OOK, SBIR Program, Topic No. N91-_____
Arlington, VA 22202

Topics No. N91-063

Mail Address:

Commanding Officer
Naval Medical Research & Development Command
National Navy Medical Center
Code 402 SBIR Program, Topic No. N91-_____
Bethesda, MD 20814-5044

Commander R. Wolf
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Handcarry Address:

Commanding Officer
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Bethesda, MD 20814

Topic Nos. N91-097 through N91-151

Mail Address:

Commander
Naval Sea Systems Command
Attn: Code CET-4, SBIR Program, Topic No. N91-_____
Washington, D.C. 20362-5101

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Handcarry Address:

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Naval Sea Systems Command
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Arlington, VA 22202

Topic Nos. N91-152 through N91-186

Mail Address:

Commander
Naval Surface Warfare Center
White Oak Laboratory
Attn: Code R-05, SBIR Program, Topic No. N91-_____
Silver Spring, MD 20903-5000

Mr. Donald Wilson
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Commander
Naval Surface Warfare Center
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Silver Spring, MD 20910

Topic Nos. N91-187 through N91-188

Mail Address:

Headquarters, Naval Air Systems Command
Attn: Code AIR 9342E, SBIR Program, Topic No. N91-_____
Washington, D.C. 20361-9301

Mr. Johnny Johnson
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Headquarters, Naval Air Systems Command
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Attn: Code AIR-9342E, SBIR Program, Topic No. N91-_____
Arlington, VA 22202

Topic Nos. N91-189

Mail Address:

Headquarters, Naval Air Systems Command
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Arlington, VA 22202

Topic Nos. N91-190 through N91-201

Mail Address:

Commander
Naval Air Development Center
Attn: Code 094, SBIR Program, Topic No. N91-_____
Warminster, PA 18974-5000

Ms. Carol Van Wyk
(215) 441-22375

Handcarry Address:

Commander
Naval Air Development Center
Bldg. #3
Attn: Code 094, SBIR Program, Topic No. N91-_____
Warminster, PA 18974-5000

Topic Nos. N91-202 through N91-205

Mail/Handcarry Address:

Commercial Acquisition Department
Naval Underwater Systems Center
Attn: Code 0911, SBIR Program, Topic No. N91-_____
Shaws Cove Office Park, Bldg. #4
Howard Street
New London, CT 06320-594

Mr. Jack Griffin
(203) 440-4116

Topic Nos. N91-206 through N91-209

Mail Address:

Commanding Officer
Naval Air Engineering Center
Attn: Code 09R, SBIR Program, Topic No. N91-_____
Lakehurst, NJ 08733-5000

Mr. Pete O'Donnel
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Handcarry Address:

Commanding Officer
Naval Air Engineering Center
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Attn: Code 09R, SBIR Program, Topic No. N91-_____
Lakehurst, NJ 08733-5000

Topic No. N91-210

Mail/Handcarry Address:

Commanding Officer
Naval Civil Engineering Laboratory
Bldg. 90
Attn: Code 271, SBIR Program, Topic No. N91-_____
23rd Avenue and Ventura Road
Port Hueneme, CA 93041

Topic Nos. N91-211 through N91-215

Mail Address:

Commanding Officer
Naval Air Propulsion Center
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Commanding Officer
Naval Air Propulsion Center
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1440 Parkway Avenue
Trenton, NJ 08628-0176

Topic Nos. N91-216 through N91-222

Mail Address:

Commander
Naval Air Test Center
Attn: Code CT222, SBIR Program, Topic No. N91-_____
Patuxent River, MD 20670-5304

Mr. Dan Watters
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Handcarry Address:

Commander
Naval Air Test Center
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Attn: Code CT222, SBIR Program, Topic No. N91-_____
Patuxent River, MD 20670-5304

Topic No. N91-223

Mail Address:

Commanding Officer
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Crane, IN 47522-5060

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Crane, IN 47522-5060

Topic Nos. N91-224

Mail Address:

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Naval Ocean Systems Center
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San Diego, CA 92152-5000

Dr. Richard November
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Naval Ocean Systems Center
Attn: Code 232B, Bldg. 88, SBIR Program, No. N91-_____
San Diego, CA 92152-5000

Topic Nos. N91-225 through N91-230

Mail Address:

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David Taylor Research Center
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Bethesda, MD 20084-5000

Mr. Frank Halsall
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Topic Nos. N91-231 through N91-234

Mail/Handcarry Address:

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Naval Research Laboratory
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Washington, DC 20375-5000

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Topic Nos. N91-235 through N91-239

Mail/Handcarry Address:

Commander
Naval Training Systems Center
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12350 Research Parkway
Orlando, FL 32826-3224

Topic Nos. N91-240 through N91-279

Mail Address:

Commanding Officer
Naval Weapons Center
Attn: Code 2503, SBIR Program, Topic No. N91-_____
China Lake, CA 93555-6001

Ms. Lois Herrington
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515 Blandy Avenue, Annex A1
Attn: Code 2503, SBIR Program, Topic No. N91-_____
China Lake, CA 93555-6001

Topic Nos. N91-280 through N91-286

Mail Address:

Commander
Pacific Missile Test Center
Attn: Code 3121, SBIR Program, Topic No. N91-_____
Point Mugu, CA 93042-5000

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Point Mugu, CA 93042-5000

Topic No. N91-287

Mail/Handcarry Address:

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Naval Avionics Center
Technology Transfer Office
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Indianapolis, IN 46219-2189

Mr. Larry Halbig
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Topic Nos. N91-288 through N91-290

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Naval Ordnance Station\Indian Head
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Indian Head, MD 20903-5000

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Indian Head, MD 20903-5000

DEPARTMENT OF THE NAVY
FY 1991 TOPIC DESCRIPTIONS

OFFICE OF NAVAL TECHNOLOGY

N91-001 TITLE: Ozone Depletion Determination for Shipboard Fire Extinguishing Agents

CATEGORY: Exploratory Development

OBJECTIVE: To determine the potential ozone depletion effects of shipboard fire extinguishing agent alternatives to Halon 1301.

DESCRIPTION: Halon 1301 is a very effective fire extinguishing agent, however, because of the presence of the bromine atom, it has a high potential for destroying the earth's ozone layer. Current Navy exploratory development is identifying prospective alternatives for shipboard use. Analytical techniques and associated experimental studies on ozone depletion potential (ODP) are desired to complement the ongoing effort. Additional candidate compounds may be identified for evaluation by selected proposers.

During Phase I, a single compound will be investigated.

During Phase II, the ODP of the initial compound and that of other alternatives will be determined.

N91-002 TITLE: Millimeter-Wave Optical Waveguide Modulator

CATEGORY: Exploratory Development

OBJECTIVE: To develop optical waveguide intensity modulators operable at 1.3-1.5mm wavelength and for 3dB-bandwidth application that exceeds 20GHz.

DESCRIPTION: Using optical techniques to transfer high-speed information has many advantages over standard metallic waveguide techniques, especially in a combatant ship environment where size, weight, and EMI/EMP issues are important. For many applications, it is important to process extremely broadband information either about a center frequency or from essentially dc to a given frequency. The intensity modulator desired may operate on various principles such as (i.e., interferometric which can be fabricated on any substance). It must be operable at an optical wavelength of 1.3 or 1.5 millimeters and be able to be efficiently coupled with single-mode optical fibers. The modulator's 3 dB bandwidth should exceed 20GHz with a fairly flat response across the chosen band,

During Phase I, and analytical model shall be used to demonstrate the feasibility of the concept.

During Phase II, a brass board will be fabricated and demonstrated.

N91-003 TITLE: Infra-Red (IR) Signature Suppression

CATEGORY: Exploratory Development

OBJECTIVE: Identify and show feasibility of novel methods for attenuation of IR signatures in naval system.

DESCRIPTION: Advanced Navy systems such as the Advanced Tactical Fighter (ATF) et. al., are expected to have an IR signature design requirement imposed. Novel techniques are sought to attenuate/suppress such signatures. The bidder should assume a hot spot such as an engine support structure, and propose methods for reducing the maximum temperature for a given heat flux. Passive methods of thermal control are preferred because of the possible impact of active methods on system reliability and weight. However, it is acknowledged that active methods are sometimes the only practical method for cooling. The bidder should estimate the impact of the chosen method on system weight and reliability.

Phase I: Should slow the feasibility of the method.

Phase II: Should include a meaningful demonstration of IR signature suppression.

N91-004 TITLE: Solid-State Blue Laser Operating at 455 and 459 Nanometers

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate the feasibility of a solid-state laser operating at the cesium atomic line filter wavelength between 455.5 and 459.3 nanometers for use in strategic and tactical communications with submerged submarines.

DESCRIPTION: Tm,Er:Y_3,Sc_2,A_3O_{12} fluoresces at 455 and 459 nm when irradiated at 355nm, which is the third harmonic of the Nd:Y3,Al5,)12 laser fundamental. The 455 and 459 nm fluorescence corresponds to the wavelengths of an existing detector system employing a cesium atomic line filter. Lasing should occur on the long wavelength side of the fluorescence.

Phase I: Construct a prototype laser using Tm:Y_3,Sc_2,A_3O_{12} with or without a sensitizer such as Er^3+ to demonstrate feasibility (proof of principle) and determine slope efficiency.

Phase II should determine whether the laser output wavelength exactly matches the cesium atomic line filter. If not, explore the effect of an electric field or other means to bring about shifts in the wavelengths of the laser sufficient to concentration of Tm and sensitizer.

N91-005 TITLE: Massive Parallelism Software and Algorithms

CATEGORY: Exploratory Development

OBJECTIVE: To develop software and algorithms for massive parallel systems.

DESCRIPTION: While a number of promising computer system architectures for massively parallel systems currently exist, a corresponding advancement in software technology and algorithms for a massive parallelism has not been forthcoming. It is imperative that advances in software technology and algorithms be pursued, if we are to take advantage of this increase in compute power. Key areas of potential research and development include: fundamental principles for designing architecture independent programming languages; new compilation techniques for extracting more parallelism from programs and a mapping onto a variety of parallel architectures; methods for generating compilation and debugging systems from descriptions of machine architectures; design of retargetable implementations of efficient parallel algorithms; and software tools and environments for developing and debugging parallel systems.

Phase I: Should consist of definition investigation.

Phase II: Shall expand on development of Phase I and implement the software routines and algorithms in a massively parallel system.

N91-006 TITLE: Detection of Buried Mines

CATEGORY: Exploratory Development

OBJECTIVE: Develop a seismic method for detecting mines buried in the ocean bottom.

DESCRIPTION: Investigation of seismic data acquisition and processing techniques is desired for the purpose of evaluating their effectiveness in detecting mines buried 3 to 4 meters below the sea floor. Current capabilities with standard sonars operating in the 30 kHz range are effective against targets buried from .3 to 1 meter depending on the degree of water saturation of the sea floor sediment. Lower frequencies (from approximately 1 to 10 kHz) are required for penetration to deeper depths.

Phase I: Predominantly theoretical in nature and include at a minimum a synthetic model of the buried mine scenario that demonstrates the effectiveness of the proposed seismic data acquisition and processing techniques. The model should incorporate the effect of sea floor elastic properties on acoustic penetration. Validation of the synthetic model with real data acquired in a laboratory or a localized field setting would be beneficial although this is not required for the Phase I effort.

Phase II: Conducted on a regional scale in areas prepared by the U.S. Navy and would demonstrate the effectiveness of the seismic-based technology in detecting mines buried at depths up to 4 meters.

N91-007 TITLE: High Performance Battery Technology

CATEGORY: Exploratory Development

OBJECTIVE: To develop a high-performance battery with improved energy/power density for one of the many naval requirements.

DESCRIPTION: The Navy requires high performance batteries for a wide variety of applications; to power both active surveillance systems and small vehicle propulsion systems, in particular. Future active sonobuoys being investigated for ASW surveillance systems require a significant advance in power density over the present state-of-the art with the goal of 3.5 W/cc for the power supply, a shelf life of 5-7 years, and active life of several minutes and a total discharge time of up to 500 seconds (20 seconds pulse width, 10% duty cycle). In contrast, the AgO/Zn cells of rechargeable batteries for a naval propulsion system are limited by a relatively low cycle life, energy density and wet stand life. Although battery manufacturers report an energy density of 70 Wh/lb with 50 cycles, the swimmer delivery vehicle battery gets only 55 Wh/lb for approximately 30 cycles. Rechargeable battery capacity and cycle life could be substantially increased with improvements to either the zinc electrode, the separator, or both.

N91-008 TITLE: Wideband Sonar Signal Processor

CATEGORY: Exploratory Development

OBJECTIVE: To develop a compact high-power propulsion system for underwater mobile vehicles.

DESCRIPTION: Recent applications have been made of monopulse radar techniques in sonar design (e.g. SQQ-32). The basic method incorporates using two separate shading functions over a single aperture to obtain directional information for signals arriving at a measurement array. Theoretical work has been published on extending the basic processing scheme to wideband signals (Henderson, 1985). It is proposed that a variant of this method could be useful in analyzing backscattered returns from complex objects in order to localize the significant scattering centers in the object. The use of wideband arrays (PVDF) incorporating geometric shading is currently under investigation (Henderson) and may greatly simplify practical implementation for analysis of signals with arbitrary spectra. Specifications for wideband measurements over a decade of frequency should be incorporated in the design, the specific frequency ranges of interest will be discussed with Navy personnel.

Phase I: Work will consist of designing a multichannel measurement system to investigate the viability of applying this method to investigate the viability of applying this method to scattering center localization. Component parts would include a PVDF receive array and computer-controlled data acquisition and analysis hardware. Basic signal processing tools as well as monopulse processors would be included in the system software to provide an on-site analysis capability.

Phase II: System design will be finalized and a prototype system developed. The prototype would be tested in both a laboratory and lake environment. Data would be collected from appropriate test objects and used to evaluate performance criteria for characterizing intermediate scattering.

Phase III will develop procedures for implementing resulting analytical tools.

N91-009 TITLE: Compact High-Power Propulsion System

CATEGORY: Exploratory Development

OBJECTIVE: To develop a compact high-power propulsion system for underwater mobile vehicles.

DESCRIPTION: This task is to design, fabricate, and demonstrate a compact propulsion system to be used in small mobile vehicles. The propulsion system required will be demonstrated in a small scale configuration. The effort will produce a propulsion system package (energy source, motor, propellers, etc.) sized not to exceed 15 inches in length by 6 inches in diameter capable of propelling 6x40 inch vehicle at 25kt for 15 minutes. The propulsion system must be controllable from one-half speed to full speed. The system should not produce excessive noise, therefore, quiet approaches are encouraged.

Phase I: Should consist of concept definition, initial investigation and detailed planning for Phase 11.

Phase II: Should consist of design, fabrication, and testing of the prototype hardware concept.

N91-010 TITLE: Cleanout and Deactivation of Lithium Byproduct Canisters

CATEGORY: Exploratory Development

OBJECTIVE: Economical and safe procedures for removing byproducts of the reaction between lithium and sulfur hexafluoride from a stainless steel canister.

DESCRIPTION: Chemical energy propulsion systems now under development by the U.S. Navy produce canisters filled with lithium, lithium sulfide, lithium fluoride, and trace amounts of compounds of sulfur, aluminum, potassium, and chlorine. For a given canister, these constituents and their approximate concentration can be identified a priority. They are generally insoluble in water and can be moderately reactive. Present techniques for the removal of these products involve: reacting the lithium slowly with water, then mechanical removal of the residue; mechanical removal; and melting of the contents in an inert atmosphere.

Phase I: Alternative, cost-effective, efficient approaches to remove these contents would be developed, as all the above approaches have drawbacks and limitations.

Phase II: It is required that the removal process be shown to be married with a recycling or disposal process which is environmentally acceptable and cost-effective. Actual development of these processes would be encouraged in addition to removal.

U.S. MARINE CORPS

N91-011 TITLE: High Speed Transport of External Loads

CATEGORY: Exploratory Development

OBJECTIVE: Develop a state-of-the-art means to make external loads compatible for high speed transport (up to 200+ knots) under advanced helicopters and VTOL cargo aircraft of the future.

DESCRIPTION: Explore technology to allow high speed external transport of tactical vehicles (including the HMMWV), artillery, MILVANs, and bulk cargo. Explore the impact of high speed flight on external cargo, and modifications that might be necessary to both cargo and aircraft. Examine methods of rigging and de-rigging loads for high speed external transport, along with their associated impact on tactical flexibility and logistical concerns.

Phase I: Conduct a study outlining the approach which will be undertaken to pursue the requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: The results of this effort will include a concept (along with necessary hardware and components) developed to a state where it can be demonstrated in a flight experiment.

N91-012 TITLE: Development of Extended Red Response for a Gated, Intensified Solid State TV Camera

CATEGORY: Exploratory Development

OBJECTIVE: Extend range of current intensified gated camera systems.

DESCRIPTION: A requirement exists to have a gated (computer controllable down to a few nanoseconds) intensified solid state TV camera capable of capturing individual fields (i.e., 60 images/second) with extended red and near IR sensitivity, ideally without losing sensitivity in the blue portion of the visible spectrum. The desired response of the camera should cover a minimum spectral range of .45-1.1 microns (1.06 microns is of particular interest.).

Phase I: Should consist of a study, evaluation, and demonstration (within cost constraints) of new technologies and techniques (or extension of existing technologies) required to extend the response of such a camera into the near IR.

Phase II: Should develop and evaluate the technology/technologies identified in Phase I for both the near IR (1.06 micron) response and the total spectral response. A gated, intensified camera with extended red response would then be fabricated and evaluated.

N91-013 TITLE: Military Personnel Assignment

CATEGORY: Exploratory Development

OBJECTIVE: Real-word problems in military personnel assignment may be predominantly linear but usually have some nonlinear aspects which are handled by piece-wise linear approximation. There is a need for mathematical algorithms that may be piggy backed on current mathematical methods to speed convergences toward a solution and, in the case of nonlinear regions, aid the search procedure in escape from local optima. In the event that the value of any given problem parameter is changed, the enhanced algorithm should be able to recalculate the global optimal solution in a matter of seconds (real-time).

DESCRIPTION: Generally the standard military personnel assignment problem involves the assignment of ~ 100 people at a time. Sometimes, there is a need to match as many as 1,000 people to between 1,200 and 1,800 job vacancies. Assignments often require enroute training at a variety of training classes (~500), each with a limited student capacity. There are moving costs associated with sending any given person to any given job, largely a function of the distance traveled. Additional considerations include a fixed travel/relocation budget for the year, as well as goals for per capita moving expenses. There are constraints on personnel "balancing" in terms of fleet manning, gender, and job priority, leading to nonlinear objective functions. Additionally, if, for any reason, a person represented in the computer program should exercise his/her right to reject the job assignment and choose another, the enhanced algorithm should be able to recalculate the global optimal solution of using a new job assignment in a matter of seconds (real-time).

Phase I: Should demonstrate feasibility of method selected/devised on fully constrained, small-scale problem.

Phase II: Should demonstrate the optimum solution and measurement of computing time on a fully constrained, large-scale problem(s).

N91-014 TITLE: Large Area Fast Spectroradiometer

CATEGORY: Engineering Development

OBJECTIVE: Provide high resolution, large area coverage of a scene in fine spectral increments over a large spectral range in near real time.

DESCRIPTION: Multispectral scene analysis (in field) is of great concern to the Navy and the Marine Corps. Current approaches sacrifice resolution in either the area or spectral range. Current programs whose goal is to detect targets in a large cluttered environment could profit from this proposal. Innovative concepts are sought to extrapolate current field portable, fast spectroradiometers to provide 2.5-5nm spectral resolution over a 200x300 ft coverage area at standoff distances of 1000-2000 ft and spatial resolution of <6". Lens attachments should allow for other closeup scenarios. The unit should be completely field portable and self contained and should provide for data storage. Each data storage take should be accomplished in near real time (i.e., <0.25 sec) and should function in various daytime conditions.

Phase I would consist of a study to show feasibility of producing or extrapolating from current technologies the specific device which can meet the proposal requirements.

Phase II would consist of building and delivery of a field portable unit which meets all necessary specs.

N91-015 TITLE: Fuel Adaptation

CATEGORY: Exploratory Development

OBJECTIVE: To develop a 35 hp and a 70 hp onboard motor JP-5 fuel adaptation suitable for use on USMC small craft.

DESCRIPTION: Safety constraints for gasoline handling aboard U.S. Navy amphibious shipping severely inhibit employment of USMC small craft. Development effort will adapt the OMC outboard engine to accept JP-5 aircraft fuel (standard available fuel aboard U.S. Navy amphibious shipping). Desired engine modification should be simple to apply and able to be performed at the organizational level. Modification should not significantly increase the overall weight of the engines. Target weights are less than 125 pounds for the 35 hp motor and 275 lbs for the 70 hp motor. Horsepower will be measured at the propeller. Cubic dimensions and audio signature will not differ markedly from current industry standard for gasoline-powered outboard motors. Engines will have work-boat gear ratio and long shaft design as defined by industry standard.

Phase I: Development of a prototype 35 hp and a prototype 75 hp JP-5 jet fuel modified outboard motor.

Phase II: Refinement of the design and the delivery of test and results of laboratory tests designed to measure performance specifications.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N91-016 TITLE: Data Compression of Geophysical Data

CATEGORY: Advanced Development

OBJECTIVE: Facilitate implementation of decentralized environmental support architecture by increasing the throughput of geophysical information through available communication channels.

DESCRIPTION: The Navy's current architecture for environmental support creates large volumes of data which are now stored and maintained on large central site mainframe computers. The next generation of environmental support systems will distribute this data for processing at shore sites and ships. The volumes of data that must be transferred exceeds the existing pipelines for data distribution available to users of geophysical information. Data compression techniques must be employed to allow the required data to flow through the available communications channels and to reduce the burden on the small scale computers that are used on ships and shore sites.

Phase I: Investigate innovative data compression concepts that have the best potential for application to geophysical data in terms of minimum information loss and maximum compression performance. Types of data to be studied include satellite imagery, graphics and multi-dimensional array fields.

Phase II: Development of data compression technique.

N91-017 TITLE: Mission Area Subnets

CATEGORY: Exploratory Development

OBJECTIVE: Provide a means to subdivide Naval Tactical Data System (NTDS) tactical data into Mission Area Subnets for improving throughput and response time to high priority track data.

DESCRIPTION: Techniques and algorithms are sought for separating NTDS track data into Mission Area Subnets (MAS) such that each MAS can be assigned a different priority, speed of delivery, and destinations. A MAS address would typically be a subset of the entire battle group (i.e., multicast versus broadcast). Network resource sharing protocols should be defined which complement MAS. Networks will include relay nodes to extend the horizon. The resulting algorithms should be developed and tested in the Naval Ocean Systems Center (NOSC, San Diego, CA) Communications Support System (CSS) test facility.

Phase I: Address the technical feasibility of the proposed effort.

Phase II: Product Development

N91-018 TITLE: Network Initialization and Synchronization

CATEGORY: Exploratory Development

OBJECTIVE: Provide for initial frequency selection and slot synchronization in a High Frequency (HF) Time Division Multiple Access (TDMA) battle group network.

DESCRIPTION: This task is to develop algorithms for initial frequency selection and slot synchronization in a HF TDMA network. Techniques need to be developed which select a HF frequency which maximizes network connectivity. This frequency selection needs to be disseminated throughout the network to each platform. Also, in the TDMA network each platform will be assigned a fixed number of TDMA slots in a fixed frame format. Upon network initialization, all platforms need to gain synchronization at both the slot and frame boundary without the use of global clocks. (It can be assumed that each platform has very stable clocks.)

Phase I: Show technical/scientific feasibility of algorithms.

Phase II: Algorithm development.

N91-019 TITLE: Internetwork Routing

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques to use mixed Radio Frequency (RF) media for distributing tactical data within a Navy battle group.

DESCRIPTION: Develop techniques and algorithms for dynamically selecting internetwork gateways. Potential gateways are ships and aircraft which have multiple RF networks. The concept is that a platform with one RF medium (such as UHF-LOS) needs to broadcast tactical data to all platforms, some of which can only be reached on another medium (e.g., HF). The objective is to dynamically select intermediate nodes which can function as gateways between RF media. Net management overhead is to be minimized due to generally low data rates of Navy radio links. This effort will include the development of software for use in the Naval Ocean Systems Center (NOSC, San Diego, CA) Communication Support System (CSS) test facility.

Phase I: Show technical/scientific feasibility of algorithms.

Phase II: Algorithm development.

N91-020 TITLE: Dynamic Net Membership

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques for adding and/or deleting network nodes in a Time Division Multiple Access (TDMA) network.

DESCRIPTION: Techniques need to be developed for assigning time slots to new net participants and reassigning slots to remaining participants after one departs. Algorithms for adding and deleting net participants in a TDMA battle group network are sought. Platforms needing to join the network need to be assigned permanent TDMA time slots. When platforms leave the network their slots need to be reassigned to the remaining net participants. Issues such as changes in cycle time and disruptions in net operation need to be addressed. This effort will include the development of software for use in the Naval Ocean Systems Center (NOSC, San Diego, CA) Communication Support System (CSS) test facility.

Phase I: Show technical/scientific feasibility of algorithms.

Phase II: Algorithm development.

N91-021 TITLE: Tactical Data Transmission Compression

CATEGORY: Exploratory Development

OBJECTIVE: Provide for data compression and data flow control methods to reduce data transfer volume, while maintaining or increasing actual information content transfer.

DESCRIPTION: This task seeks to define and develop the necessary functions and algorithms which will minimize the actual on-the-air data transmissions between Navy TADIL J units through control of message size and message flow control. The tradeoffs will include the development of minimum message flow modes relative to successful completion of specific platform missions. Benefits are to be shown relative to TADIL J, modes of operation of platform, and platform mission phase. Proposed algorithms must be suitable for incorporation in the current C2P architecture and host platform computers. This effort will include the development of software for use in the Naval Ocean Systems Center (NOSC, San Diego, CA) Communication Support System (CSS) test facility.

Phase I: Show technical/scientific feasibility of algorithms.

Phase II: Algorithm development.

N91-022 TITLE: Resource Management for Automatic Demand Assigned Multiple Access (DAMA)

CATEGORY: Exploratory Development

OBJECTIVE: Develop automatic time slot assignment algorithms for automatic DAMA including decision aids, queuing strategies and synchronization methods.

DESCRIPTION: The current DAMA satellite system does not include the feature to automatically assign time slots according to the dynamically changing demand. This effort requires the simulation of expected events, understanding of the changing operating environment, and the definition and development of control algorithms and decision support systems. The effort should include evaluation of various control schemes over the order wire (inband and out of band), strategies to deal with new subscriber requests, congestion, impact of interrupting service for existing subscribers to reorganize channel allocations, evaluation of channel control frames other than Time Division Multiple Access 1 (TDMA1), strategies for database synchronization, operator support tools, and assurance of subscribers privacy. Proposed algorithms shall be developed and coded for use and evaluation in the Naval Ocean System Center (NOSC, San Diego, CA) test facility.

Phase I: Show technical/scientific feasibility of algorithms.

Phase II: Algorithm development.

N91-023 TITLE: Ship-To-Ship Video and Data Communication System

CATEGORY: Advanced Development

OBJECTIVE: Develop a secure LPI ship-to-ship data and audio/visual communications system based on CAINS technology.

DESCRIPTION: The CAINS system transmits LPI low power digital microwave signals from aircraft carrier to aircraft for navigational purposes. These signals are undetectable at distances of 5,000 meters or more from the transmitter. The objective is to develop ship-to-ship audio, data and video teleconferencing communications systems utilizing CAINS technology. The system should be capable of transmitting audio, T-1, and full motion color video simultaneously. The signals should be undetectable at distances greater than 10,000 meters from the transmitter. Consideration should be given to compensating for the relative pitch, roll, and yaw motions of the ships.

Phase I: Determine the feasibility of adapting CAINS technology to ship-to-ship communications.

Phase II: Develop a prototype system(s) suitable for potential Phase III follow-on.

N91-024 TITLE: A Non-Corrosive, Non-Volatile Replacement Battery for Search and Rescue Emergency Radios

CATEGORY: Engineering Development

OBJECTIVE: The objective is to develop a non-corrosive, non-volatile battery for use in search and rescue radios.

DESCRIPTION: All surface and sub-surface vessels are equipped with an emergency search and rescue radio with a lithium-sulphur dioxide battery installed. The battery requires special handling and storage, and has exploded aboard a surface ship causing equipment damage and personnel injuries. A battery is needed that can he handled and stored safely. This battery must meet requirements for safety, storage and extended operations beyond seventy-two hours. This battery must also be physically, electrically, mechanically, and functionally interchangeable with currently installed batteries that meet radio performance requirements. Safety requirements dictate that the search

and rescue radios incorporate self diagnostic computer capability to pre-determine the status of the radio prior to emergency use requirement. The radio must provide a covert operational link which functions to restrict information and data which could support target acquisitions by enemy forces during emergency search and rescue operations. The current sensitive location information is available within the line of sigh thirty mile range.

Phase I: Feasibility model to demonstrate operational capability.

Phase II: Service Test Models.

Phase III: Transition will be realized with a pilot production Phase II option.

N91-025 TITLE: High Speed LED-Based Optical Transmitter for Digital Communications

CATEGORY: Exploratory Development

OBJECTIVE: Develop a high speed LED-based optical transmitter for use in military Local Area Networks (LANs).

DESCRIPTION: Advanced avionics architectures will feature Local Area Networks which operate at serial data rates approaching 1 gigabit per second. Currently available optical transmitters which operate at these speeds employ laser diodes which suffer from serious temperature problems due to the exponential temperature dependence for their threshold current. Moreover, they require complex and bulky sensing and feedback circuitry to stabilize their output over even a limited temperature range. LED transmitters do not suffer from these problems, but they are currently limited in bandwidth to several hundred megabits per second. The purpose of this effort is to develop a high speed LED-based optical transmitter suitable for operation in a military environment.

The transmitter must be capable of modulation at 1 gigabit and couple at least 100 microwatts of optical power into 100/140 micron graded index fiber. The transmitter input should be compatible with Emitter-Coupled Logic (ECL) levels. Initially the operating temperature should cover the range of 0-85 celsius with an ultimate goal of the full military temperature range. Technologies to be considered may include speedup drive circuitry and quantum well devices.

Phase I: Show technical feasibility of conceptual optical transmitter.

Phase II: Development of the optical transmitter.

N91-026 TITLE: Transputer Applications for Multiple Target Tracking in Anti-Submarine Warfare (ASW)

CATEGORY: Exploratory Development

OBJECTIVE: (a) Design and develop algorithms to partition the parallel components of a multiple target tracking problem, and (b) implement these components in hardware with the combination (number, type, and configuration) of transputers that best meet the performance and cost specification of a system.

DESCRIPTION: Since the ASW Systems employ a suite of diverse sensors to track multiple surface and subsurface targets in a cluttered environment, the computational requirements of track initiation and track maintenance can be enormous. In a barest from a central issue in multi-sensor, multi-target tracking is the assignment problem. It has been found that the amount of computer resources and computer time of conventional computers increases exponentially as the number of targets increase. The track-contact association is inherently a parallel task which is ideally suited for decomposition. The idea here is to exploit this high degree of concurrence using transputers (microprocessors with parallel architectures). The transputer architecture directly implements the process model of concurrence to describe parallel systems naturally and simply. The key feature of this modularity and synchronized point-to-point communication create a unified systems structure.

Phase I: Design and development of the software.

Phase II: Refine the design and selection of best alternatives, and integrate this product with the existing software and hardware tracking systems for ASW at some selected Navy facilities.

N91-027 TITLE: Network Security Study

CATEGORY: Research

OBJECTIVE: Investigate the security risk associated with a trusted End-to-End Encryption (E3) system hosted on a trusted operating system.

DESCRIPTION: End-to-End Encryption (E3) offers high assurance for message confidentiality and integrity in a network environment, even if the communication crosses several physical network boundaries by use of multinet bridges and gateways. Research is needed to be performed in which a trusted E^3 system is hosted on a trusted operating system configured on a network. The seriousness of the traffic flow leakage should be examined using methods such as link super-encryption, traffic padding, varied routing and controlled timing. Emphasis should be given to methods that have the least negative impact on the network capacity and message transmission speed, and to methods that can be performed as trusted operating system services so that the entire communication can be performed using trustworthy processes.

Phase I: Examine methods to determine the seriousness of the traffic flow security problem and techniques to prevent leakage.

Phase II: Implement and demonstrate those most promising E^3 methods which have the least negative impact permitting trust in the communications process.

N91-028 TITLE: Multilevel Computer Security Implementation Constraints on Operating Systems for Navy Warfare Systems

CATEGORY: Research

OBJECTIVE: To identify and analyze multilevel computer security implementation constraints on operating systems for Navy warfare systems.

DESCRIPTION: Navy warfare systems operate in very demanding tactical real time environments ranging from an embedded system to a widely distributed system. The operating systems must provide timely critical system resource control and guarantee predictable services to support Navy applications. The Navy has requirements for secure tactical computer systems. Multilevel computer security implementations will adversely impact operating system efficiency. A study is required to identify and analyze the constraints imposed on operating systems for multilevel secure environments in Navy tactical warfare systems. The study should analyze various implementation strategies for successful operating system performance in light of the identified constraints.

Phase I: Explore techniques to identify and analyze the constraints imposed on operating systems in multilevel secure environments.

Phase II: Conduct necessary research and demonstrate strategies for successful operating system performance.

N91-029 TITLE: Multiple Net Data Link

CATEGORY: Exploratory Development

OBJECTIVE: Study the feasibility and implement a working prototype of a multiple net data link tailored to Navy tactical data link needs guided by the Navy Tactical Data Link Plan.

DESCRIPTION: Present data links are limited to single nets. Tactical needs require multiple, as few as two, data links that can easily communicate with each other. Standard links are well established and existing hardware and software could be modified to meet this need, or new equipment could be specified if desired.

Phase I: Investigate the feasibility of multiple net architectures for existing Navy data links. Present and future equipment must be considered and minimal modifications are desirable if possible. Implementation could be in conjunction with modernization and improved capability. A preliminary design would detail the best architecture and implementation.

Phase II: Design multiple net data link using the output from Phase I. Existing hardware will be modified or new equipment will be designed and prototyped to test and demonstrate the data link net. Deliverables will include a design analysis, a complete design and documentation package, and hardware, modified or new.

N91-030 TITLE: Generic Modem for Data Terminal Set (GM)

CATEGORY: Exploratory Development

OBJECTIVE: Study of feasibility and implement a working prototype of a generic modem capable of performing various functions in a data terminal set used in standard Navy tactical data links. This includes, but is not limited to, Link-11, Link-4 and the Link-11 Improvement Program (LEIP) Single Tone.

DESCRIPTION: Present modems are limited to single functions. Tactical needs require multiple functionality to be able to adapt communication needs to changing situations. Standard data links are well established but existing modern hardware can only perform a single function. New functions could be specified if deemed desirable and sufficient processing to allow for product growth is desirable.

Phase I: Investigate the feasibility of multiple function architectures for Navy modems. Present and future equipment must be considered and modifications to existing equipment are desirable if possible. Implementation could be in conjunction with modernization and improved capability. A preliminary design would detail the best architecture and implementation.

Phase II: Design multiple net data link using the output device from Phase I. Existing hardware will be modified or new equipment will be designed and prototyped to test and demonstrate the modem. Deliverables will include a design analysis, a complete design and documentation package, and hardware, modified or new.

N91-031 TITLE: VME Single Card Link-11 Monitor System (LMS)

CATEGORY: Exploratory Development

OBJECTIVE: Study the feasibility and implement a single card VME bus LMS that will perform all functions of the present hardware implementation.

DESCRIPTION: The fleet LMS is implemented in special hardware as a component of Link-11. Future Link-11 systems will be integrated in a VME bus computer and compressing component functionality onto single card computers would be extremely cost and space efficient. Sufficient processing to handle Link-11 Improvement Program Single Tone is necessary and additional processing to allow for product growth is desirable.

Phase I: Investigate the feasibility of a single card LMS implementation and identify the appropriate architecture. Any available technology may be utilized, however, 1750A is the standard Navy embedded language. Any ideas for improvements to LMS are welcome and will be considered.

Phase II: Design and construct a single card LMS prototype using knowledge learned from Phase I. VME bus from, fit and function compatibility is a must. Deliverables shall include, but are not limited to, a detailed design analysis, a design and documentation package, and one or more VME single card LMS implementations. Test procedures will be defined and test results documented in a final, comprehensive report.

N91-032 TITLE: Modular Ada Software Development for SPARC Station TM 300 Series

CATEGORY: Engineering Development

OBJECTIVE: The Navy's Command, Control, Communications, and Intelligence (C3I) hardware and software architecture is being evolved utilizing the Navy standard desktop computer (DTC II) hardware and Ada software language. Software programs are currently being developed on other more costly and larger Navy standard hardware or special purpose processors. The DTC II or RISC-based SPARC Station 300 Series Graphic Workstation has the following computational power:

- 16-MIPS integer performance for computer intensive applications
- 26 Mflops double precision Linpack performance for enhanced speed of loading-point calculations
- 128 Kbyte virtual-address, write-through cache memory for maximum CPU performance
- 40 Mbytes on-board memory

Several software modules are to be converted to Ada and rehosted/integrated on the DTC II workstation to allow cost savings in that the procurement of the other Navy standard Navy hardware will not be required. Access to other platforms which are currently scheduled to receive DTC II hardware and are not scheduled or programmed to receive the other Navy standard hardware is also a major advantage to the Navy on this effort.

DESCRIPTION: Software modules which require conversion to Ada include those which process communications I/Os (i.e., OTCIXS, TADIX, TACINTEL, NAVMACS, etc.), Local Area Network (LAN) management and controller software. This effort would require the small business contractor to code this software in Ada language suitable for implementation on the DTC-II workstation in three phases.

Phase I: Includes the software coding and documentation in Ada.

Phase II: Includes the software coding and documentation in Ada.

Phase III: Includes testing the software at a government laboratory to verify its acceptability for use in Navy systems.

N91-033 TITLE: Advanced Systems and Concepts for Future Naval Warfare

CATEGORY: Exploratory Development

OBJECTIVE: Enhance Navy's future warfare capabilities in Space C3I, Undersea Surveillance and ASW.

DESCRIPTION: Navy is seeking new, innovative, high risk/high payoff ideas in technologies and/or advanced systems concepts that support space, C^3I, Undersea Surveillance and ASW systems for the years 2005 and beyond.

Phase I: Proposal should address a) the system concept or technology being proposed, b) the innovative operational utility in future Naval warfare, c) the scientific principal(s) involved (show quantitative formulation where appropriate), d) the maturity of the technical discipline, and e) the work planned to demonstrate technical feasibility.

Phase II: Development of the requisite subsystem and/or new technology to realize the proposed system concept.

N91-034 TITLE: Critical-Time/Real-Time Database Management

CATEGORY: Research

OBJECTIVE: Develop critical-time/real-time database management capabilities that will provide the performance improvement demanded by mission critical applications with stringent processing/response requirements.

DESCRIPTION: The data requirements of mission critical Navy systems have been increasing dramatically. Navy C3I systems must manage land, sea, airborne and space data elements. Driving such systems are significant requirements for maintenance of thousands of objects, discriminating the real threats among them, and tracking them with real time updates. Tactical weapons systems require performance in the highly real-time to critical-time performance envelopes. Autonomous sensor/weapons control systems must deal with an enormous quantity of unfiltered data coming in at very high data rates. Critical to the success of mission critical Navy systems is the ability to manage large (gigabit) databases in a fast, predictable and reliable manner. The demanding mission critical environment will become even more challenging due to a substantial increase in the amount of data to be considered as a result of new sensor systems and communications capabilities, and reduced reaction time resulting from increasingly sophisticated weapons that can minimize detection time. Response to critical-time/real-time requirements for large databases is beyond the capability of currently available database management systems (DBMSs). Such DBMSs lack an awareness of, and the ability to meet, the deadline and/or time-critical nature of the processing requirements. Additionally, currently available DBMSs are not able to offer the high throughput rates required by Navy systems. Existing Navy systems utilize a significant level hand tailored assembly level code to meet these types of performance requirements.

Phase I: Identify research needed to develop the technology to permit database management systems to support the Navy's critical-time/real-time data management requirements.

Phase II: Implement the research identified under Phase I.

N91-035 TITLE: Local Are Network Security (LAN) Security

CATEGORY: Research

OBJECTIVE: Develop innovative approaches to achieve LAN security.

DESCRIPTION: The U.S. Navy is investing manpower and resources into the definition, standardization and acquisition of LANs for use on Naval ship and shore platforms. Some of these applications will require security protection in areas such as:

- Data Confidentiality – protection against improper disclosure
- Data Integrity – protection against alteration or destruction
- Access Control – protection against misuse of resources
- Traffic Padding – protection against analysis
- Proof of Origin – protection against masquerading
- Proof of Delivery – protection against repudiation
- Proof of Originality – protection against reflection or repay

Innovative approaches are needed for the cost-effective provision of the above services while addressing issues such as the following:

- Impact of added security overhead upon network performance
- Techniques for key distribution
- Time to set-up a secure session
- Advantages/disadvantages of symmetric (DES) versus asymmetric (RSA) keys

Phase I: Identify innovative approaches to achieve LAN security.

Phase II: Demonstrate LAN security.

N91-036 TITLE: Constraints and Systems Primitives in Achieving Multilevel Security in Real Time Distributed Systems Environments

CATEGORY: Research

OBJECTIVE: Study trusted distributed systems which operate over a heterogeneous collection of processors.

DESCRIPTION: This effort should produce a preliminary design for a distributed operating system and develop an initial proof-of-concept prototype to investigate the principal mechanisms that support distributed operating systems. Central to this research effort is the examination of the network server interaction locally and across the network. Issues of object name space, user and machine identification and authentication, exploitable covert channels, and configuration control should be addressed. A design for audit across the distributed system should also be considered.

Phase I: Conduct analyses of trusted distributed systems which operate over a heterogeneous collection of processors.

Phase II: Produce a preliminary design for a distributed operating system and develop an initial proof-of-concept prototype to investigate the principal mechanisms that support distributed operating systems.

N91-037 TITLE: Low Probability of Intercept Sensor Network

CATEGORY: Advanced Development

OBJECTIVE: Development of design requirements for a Low Probability of Intercept (LPI) network of sensors which may be directly applied to design specifications of various types of sensors (infra-red, optical, ESM, acoustic, multi-static radars) for use in.

DESCRIPTION: Currently, the primary means of surveillance of hostile airspace is high-powered, mono-static radars. With the increasing capabilities of Anti-Radiation Homing Missiles (ARMs) and Anti-Ship Missiles, it is essential to significantly decrease the radiated signature of U.S. tactical forces. Additionally, with the scenarios of "Low-Intensity Conflict" (LIC) and/or deployment in the vicinity of "neutral" nations, it is desirable to have the capability to perform electromagnetically covert surveillance.

Phase I: Identify the critical technical issues which must be addressed and analyze the advantages and constraints associated with various techniques to accomplish "covert" surveillance.

Phase II: Include conducting system-level trade-offs of performance, technical risk, and relative cost of these system architectures. Phase II would culminate in development of specifications for key elements of the system such as data fusion, and appropriate sensors.

Phase III: Include the development of an Engineering Development Mode of an LFI Sensor Network.

N91-038 TITLE: Non-Cooperative Target Identification

CATEGORY: Advanced Development

OBJECTIVE: Design concept and experimental data to verify method for adding non-cooperative target identification capability to USMC and Navy long-range surveillance radars.

DESCRIPTION: Verifying identification of targets which are not squawking or confirming ID of squawking targets remains a highly desired capability for air defense sensors used for ground controlled intercept. Many techniques

are available to provide this capability by significant augmentations to the radar which add auxiliary sensors and processors. A technique is sought which is integral to the various radars and does not result in greater radar transportable weight or require significant package alternation.

What is needed is a technique which enables a designated target ID to be determined without significantly impacting the on-going surveillance process. Operator interaction in the recognition process must be minimal; the recognition must be an aid to the operator, not a new functional process for him to perform. Display requirements must not perturb existing formats to any significant degree.

Phase I: Synthesize a cost-effective integrated concept for the various radars and propose a means to validate the concept through the use of real radar data exercising a simulation of the recognition technique.

Phase II: Implement and field-test an advanced development model of the proposed technique on the candidate radar.

N91-039 TITLE: Automated Training for the Integrated Undersea Surveillance System

CATEGORY: Engineering Development

OBJECTIVE: Develop a system to aid operator training for the Integrated Undersea Surveillance System.

DESCRIPTION: The Integrated Undersea Surveillance System consists of hardware and software for the purpose of processing large amounts of acoustic data. This process is labor-intensive in all its phases. The operators on which it depends are currently trained in a classroom by personnel who would otherwise be operating the system. Space and Naval Warfare Systems Command requests proposals for embedded automated training aids in the Integrated Undersea Surveillance System which will allow on-the-job training using real data as those data are processed. An embedded training capability would significantly reduce the manpower and funding required to provide formal operator training in a classroom environment. The training capability must be structured enough to allow for stand alone operation and individual system operating training, while being flexible enough to provide operators the capability to participate in simulated exercises and scenarios. The training aids should require minimum oversight by previously trained operators.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review, and c) a brief and final report to the Navy project manager.

Phase I: Concept review and cost benefits study.

Phase II: Promising automation concepts will be implemented on a DTC-II provided as GFE for this development effort by PD-80 and installed and tested at a Navy facility. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-040 TITLE: Time-Frequency Representation Using the Wigner-Ville Distribution

CATEGORY: Advanced Development

OBJECTIVE: Develop and test and optimum time-frequency representation of sonar signals.

DESCRIPTION: The Lofargram has long been a standard means of representing sonar signals in a combined time-frequency presentation. The Lofargram represents a particular trade-off between the conflicting demands of resolution in the time and frequency domains. Recent theoretical work has suggested that an optimum compromise between demands of good resolution in time and frequency can be found, based on a generalized Wigner-Ville distribution but displayed on a Desk Top Computer (DTC-II) Cathode Ray Tube (CRT) versus the conventional paper display.

Each phase will require a) an initial brief including a program objective, actions, and milestone review, b) a final review, and c) a brief and final report to the Navy project manager. The concepts will be demonstrated at one of the Navy's Ocean Processing Facilities.

Phase I: Investigate this concept on real and synthetic data and attempt to transition practices currently in operational use (e.g., "walking the grams") from paper displays to high resolution DTC-II displays.

Phase II: Production of a real time display system, compatible with existing Navy systems, to demonstrate the potential Wigner-Ville distribution. Successful Phase II contractors will transition their technology into the Undersea Surveillance Program Research and Development Program.

N91-041 TITLE: Image Analysis, Automation and Detection for the Integrated Undersea Surveillance System

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the application of acoustic communications systems concepts to provide improved tactical connectivity for Anti-Submarine Warfare (ASW) forces.

DESCRIPTION: The Integrated Undersea Surveillance System consists of hardware and software for the purpose of analyzing large amounts of acoustic data. This process is currently very labor-intensive in all its phases. Space and Naval Warfare Systems Command requests proposals to automate this system using advanced image analysis, automation and detection techniques. Proposals for automated image analysis and detection processes are solicited.

Each phase will require a) an initial brief including a program objective, actins and milestone review, b) a final review and c) a brief and final report t the Navy project manager. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

Phase I: Concept review, analysis study and high level design for the proposed category.

Phase II: Promising advanced image analysis and detection concepts will be implemented, installed and tested at a Navy Facility.

N91-042 TITLE: Acoustic Communication for the Integrated Undersea Surveillance System (IUSS)

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the application of acoustic communications systems concepts to provide improved tactical connectivity for Anti-Submarine Warfare (ASW) forces.

DESCRIPTION: Improved acoustic communications techniques are required to provide survivable and enduring ASW communications. This project will examine the potential for application of acoustic communications to IUSS as an alternate path for ASW users.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) final review and c) a brief and final report to the Navy project manager.

Phase I: Analysis will include a system design concept for integration of acoustic communications to ASW platforms, systems and sensors. The plan will include a survey of existing and planned IUSS/Fleet resources. IUSS system/subsystem improvements, acoustic conditions and environmental parameters/issues will be addressed. The feasibility of the proposed systems concept must be demonstrated.

Phase II: Encompass modeling, development, laboratory testing, validation and demonstration of the utility of the design concepts. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction Research and Development program.

N91-043 TITLE: Meteor Burst Communications in Northern Latitudes

CATEGORY: Advanced Development

OBJECTIVE: Explore the feasibility of employing meteor burst communications to improve Integrated Undersea Surveillance System (IUSS) operations I northern latitudes of the Atlantic Ocean.

DESCRIPTION: Meteor burst communications technology offers reliable communications, consists of available off-the-shelf technology and represents a low-cost opportunity to initiate communications at distance of up to 1000 nautical miles.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Investigate the feasibility of employing meteor burst technology in northern latitudes by investigating and documenting the current capabilities of the technology. The results of this investigation shall be applied to designing a system which incorporates meteor burst technology into IUSS ships deployed in northern latitudes of the Atlantic Ocean. The design must address basic performance parameters (e.g., throughput, wait time) and should improve performance through proper system design (e.g., transmitter power, antenna gain, receiver sensitivity).

Phase II: Demonstrate the utility of the design through the testing and evaluation of the system in an operational environment. A test plan shall be developed and will include preparing test messages, verifying the accuracy of their transmission and determining the throughput and wait time involved in the transmission of these messages. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-044 TITLE: Advanced Signal Processing Techniques for the Integrated Undersea Surveillance System

CATEGORY: Engineering Development

OBJECTIVE: Develop advance signal processing techniques to further the automation of the Integrated Undersea Surveillance System.

DESCRIPTION: The Space and Naval Warfare Systems Command is soliciting advanced signal processing algorithms to improve the following areas: a) reporting time as measured by time late, b) probability of detection and false alarm, and c) operator productivity and system automation. These areas are currently very labor-intensive. Space and Naval Warfare Systems Command requests proposals to automate these areas either in part or in hole. Proposed systems should significantly reduce the amount of time required to analyze data and to produce accurate reports.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Concept review, analysis study and high level design for proposed area.

Phase II: Promising automation concepts will be implemented, installed and tested at a Naval Ocean Processing Facility. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-045 TITLE: Acoustic Images From Active Sonar

CATEGORY: Advanced Development

OBJECTIVE: Produce an image of a target from active sonar data.

DESCRIPTION: Recent developments in high-speed computing have been exploited to build systems which can form images of aircraft from pulsed radar returns. The ability to form similar images of underwater targets, using one or more active sonar pulses, would be of great benefit to the Navy. Space and Naval Warfare Systems Command requests proposals to design, construct and demonstrate such a system.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Design effort, devoted to selecting transmitter, receivers, transmitted waveforms and signal processing algorithms.

Phase II: A prototype system will be constructed and tested against targets of interest to the Navy. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-046 TITLE: Automated Computer On-Line Library

CATEGORY: Advanced Development

OBJECTIVE: Develop an on-line library of information current in the Integrated Undersea Surveillance environment.

DESCRIPTION: Twenty years worth of pertinent information is provided to the Integrated Undersea Surveillance System Oceanographic Technicians in the form of text books and papers. The information is currently stored in handwritten notes. It would be extremely useful to the Navy to be able to provide this information to these Oceanographic Technicians from an on-line computer system. This would require a) determining which set of documents should be proved as on-line material, b) examining all results for site peculiarities, c) scanning or entering the pertinent information into a database, and d) providing the software capability to search and find any topic area by key words and titles.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Study should describe a method of performing this task which includes a basic list of documents and areas of interest and a high level design to be implemented in Phase II.

Phase II: Promising designs will be implemented, reviewed and tested at an operational Navy facility. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-047 TITLE: Non-Developmental Item Software Application to Undersea Warfare Systems

CATEGORY: Advanced Development

OBJECTIVE: Apply commercially available software to enhance Undersea Warfare Operational Systems to increase operator productivity, support data fusion and reduce training needs for military personnel in the areas of C^3I, undersea surveillance and Anti-Submarine Warfare (ASW).

DESCRIPTION: With no expected growth in naval personnel and a substantial increase in systems complexity, a greater burden has been placed on the operator. Operators need real-time access a myriad of active and passive sensor data as well as an increased need to simultaneously view and image data. The Navy is seeking innovative concepts using proven, commercially available Non-Developmental Item (NDI) software for on-line interactive text, friendly interface design, and image capture and management or create undersea warfare computer systems. The purpose is to increase operator productivity, support data fusion and reduce training needs for military personnel in the areas of C^3I, undersea surveillance, and ASW. This research effort will provide a software package which will increase operator productivity and strengthen usability.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Show feasibility of the NDI software to improve operator productivity.

Phase II: Finalize the NDI software.

NOTE: It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-048 TITLE: Develop an All-Electronic Storage Medium

CATEGORY: Advanced Development

OBJECTIVE: Develop an all-electronic storage medium to replace mechanical disk drives.

DESCRIPTION: The project will include studies on short term and long term retention of data in a semi-conductor device to replace the existing data storage devices in the Integrated Undersea Surveillance System.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Identify promising technologies and assess their merits for this project.

Phase II: Construct a prototype system using off-the-shelf items where possible. The Phase II prototype should interface with a DTC-II workstation GFE during Phase II for demonstration. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-049 TITLE: Workstations in Future Warfare Systems

CATEGORY: Advanced Development

OBJECTIVE: Optimize workstations in future Naval warfare systems.

DESCRIPTION: The most far reaching developments in warfare systems design have been the advances in technology that make workstations so important to future warfare systems. It is anticipated that these workstations can be further improved. Areas of improvement include displays, where color-coding, display rates, screen size, survivability, security, maintainability and reliability can be improved. Future systems will require significantly increased operator productivity in tactical and surveillance operation modes, embedded operator training and reduced operator monotony and stress. Finally, future hardware and software should be common to all Navy systems in order to reduce acquisition and training time costs.

The purpose of this solicitation is to request proposals to improve workstations for future Navy systems. It also request proposals for an expert system which can a) evaluate systems currently fielded and b) analyze the Operator

Machine Interface design of systems being developed. Optimization includes increasing probability of detection, classification and location: ensuring hardware and software commonality; reducing operator workload; improving operator response time; providing automatic error correcting; providing embedded training; overcoming the boredom associated with highly repetitive tasks; and reducing operator fatigue associated with current cathode ray tube displays. This effort includes applying analytical tools and methodology, tables, lists, charts, statistical and other data methods, and graphics to develop a cost effective Navy wide approach. This effort would be pursued as a general purpose Navy workstation study and design effort but would have significant application for the Integrated Undersea Surveillance System (IUSS) (i.e., Sound Surveillance System Program (SOSUS)/FDS).

Each Phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief a final report to the Navy project manager.

Phase I: Should include background research resulting in a high level design to be developed further in Phase II.

Phase II: Construct a prototype workstation or expert system and demonstrate with real data at a Navy facility. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-050 TITLE: Towed Acoustic Array Shape Estimation

CATEGORY: Exploratory Development

OBJECTIVE: Explore techniques of accurately measuring relative hydrophone positions in very long towed acoustic arrays.

DESCRIPTION: Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Identify feasible schemes for sensing the position of hydrophones in very long acoustic arranges. Proposed techniques should include transmitter and sensor placement, processing algorithms and sensitivity analysis for key parameters.

Phase II: Implement the techniques and design an experiment for at-sea performance analysis. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-051 TITLE: Quantitative Analysis of Computer Assisted Acoustic Detection and Tracking Algorithms

CATEGORY: Advanced Development

OBJECTIVE: Measure the quantitative improvement realized by computer-aided algorithms in detecting and tracking acoustic targets. Phase I would develop performance criteria and an analysis method, with limited prototyping on synthetic and real ocean data. Phase II would entail analysis of a large volume of ocean data.

DESCRIPTION: The analysis would address both stable and dynamic targets at various signal-to-noise ratios, bearing rates and bandwidths. The performance analysis algorithm would be implemented on a laboratory computer suite of the offeror's design. Test data would be analyzed to validate the algorithm.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Develop a set of performance metrics which accurately quantify the value of a computerized detection and tracking system.

Phase II: Should be a high volume data analyses using ocean data from surveillance archives. A final report would be submitted summarizing the results of all data analysis and comparing the performance of all detection/tracking systems analyzed. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-052 TITLE: Active Sonar Operator Training Workstation Concepts

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to explore innovative methods of training active sonar operations. Techniques should include methods for building operator confidence through interaction with simulated and real work data sets of varying complexity.

DESCRIPTION: Active sonar is the merging technology for ASW systems of the future. The active sonar problem presents the operator with a complex set of sonar systems and environmental operating parameters. Ocean clutter presents the operator with false detections which will have to be eliminated through both operator identification and application of new technology. This topic is to explore innovative techniques for training operators to deal with this new technology. Workstation based techniques which present the operator with an interactive learning environment and which build confidence and measure effectiveness are needed. Training techniques should include both monostatic and multistatic systems and be usable across multiple platforms.

Phase I: Show ability of training techniques to build operator confidence.

Phase II: Product development.

N91-053 TITLE: Machine Assisted Anti-Submarine Warfare (ASW) Passive Acoustic Classification System

CATEGORY: Advanced Development

OBJECTIVE: Develop a machine assisted ASW passive classification system.

DESCRIPTION: Machine assisted ASW passive classification systems have been under development for a number of years. They have seldom produced the spectacular results which had been promised. One of the reasons for this is that real experts in classification have not built up the classification database and procedures used in these systems. In this task, it is desired that businesses with experts in submarine classification build an innovative database and set of rules which will help acoustic operators to improve their ability to classify submarines, with primary emphasis on distinguishing submarines from anything else.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Compile algorithms which will classify submarines, based on the experience of experts. This will be demonstrated with a number of taped submarine signals.

Phase II: Code the classification algorithms generated in Phase I in an interactive computer system and demonstrate the classification capability in real time with recordings of signals from actual submarine encounters. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-054 TITLE: Development of Fluctuation Parameters for Use in Anti-Submarine Warfare (ASW) Acoustic Performance Prediction Models

CATEGORY: Advanced Development

OBJECTIVE: Measure characteristic of ocean propagation and noise and determine fluctuation parameters to be used in ASW acoustic performance prediction models.

DESCRIPTION: The acoustic performance prediction models for most ASW systems use the fluctuation properties of acoustic propagation and noise as an important feature in determining performance. Many of the models have been validated only to the extent that there is provision for using these statistical properties, with the operator providing the appropriate parameters. Validation of the correct values to use for these parameters has not been completed.

There is a need to gather sufficient acoustic data and provide an innovative approach to measuring its statistical properties. This would include the mean and variance and also the short term, medium term and long term fluctuation properties. Under this task, existing data will be identified and analyzed, test plans will be generated for gathering additional data, data will be gathered and analyzed and the statistical properties will be determined.

Each phase will require a) an initial brief including a program objective, actions and milestone review, b) a final review and c) a brief and final report to the Navy project manager.

Phase I: Perform a survey of existing data and identify those suitable for analysis. Additional data needed will be specified, and data gathering plans will be generated. In addition, a small amount of data will be analyzed and a data analysis plan will be generated.

Phase II: Analyze existing data identified in Phase I and gather and analyze additional data. The mean, standard deviation and associated fluctuation properties of propagation loss and ambient noise will be determined for immediate application to existing performance prediction models, along with any generalizations or caveats which will describe the limits of its application. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N91-055 TITLE: High Assurance Trusted Systems

CATEGORY: Research

OBJECTIVE: Investigate new approaches for achieving high assurance for trusted systems that accommodate innovative designs.

DESCRIPTION: The Trusted Computer System Evaluation Criteria requirements for Al systems (the highest rating specified) call for proof that a Formal Top Level Specification (FTLS) of the Trusted Computing Base (TCB) is consistent with the security policy model of the TCB and a mapping of the FTLS to the TCB code. Experience is showing that a combination of verification tool limitations and difficulty in managing the disparity of abstraction level between FTLS and code, is having a negative impact on Al system design and performance. Al systems are being designed very conservatively in order to facilitate verification constraints, with the conservative design having a negative impact on system performance and cost. New approaches need to be investigated for achieving high assurance for trusted systems that accommodate innovative designs for high performance. The new techniques should be clarified and validated through application to assure security critical properties of software modules of novel design. Techniques shall be investigated, developed, and validated to provide high assurance of high performance trusted systems.

Phase I: Innovative techniques to assure security critical properties of software modules.

Phase II: Implementation and demonstration of the technique(s).

N91-056 TITLE: Characteristics of Processing Elements with Respect to Multilevel Security

CATEGORY: Research

OBJECTIVE: Research the impact that the requirement to support the implementation of highly secure systems has on the architecture of the processing elements.

DESCRIPTON: Navy warfare systems must address the conflicting requirements of ensuring that all information necessary for mission performance is available but that access to classified information is controlled, while providing a level of system performance adequate to successfully achieve mission objectives. Experience is indicating that provision of high levels of security in INFOSEC systems has a negative impact on system performance. Advanced architectures are now emerging, such as array processors, database machines and dataflow machines that offer the potential to enable the Navy to design advanced systems to meet future operational threats. Research is required to: 1) analyze the impact that implementation of highly secure systems has on the architecture of the processing elements, 2) analyze the role that the architecture of the processing element(s) (ranging from a single chip to massively parallel architectures) plays in the design of secure systems, 3) identify architectural characteristics of processing elements that are either required for or supportive of achieving high levels (B3/AI) of multilevel secure systems, and 4) identify the tradeoffs between implementing security features in hardware, software and a combination of the two. Ideally the research will quantify the tradeoffs with respect to processing speed and throughput.

Phase I: Analytical effort to examine processing element features with respect to incorporation of security.

Phase II: Demonstration of effect of processing elements incorporating security on system performance and quantify trade-offs.

N91-057 TITLE: Security Features for Workstations

CATEGORY: Research

OBJECTIVE: Investigate techniques to develop highly trusted security features for workstations.

DESCRIPTI0N: Current workstation technology allows for security at the B2 level. Improvements on this are difficult due to the nature of the architecture and use of a workstation. Efforts at developing a highly trusted workstation in the past have been incompatible with most commercial software due to unique operating systems, while efforts using standard operating systems have been unable to achieve the necessary security levels. Other areas needing research are in server and window management techniques.

Practical use of workstations in a trusted environment will require high levels of security (B3 or A1) while being compatible with existing operating systems and applications software. Research is required to: 1) provide security features for all components of workstations (i.e., operating system, window manager, data retrieval, etc), and 2) provide compatibility to existing workstation software.

Phase I: Analyze security features of workstations and determine effect on data entry/data retrieval capabilities.

Phase II: Demonstrate security features of workstations using modern man-machine interfaces such as windows.

N91-058 TITLE: Technology to Establish and Support the Role of Man in Computer Security Systems

CATEGORY: Research

OBJECTIVE: Develop technology and methods to ensure secure access to information residing in compartmented databases.

DESCRIPTION: Navy computer based systems need appropriate security features to ensure that all information necessary for performance is available but that access to classified information is controlled. The driving need is to ensure that the required information is available but is not compromised. Information residing in special compartmented information databases must be transferred to general service users who need it. Since this transfer is currently performed by human controlled interfaces, developers of systems must be provided with the means of ensuring that human performance does not impair the flow of information nor compromise the security of the information. Current system design concepts identify a critical role of man in system operation without the requisite technology to support these assigned roles. Problems of impaired vigilance, confusion, boredom, overload, stress, and inadequate motivation serve to degrade the performance of human operators in routine and continuous activities. The research should address the following: 1) human performance limitations in allocating system functions to man or machine; 2) the design of system displays, software and procedures to enhance human performance while compensating for human limitations; 3) quantify the problems associated with impaired vigilance, confusion, boredom, overload, stress, and inadequate motivation; and 4) provision of intelligent decision aids to assist and support the performance of human functions.

Phase I: Conduct analytical effort to identify technologies supporting the role of man in computer security systems.

Phase II: Demonstrate the requisite technologies.

N91-059 TITLE: Expert System for Multilevel Security

CATEGORY: Exploratory Development

OBJECTIVE: Propose, design and develop an advanced decision aid to assist and support the performance of human functions in multilevel secure systems.

DESCRIPTION: Navy computer based systems need appropriate security features to ensure that all information necessary for performance is available but that access to classified information is controlled. Current system design concepts identify critical roles for human operators in secure system operation (e.g., for information fusion and reclassification, for transferring information in a compartmented database to general service users, etc.). Problems of impaired vigilance, confusion, boredom, overload, stress, and inadequate motivation serve to degrade the performance of human operators in routine and continuous activities. Artificial Intelligence (AI)/expert system technology makes the development of "advanced" decision aids which can perform logical evaluation of the information feasible. The development of such AI based decision aids differs from that of conventional decision aids in that they incorporate the logic or "knowledge" of experienced users rather than just mathematical algorithms. Expert system technology is promising in that it offers the potential to capture the knowledge of experienced personnel, and to off load the human operator by evaluating the information and making recommendations. Research is required to investigate the applicability of artificial intelligence technology to the domain of multilevel security. The research should identify areas where expert systems could significantly contribute towards achieving secure systems, and select one or more areas for detailed definition, design and implementation of a prototype intelligent display aid.

Phase I: Investigate applicability of artificial intelligence technology to multilevel security.

Phase II: Demonstrate expert system(s) as applied to multilevel security in Navy systems.

N91-060 TITLE: The Inference Problem in Multilevel Secure Database Management Systems

CATEGORY: Research

OBJECTIVE: To propose and investigate possible solutions to the inference problem which occurs in Multilevel Secure/Database Management Systems (MLS/DBMSs).

DESCRIPTION: It is possible for users of any DBMS to draw inferences from the information that they obtain from the databases. The inferred knowledge could depend only on the data obtained from the database system. The inference process can be harmful if the inferred knowledge is something that the user is not authorized to acquire. A user acquiring information which he is not authorized to know has come to be known as the inference problem in database security. In a multilevel secure environment, the users are cleared at different security levels and they access a multilevel database where the data is classified at different sensitivity levels. Security violation by inference occurs in multilevel databases if a user acquires unauthorized information from information he has obtained by either querying the database, updating the database, examining the metadata, or some combination of those actions supplemented by some real world knowledge. In a multilevel environment, unauthorized information is any information which is classified at a level that is not dominated by the user's level. Providing a solution to the inference problem, where users issue multiple requests and infer unauthorized knowledge, is beyond the capability of currently available MLS/DBMSs. Research is needed to minimize the risk of security violations by inference in MLS/DBMSs.

Phase I: Identify possible solutions to the inference problem in MLS/DBMSs.

Phase II: Demonstrate solutions to the inference problem.

N91-061 TITLE: Placement of Network Security Services for Secure Data Exchange

CATEGORY: Research

OBJECTIVE: Determine the security services required to address Navy threats.

DESCRIPTION: ISO 7498-2 identifies five basic security services: 1) access control, 2) authentication, 3) data confidentiality, 4) data integrity, and 5) non-repudiation. These services provide assurance against the security threats of unauthorized resource use, masquerade, unauthorized data disclosure, unauthorized data modification, and repudiation, respectively. This effort is to address the layers within the ISO OSI Basic Reference Model, ISO 7498, where it is appropriate to apply security services for Navy applications. The distinction is to be made between Local Area Networks (LANs) and Wide Area Networks (WANs). For example, at Layer 2, a WAN is a set of discrete, point-to-point links. Data received at one endpoint of a link can be assumed to have come from the other end of the link. This is not the case at Layer 2 of the LANs and Layer 3 of the WANs. The nature of data transmission in Layer 2 of WANs and the associated risks do not require security services to counter the threat of masquerade and unauthorized resources use. However, these threats must be addressed at Layer 3 of WANs. What is needed is a thorough analytical effort that addresses the security characteristics that should be included in each of the seven layers of the ISO OSI model for both LANs and WANs, taking into account features that are important to the Navy such as bandwidth, speed, survivability, reconfigurability, etc.

Phase I: Analyze security characteristics that should be included in each of the seven layers of the ISO OSI model for both LANs and WANs.

Phase II: Demonstrate a sub-set of the security features in selected levels of the ISO OSI model.

N91-062 TITLE: Composibility Constraints of Multilevel Secure Systems

CATEGORY: Research

OBJECTIVE: Research into techniques for achieving verifiable security levels when aggregating and integrating trusted elements, components, and sub-components.

DESCRIPTION: Current Information Security (INFOSEC) systems are networks of interconnected processing elements and databases connected to devices which allow human operators to interface with the data and computing resources. The collection of processing elements typically represent a heterogeneous mix of architectures, capability and classes of trust. The concept of a Trusted Computer Base (TCB) was initiated when computer systems were

basically monolithic systems consisting of a mainframe or host computer which interfaced to the users by directly connected unintelligent terminals. These terminals had a unique I/O port or were multiplexed to a single port in such a way that the host computer knew which terminal or group of terminals it was talking to by knowing the physical port to which the terminals were connected. Present computer systems are networks constructed with many processing elements which may or may not include a host computer. Local Area Networks (LANs) have replaced the direct connections. This effort should address the issues/constraints associated with developing trusted systems through the combination and integration of trusted components such as trusted operating systems, trusted Database Management Systems (DBMSs), and secure LANs. A composibility model is to be developed which will allow an evaluation of the security properties of a combination of trusted components whose individual security properties have been evaluated separately.

Phase I: Analyze issues/constraints in system development associated with combining trusted components.

Phase II: Demonstrate a subset of the effect of combining trusted components in the system development process.

NAVY MEDICAL RESEARCH AND DEVELOPMENT COMMAND

N91-063 TITLE: Isolation and Characterization of Proteins from Campylobacter Jejuni, Campylobacter Coli and Other Important Enteric Pathogens for Oral Immunization

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate ability to isolate and characterize immunologically relevant proteins from bacteria for rapid diagnosis and immunization. The goal is to provide quantities of material for laboratory and field testing.

DESCRIPTION: Immunization against enteric infections involves priming the local immune environment against the antigens of the infecting agent. For an intestinal infection, such as is seen in Campylobacter species and other enteric infections, the priming (inductive) sites are the Peyer's patches, small lymphoid nodules located in the small intestine. Considerable cross reactivity exists among the antigens of enteric pathogens and normal host flora of the small intestine. It is important, therefore, to identify antigens unique to the immunizing strain which are recognized by intestinal (IgA) antibodies of protected animals. We have shown that animals can be protected against infection with immunizing organisms. A need exists for the identification and preparation of protective proteins specific for strains of Campylobacter species or other important enteric pathogens. Proteins isolated by the offeror will be tested for their ability to elicit immune responses, such as T-cell and antibody reactivity, and these responses compared to those in animals immunized by infection. Additional material will be used for experimental immunization and rapid diagnostic techniques. The offeror must provide capability in Western Blotting, ELISAs, as well as FPLC or preparative gel electrophoresis techniques for the isolation of proteins of selected strains of Campylobacter species.

NAVAL AIR SYSTEMS COMMAND

N91-064 TITLE: Data Compression Schemes for UAV Sensor Data

CATEGORY: Exploratory Development

OBJECTIVE: To develop and implement data compression schemes to support near-real-time transfer of UAV sensor data on limited bandwidth data links.

DESCRIPTION: One of the primary missions for non-lethal unmanned aerial vehicles (UAVs) is near-real-time reconnaissance in a hostile environment. To perform this mission the UAV may use an imaging system such as a video camera. The video data is transmitted through an RF data link to the UAV controller. The techniques used to make a data link resistant to jamming may reduce the data link transfer capability to 1/20 of the rate at which data is collected by the sensor. Techniques and/or algorithms which would compress the sensor data to match the link data rate are required. Data compression, expansion and display are required in near-real-time.

Phase I: Demonstrate feasibility of a near-real-time data compression and expansion scheme which would allow transfer of video data on a 50K Baud stream. Efforts shall be reported in a Phase I final report.

Phase II: Develop a prototype system to demonstrate the proposed scheme.

N91-065 TITLE: Ultra Wideband (UWB) Radar/Data Link

CATEGORY: Exploratory Development

OBJECTIVE: Develop small, lightweight, survivable UWB radar for potential use as a data link. This approach would reduce payload cost and weight, while increasing operability, maintaining covertness and providing a wide bandwidth survivable data link.

DESCRIPTION: Current generation data links are susceptible to enemy countermeasures, can be detected, may highlight the unmanned aerial vehicle's (UA V's) position to enemy air defenses and provide a poor cost/performance tradeoff for UAV's. The purpose of this project is to demonstrate the feasibility of using UWB/Impulse radar techniques for a UAV data link.

Phase I: Study to determine the feasibility and characteristics of UWB/Impulse radar data link and the design for a proof-of-concept demonstrator for UAV application.

Phase II: Fabricate a proof-of-concept design and experimental verification of the approach used.

N91-066 TITLE: Status Boards for Use with Air Traffic Control Radars on Aircraft Carriers and Amphibious Ships

CATEGORY: Advanced Development

OBJECTIVE: To provide an automated status board system for use with the Carrier Air Traffic Control (CATC) and Amphibious Air Traffic Control (AATC) Direct Altitude Identity Readout Systems. Existing status boards are out-moded, manpower intensive to maintain and not user friendly to update.

DESCRIPTION: In addition to controlling aircraft, CATC Center and AATC are information gathering operations. Information status boards are used for both planning and action. They must be accurate and continuously updated. The present system of requesting, relaying, posting and updating information is too slow, cumbersome, time consuming and not always 100 percent accurate. The present status board now requires six board writers to accomplish the work required to update and maintain. A new system is required to alleviate these problems including a fail safe back up capability.

Phase I: Study outlining the approach which will be undertaken to pursue the requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to convert one government furnished status board and deliver it to the government for testing.

N91-067 TITLE: Advanced ESM Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop new ESM subsystem architectures and signal processors to detect and effectively handle modem radar waveforms, potential radar reserve modes and modem ECM jamming waveforms.

DESCRIPTION: S-3 aircraft are currently using the ALR-76 system to perform EW related functions. The primary purpose is to develop improved ESM subsystem architecture and signal processing techniques which can be added to the current system to handle hostile environments expected in the 1990s and later.

Key technical problems are signal detection, sorting and classification of modem radar waveforms. Also, the improved ESM system should handle potential radar reserve modes and modem ECM jamming waveforms.

Phase I: Develop improved ESM subsystem architecture and signal processing concept, critical technical tradeoff analysis, and determine measures of effectiveness in simulated environments.

Phase II: Demonstrate critical technical elements associated with the enhanced EW system and quantify expected performance in S-3 aircraft operational systems.

N91-068 TITLE: Radar ECCM Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop radar ECCM techniques to detect and eliminate ECM noise jammer, repeater jammer, and transponder jammer signals from radar target track files.

DESCRIPTI0N: S-3 aircraft are currently using the high resolution AN/APS-137 radar system for surveillance and target tracking functions. The fundamental purpose of this development effort is to develop new ECCM techniques for the APS-137 radar system to defeat modem ECM systems. ECM systems include repeater jammers, transponder jammers and noise jammers. Currently radar track files are overflowing with real targets and active ECM false targets. These ECM false targets come from noncoherent and coherent ECM jamming systems.

The basic technical problem is to discriminate and eliminate active ECM signals and leave only true target returns in the radar track files. This capability implies optimal use of radar assets and fire control system assets for targeting purposes.

Phase I: Develop basic ECCM technical concept, technical tradeoff analysis, simulation of basic ECCM discrimination technique, and determine radar target/ECM signal discrimination improvements. Also, an improved APS-137 radar architecture configuration will be developed which includes the new ECCM discrimination technique.

Phase II: Demonstrate the technical feasibility of the new ECCM discrimination technique for the APS-137 radar.

N91-069 TITLE: Supersonic Conformal Radomes Covering 2.0 Thru 100 GHz

CATEGORY: Advanced Development

OBJECTIVE: To develop and build antenna radomes which can withstand supersonic shock waves, large temperature variations, all environmental conditions of a Naval fighter aircraft or missiles and be electronically transparent from 2 to 100GHz. If successful, the radomes and/or materials would be used as the advanced radar warning receiver antenna radomes.

DESCRIPTION: Environmentally suitable aircraft antenna covers are available for the conventional microwave frequency region of 0.1 to 8.0 GHz. New requirements exist to extend antenna performance to 100 GHz. The purpose of this project is to develop new dielectric material or extend the capability of existing antenna cover materials to provide the desired environmental and electrical performance.

Phase I should consist of a materials study intended to identify the candidate antenna cover materials, their properties and availability/producibility.

Phase II should provide material samples along with appropriate environmental and electrical test data. The material sample(s) should be in the form of a usable antenna cover. The design drawing for the test cover(s) will be provided by the government as part of this phase.

N91-070 TITLE: Automation Tradeoffs Analysis Tool

CATEGORY: Exploratory Development

OBJECTIVE: Analyze, design, and prototype a tool for evaluating the costs and benefits of automating various functions within an unmanned aerial vehicle (UAV) system.

DESCRIPTION: Current generation UAV systems depend heavily upon man-in-the-loop operations for many of their functions (e.g., mission planning, air vehicle control, sensor control and interpretation, etc.). With the manpower drawdown and increasing application of expert system technologies, there will be significant opportunities for automating many of the critical UAV functions. A tool is needed to aid in determining which functions should be automated, how the interface with the operator should be redesigned to reflect this automation, and what the payoffs are in terms of system performance, to optimize design investments. This tool would involve several components. First, there would be a simulation of the UAV system and its subsystems, including the man-machine interfaces. Second, a human operator model is necessary, to project the impact of changes in system design on operator performance. Third, there must be a simulation of the combat environment, to provide a context for determining relative system performance and examining tradeoffs in a variety of mission situations. The development of this Automation Tradeoffs Analysis Tool would be divided into two phases.

Phase I: Design study conducted to establish the system architecture including the structure and interactions of the component models.

Phase II: Fabricate a prototype system for experimental verification and validation of the concept.

N91-071 TITLE: Helicopter Main Rotor Blade Elastomeric Dampers

CATEGORY: Advanced Development

OBJECTIVE: To study the application of advanced materials to solve the problem of helicopter main rotor blade damper failure.

DESCRIPTION: The SH-60B helicopter has experienced excessive damper failure due to the materials used and the design of the damper system.

The contractor will study alternate main rotor blade systems and materials for application to the SH-60B and other Naval helicopters in Phase I.

Phase II will consist of testing the concept of design and materials determined to be optimum in Phase I.

N91-072 TITLE: Helicopter Main Rotor Blade Pitch Change Rod End Bearings

CATEGORY: Advanced Development

OBJECTIVE: To find an alternate material for SH-60B Pitch Change Rod End Bearings. If successful, the Navy will save money used to buy spares and increase operational availability of SH-60B helicopters.

DESCRIPTION: Pitch change rods are used to change the angle of attack of the main rotor blades. The rods rotate around end bearings, which wear out rapidly. Each time one of the end bearings (8 bearings per rotor head) is replaced a post maintenance check flight must be conducted, keeping the aircraft from operational flights.

The contractor will research applications of advanced materials to increase the rod end bearing life.

N91-073 TITLE: MV-22/HV-22 Weapons System Integration and Armament Control

CATEGORY: Engineering Development

OBJECTIVE: To develop a Stores Management System (SMS) integrating weapons loadout capability with the helmet mounted display/sight (HMDS) in the V-22. After a successful system architecture is defined an engineering development model would be built and flight tested on a V-22. If successful, the goal would be to incorporate the system.

DESCRIPTION: There exists an outstanding operational requirement to incorporate defensive armament on the V-22. Currently the projected armament includes the following: turret mounted 50 caliber machine gun; two to four Stinger missiles; two Sidewinder and/or Sidearm missiles; two to four Sparrow missiles. The SMS will be the aircraft avionic subsystem that controls and monitors the operational status of installed weapons and provides and manages the communication between affected aircraft subsystems. This system architecture will split the Stores Management Control Unit into separated units into different aircraft areas. These units will be interconnected with a MIL-STD-1553B bus and a wideband signal network (for video, audio, RF and pulse signals). The aircraft subsystems that will be managed on these networks, will be a HMDS, a Forward Looking Infrared and threat warning equipment. The goal of this systems architecture is to minimize flight crew work load and maneuvering and deviation from preplanned flight path while still allowing the crew to meet the threat. This is of particular importance when approaching a landing zone or a strike rescue pickup.

Phase I should consist of a system architecture study which will be undertaken to pursue the requirements addressed above with sufficient data to demonstrate feasibility.

Phase II should use the approach outlined in Phase I to develop an engineering model and deliver it to the government for testing.

N91-074 TITLE: AH-1W Attack Helicopter Detectabilitv Reduction

CATEGORY: Advanced Development

OBJECTIVE: Develop methods to reduce detectability of the AH-1W aircraft. Successful reduction methods could lead to prototype development and testing.

DESCRIPTION: The US Marine Corps, through new production and a block upgrade modification program, will achieve an all AH-1W attack helicopter fleet by the mid-1990s. This aircraft must remain capable of meeting the threat well into the 21st century. Increasing operational commitments require a reassessment of AH-1W detectability, which addresses, as a minimum, materials and systems in the following areas: (1) infrared (IR) signature; (2) radar cross section (RCS)/low observables, including fuselage/rotor shape and angles; (3) electromagnetic emissions; (4) visual features, including surface treatment and rotary-wing unique features; and (5) acoustic levels, including both vertical and forward flight.

Phase I: Design/trade-off study which evaluates the application and availability of advanced technology.

Phase II: Develop simulation models to demonstrate selected detectability reduction approaches.

N91-075 TITLE: AH-1W Attack Helicopter Maintenance/Manpower Reduction

CATEGORY: Advanced Development

OBJECTIVE: Develop methods to reduce maintenance and associated manpower requirements for the AH-1W aircraft. Successful reduction methods could lead to development of technical documentation and training material.

DESCRIPTION: The US Marine Corps, through new production and a block upgrade modification program, will achieve an all AH-1W attack helicopter fleet by the mid-1990s. This aircraft must remain capable of meeting the threat well into the 21st century. Improving the AH-1W maintenance process--with attendant manpower, documentation and reporting requirements--is an area requiring focused attention.

Phase I: Investigate and evaluate the AH-1W maintenance process and development of design/trade-off studies which report these results. The report also will offer recommendations concerning methods for improving the process, along with implementation plan(s).

Phase II: Implement appropriate technical documentation and training material.

N91-076 TITLE: AH-1W Attack Helicopter Cockpit Workload Reduction

CATEGORY: Advanced Development

OBJECTIVE: Develop recommendations to reduce pilot and copilot/gunner cockpit workload in the AH-1W aircraft. Successful reduction methods could lead to development of computer simulation models and ultimate prototype development/testing.

DESCRIPTION: The US Marine Corps, through new production and a block upgrade modification program, will achieve an all AH-1W attack helicopter fleet by the mid-1990s. This aircraft must remain capable of meeting the threat well into the 21st century. Naval Aviation Board of Inspection and Survey Yellow Sheet Reports identify cockpit design/integration deficiencies which range from man-machine interface issues such as critical field of view blockage and increased crew workload to those problems associated with aircraft ingress/egress. Such deficiencies jeopardize crew safety and preclude realization of enhanced mission capabilities.

Phase I: Investigate and evaluate cockpit workload, which will be documented in design/trade-off studies. The report also will offer recommendations to reduce this workload or methods that could reduce workload. Yellow Sheet Reports will be available to those firms possessing a security clearance of confidential.

Phase II: Develop selected computer simulation model(s), if applicable.

N91-077 TITLE: Advanced Aircraft Coating Removal

CATEGORY: Advanced Development

OBJECTIVE: Develop processes and methodologies for the removal of aircraft coatings that are environmentally benign. Such processes must be technologies that have some already developed applications related to paint removal. Suggested processes include but are not limited to ultrasound, flashlamp, ultraviolet radiation, etc. The process cannot use hazardous chemicals or energetic blasting media to remove aircraft paint.

DESCRIPTION: Current and anticipated environmental regulations do not favor the traditional chemical stripping of aircraft coatings. Energetic blasting methodologies are considered limited due to attendant structural damage and the need to dispose or recycle the hazardous blasting media wastes. Alternative innovative technologies are sought which will result in a controlled removal of aircraft paint without the generation of hazardous wastes. Naval aircraft paint systems consist of an epoxy based primer and a polyurethane topcoat. Substrate materials include aluminum, titanium, and graphite-epoxy composites.

Phase I: Selection and development of the most promising coating removal candidate with a small scale demonstration of the removal process on sample panels with the aircraft coating system. Phase I must show effective coating removal without substrate harm.

Phase II: Consists of a scale-up of the operation to determine the operational and industrial effectiveness of the process as well as its potential cost-benefit. Contractor should plan to work closely with a Naval Aviation Depot during this phase in implementing the full scale process.

N91-078 TITLE: Solvent Free Coating Application

CATEGORY: Exploratory Development

OBJECTIVE: Develop processes and methodologies for the application of aircraft coatings and corrosion inhibitors without the use of cut-back solvent technologies. Aircraft coatings, corrosion inhibitors, and spray treatments make use of volatile solvents as application media. The use of such solvents is becoming increasingly restrictive. Alternate innovative technologies are needed to facilitate quality application without generating solvent air emissions.

DESCRIPTION: Current and anticipated environmental regulations do not favor the traditional solvent medium for coating and surface treatment applications. While advances are being made in high coating solids technologies, there may be an upper limit of the percentage of solids in coatings and other materials similarly applied. An innovative technology program is sought for the introduction of new methods/media for application of the above materials. High temperature application processes are limited due to the temperature sensitivity of the materials being applied and the various substrate materials that are to be treated.

Phase I: Selection and development of the most promising material application candidate technology with a small scale demonstration of the process on sample aircraft substrate panels. Phase I must show effective material application without substrate harm and with satisfactory performance.

Phase II: Consists of a scale-up of the operation to determine the operational and industrial effectiveness of the process as well as its potential cost-benefit. Contractor should plan to work closely with a Naval Aviation Depot during this phase in implementing and evaluating the full scale process.

N91-079 TITLE: Biotechnological Processes to Strip Polyurethane Paint from Naval Aircraft

CATEGORY: Exploratory Development

OBJECTIVE: Develop a biotechnological process to strip polyurethane paints form Naval Aircraft

DESCRIPTION: Paints used on Naval aircraft have a polyurethane carrier for the pigment. Current practice, which does not meet EPA requirements, is to strip these paints with a methylene chloride stripper. Mechanical methods are also being considered but are not of interest here. It is desired to develop a biotechnological method to strip Milspec paints (such as Mil-C-83286) used on Naval aircraft.

Phase I: Demonstrate that microbial products such as surfactants, or enzymes, can strip paints at an acceptable rate and be consistent.

Phase II: Proceed to enhance efficacy and produce reasonable volumes of biological product which will have reasonable performance characteristics, shelf life, temperature range, and so on to make a product with satisfactory application and industrial properties.

N91-080 TITLE: Impact Damage Detection for Composite Aircraft Structures

CATEGORY: Advanced Development

OBJECTIVE: To develop a rapid detection method for field inspection of aircraft composites for low velocity impact damage. The system developed must be able to inspect both the upper and lower surfaces of wings and horizontal stabilizers, as well as vertical stabilizers.

DESCRIPTION: Current impact damage non-destructive evaluation methods to inspect composite materials are varied, and each method has specific limitations. Ultrasonic scanning devices have proven very reliable and sensitive to low energy impact damage. Simple portable modules have been made for field use. However, these systems are typically manual and tedious to use, and require significant operator care to ensure full area scanning.

Moire Methods have been proven reasonably effective on flat surfaces, but can only inspect a few square inches at a time, and results are difficult to interpret on curved surfaces such as wing skins.

Holography/Shearography methods require external excitation so that delaminations can be seen. This raises laser safety questions in implementation in the field, where working in enclosed areas may be difficult.

All current methods have disadvantages, particularly in implementation at the field level. None of these solutions provide rapid field identification of possible impact damage sites.

The proposed system will detect localized impact damage as small as 0.001 inches high. The system will inspect 20 square feet of surface area in 30 minutes with minimal setup time. The inspection process will be repeatable and inspection data will be recorded to keep a history of damaged areas.

Phase I: Evaluation of the proposed inspection techniques to determine any necessary refinements or shortcomings. An evaluation of variables found on in-service aircraft surfaces and environmental conditions at typical field sites will be conducted during this phase.

Phase II: Purchase and development of equipment determined to be necessary during Phase I. Phase II win be completed by a demonstration and full implementation of a field-hardened system at a typical site.

N91-081 TITLE: Electrochemical Machining Process Optimization for Engine Components

CATEGORY: Advanced Development

OBJECTIVE: To develop a process design and optimization program for electro-chemical machining (ECM) of jet engine components. Such a design tool would allow cost-effective production of high-tolerance components for jet engine applications.

DESCRIPTION: ECM is a complex final machining operation for nickel base and titanium alloy jet engine components, such as fan and compressor blades. Optimization of the ECM process parameters for these complex parts often requires many iterations to achieve production parameters that meet the stringent tolerances required for engine applications. The trial and error route leads to increased component fabrication costs. This project will develop a process design program, using both heuristic (knowledge-based) and analytical modeling, to establish ECM process parameters from part configuration and material description.

Phase I will entail development and Phase II will apply the program to several prototype components and will establish the resulting production cost and quality payoffs.

N91-082 TITLE: UAV Propulsion System Heat Exchanger Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop the lightest, smallest, and most efficient cooling system for use on UAV diesel engines.

DESCRIPTION: Current liquid cooling systems used with unmanned aerial vehicles (UAV's) engines consist of large liquid to air heat exchangers circulating a glycol/water mixture. When integrating the cooling system into an air vehicle, there is an aerodynamic drag penalty due to the cooling radiator. Advances in size and weight reduction with an increase in efficiency would greatly benefit present and future UAV's. DOD would therefore like to investigate any new heat exchanger/cooling system concepts that are applicable to lightweight UAV engines. It is anticipated that investigation into candidate heat exchanger/cooling system concepts would be divided into two phases.

Phase I: Conceptual designs would be generated and validated through theory and analytical assessment and/or testing.

Phase II: Fabricate proof-of-concept designs and experimental verification of the approach.

N91-083 TITLE: T64 Engine Compressor Erosion Resistant Blade Coating

CATEGORY: Engineering Development

OBJECTIVE: To develop a compressor blade coating that will reduce the erosion due to ingestion of sand and other particulate matter.

DESCRIPTION: The T64 engine is used in the U.S. Navy CH-53D/E aircraft which sometimes operates in an environment where sand is ingested into the engine. In some cases, the life of the compressor blades is reduced to 1/4 of their normal life expectancy. Erosion of compressor blades results in a reduction of operating efficiency and, if severe enough, engine stalls. A blade coating is desired that will reduce the effects of blade erosion. The T64 compressor blade base material is titanium.

Phase I: Provide the technology or technologies that would best accomplish the objective. Consideration must be given to producibility, assessment of effects on fatigue life, overall effectiveness, and repairability after use. An estimate of cost per unit of the final product would be helpful.

Phase II: 1) Perform fatigue testing and test the erosion capability of the coating compared to uncoated blades. The government will provide the blades for test. 2) Provide two engine sets of coated compressor blades. The government will provide an engine/field test for final assessment.

N91-084 TITLE: S-3 Aircraft Warfare Systems Architecture

CATEGORY: Exploratory Development

OBJECTIVE: To evaluate Warfare Architectures for the S-3 aircraft avionics system.

DESCRIPTION: Top Level Warfare Requirements (TLWRs) are currently controlling Navy acquisition decisions and warfare strategies. Warfare System Architectures need to focus on TLWRs compliance. Warfare System Architecture analysis needs to be performed for S-3 aircraft avionics system using Navy TLWRs. The Warfare Systems Architecture evaluation should include functional decomposition of the S-3 aircraft mission, develop quantitative performance evaluation algorithms for S-3 Warfare Architectures, architecture evaluation analysis to determine performance capabilities and limitations, and architecture improvements to resolve performance limitations. S-3 Warfare Systems Architecture options need to be established and related to level of compliance with TLWRs.

Phase I development will include development of quantitative performance evaluation algorithms for S-3 Warfare Architectures and preliminary evaluation analysis.

Phase II developments will include complete S-3 Warfare System Architecture analysis and establish level of compliance with TLWRs.

N91-085 TITLE: Missile Lug/Composite Material Integration

CATEGORY: Engineering Development

OBJECTIVE: Develop a design/procedure for integrating missile lugs to a cylindrical case of composite material construction (braided and filament wound). If successful, the design/procedure may be incorporated in a Navy composite rocket motor case design.

DESCRIPTION: Composite materials have been successfully applied to the construction of rocket motors. Advantages have been weight reduction, increased strength and decreased cost. Recent Navy testing has demonstrated that rocket motors of composite materials react less violently to extreme environmental hazards. However, techniques for incorporating lugs (the mechanical support for attaching the missile to the aircraft's missile launcher) have not been successfully demonstrated. This technology is required to apply composite materials to the design of state-of-the-art tactical air-launched missiles. Programs concerning both composite braiding and filament winding will be considered due to the unique nature of each method.

Phase I: Develop alternative methods of integrating missile lugs to a cylindrical body constructed of composite materials. The end product of this phase will be a technical report documenting the design/procedure alternatives.

Phase II: Demonstrate the lug integration design/procedure by designing, manufacturing and testing three sample composite cylinders. The cases will be designed to AMRAAM dimensions and maximum loads and constructed of graphite fiber composite with Kevlar outerwrap. The lug design, in the area of its missile launcher interface, will be established by the government. The contractor will be responsible for designing the lug in the missile body interface area. The tests will be conducted at a government facility. The end product of Phase II will be the contractor's final report assessing the design and detailing the production procedures.

N91-086 TITLE: Virtual Reality Technology Including True Stereo Interactive Displays for ASW Aircraft Environments

CATEGORY: Exploratory Development

OBJECTIVE: Identify state-of-the-art virtual reality three dimensional (stereo effect) interactive display technology, and develop and demonstrate a system which is potentially useful for complex data/high data rate situations aboard US Navy anti-submarine warfare (ASW) aircraft.

DESCRIPTION: Current Navy ASW display technology, including hardware, software, and man-machine interfaces (MMI), desperately needs upgrading to prevent operator overload in high data rate and complex data/high display density situations. Because of rapid improvements in all aspects of display technology, and extensive independent research on MMI's, it is difficult to assess the status of research to date. This work first will attempt to identify state-of-the-art research in display technology and MMI, both within the Department of Defense and in private industry. Virtual Reality (VR) technology (including three dimensional color displays, interactive power/data gloves, special eyeglasses (video phones), special video screens, and voice-activated display command and control), and holographic technology are only some of the techniques which should be considered. This effort will then proceed to select those techniques which seem to have the most potential for use in Navy ASW aircraft, and demonstrate them. Emphasis will be on sensor operator applications involving high data rate broadband and chaotic signals from a single source, and on tactical use in high display density situations.

Phase I: Produce a deliverable technical report surveying the field of display and MMI technology and identifying specific concepts with the greatest potential for air ASW applications.

Phase II: An optimum subset of this technology should be defined and applied to typical high data rate signals and tactical situations. Phase II deliverables should be a demonstration and a documented prototype hardware and software package which incorporates the selected technology.

N91-087 TITLE: Service Tough Composite Panels

CATEGORY: Exploratory Development

OBJECTIVE: To develop a method of toughening laminated composite panels used on aircraft structures so as to avoid delaminations around edges and fastener holes in service.

DESCRIPTION: Current Navy aircraft with fuselage skin panels fabricated of laminated graphite/epoxy composite materials experience maintenance problems with these panels. Delaminations appear along the free edges and around bolt holes, particularly when the panels are frequently handled and removed. The problem is referred to as a lack of toughness. Modifications to the resin matrix to improve its toughness do not seem to be effective in eliminating the problem. Other concepts for improving laminate toughness have so far been found to degrade the basic strength of the laminate. Innovative approaches are needed to extend the service-testing of an actual component on a Navy aircraft.

Phase I: Investigate one or more innovative concepts for toughening composite panels against delamination under service usage conditions. Limited fabrication basic properties.

Phase II: Fabricate and service-test an actual component on a Navy aircraft.

N91-088 TITLE: Reliable Sandwich Structures

CATEGORY: Exploratory Development

OBJECTIVE: Provide efficient sandwich structures without the R&M problems of current honeycomb sandwich.

DESCRIPTION: One of the most efficient structural concepts for aircraft wing and fuselage skins is the sandwich, where inner and outer face sheets are separated by a core in order to efficiently react out-of-plans bending loads. Navy service experience, however, particularly with aluminum and nomex core sandwiches, has been that excessive maintenance is required. Some of the problems are moisture intrusion and retention, and low velocity impact damage. To date, alternative cores such as foam, balsa wood, and honeycombs of fiberglass of graphite/epoxy have not provided sufficient improvement to displace the use of aluminum and nomex. Skin/stringer concepts are currently specified for all Navy application, but it would be desirable to be able to use sandwich structure without its current drawbacks.

Phase I: Examine promising innovative alternatives from a weight, cost, producibility and suitability standpoint.

Phase II: Produce prototype components and gather service experience with them.

N91-089 TITLE: Advanced Gas Turbine Engine Operability

CATEGORY: Advanced Development

OBJECTIVE: To improve fuel and air flow for varying flight environmental changes i.e. Air Combat Maneuvering (ACM), full power excursions, and extreme off axis inlet duct airflow situations that will be experienced by high agility aircraft. If successful, fewer operational engine failures would result in fewer flight departures, longer total engine life, increased engine efficiency, enhance flight safety, and lower total costs.

DESCRIPTI0N: Present aircraft engines are expected to maintain proper compressor variable geometry and fuel flow under all engine operational conditions i.e., altitude, temperature, high and low power, and during numerous rapid and instantaneous power excursions experienced during ACM. The purpose of this project is to determine the feasibility and provide for hardware demonstration of a concept that, though proper fuel and air flow management,

will eliminate the onset of engine compressor stalls. High agility aircraft in ACM will be highly dependent on ideally linear dynamic thrust response characteristics of their engines.

Phase I should consist of an approach and a study to meet the requirements addressed above with sufficient analytical and experimental data to demonstrate feasibility.

Phase II should use the Phase I approach to demonstrate the contractor's concept applicable to a current military engine available for government testing. Phase II should also demonstrate how the new concept could be incorporated into future engine designs.

N91-090 TITLE: Enhanced Lift Thru Dynamic flow Manipulation

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the effects of wing sweep and camber on the development of lift dynamic oscillating wings.

DESCRIPTION: Preliminary experimental studies have indicated a significant enhancement to aerodynamic lift can be derived from the oscillation of the wing. These investigations have been conducted primarily in the two-dimensional realm. It is desired to extend this investigations into three-dimensional flow to address the application of this technology to realistic flow conditions and representative wing/control surface configurations. Parameters of interest include wing sweep and camber, extent of surface area required to be oscillated to achieve the enhanced lift, extent of angle-of-attack/sideslip range in which enhanced lift is achievable and sensitivity to unsteadiness in the freestream.

Phase I: Study outlining the approach which will be undertaken to determine the significance of the parameters (e.g., wing sweep, camber) on the development of dynamic lift. The proposed effort may be either one or both computational fluid dynamics and an experimental investigation.

Phase II: Systematically evaluate the variable parameters. An analysis of application of the best concept for dynamic lift is also desired in this phase.

N91-091 TITLE: Modeling of Rotorcraft and Ship Dynamic Interface

CATEGORY: Exploratory Development

OBJECTIVE: Development of an analytical approach and computational tool for modeling the dynamics of a rotorcraft on approach and landing onboard a ship.

DESCRIPTION: Navy rotorcraft have the unique problem of maneuvering for safe landing onboard ships which are rolling, pitching, and heaving (depending on the ship and sea-state). This two-body dynamic situation is further complicated by the aerodynamic wakes generated from the ship's deck and superstructure. Currently the Navy performs Dynamic Interface testing using fleet rotorcraft and various ships of opportunity. This is a costly approach and is severely limited by the availability of fleet assets and the weather. There is a need to perform a greater portion of Dynamic Interface evaluation in the laboratory and to rely on actual testing for verification and training.

A computer code that can simulate this environment, study the rotorcraft performance, could be used to develop the best approach paths for safe landings, provide improved simulator training for pilots, and ultimately be used in the design or acceptance testing of future Navy rotorcraft.

Phase I: Study outlining the approach which will be undertaken to develop this capability. Specific computational methodologies for modeling the dynamics of the two bodies and the associated aerodynamics must be identified, with sufficient data to demonstrate its feasibility.

Phase II: Develop the computational tool and at least one specific rotorcraft and ship interface should be simulated for comparison with full-scale data. Specific data will be made available by the Navy for the Phase II effort.

N91-092 TITLE: Integrated Hydrophone

CATEGORY: Exploratory Development

OBJECTIVE: Integrate a hydrophone, pre-amp, *ND* converter, and serial interface into a small, low power unit for use in large acoustic arrays.

DESCRIPTION: Introduction and purpose: Decreasing target strengths require the use of large acoustic arrays to increase processing gain. As the number of elements grows, the array complexity becomes burdensome. If all the pieces for an individual element were integrated together in a very small volume, a very simple cable could connect the entire array, greatly reducing the cost and complexity of the array. Frequencies of interest would be in the middle audio range.

Phase I: A study would explore and compare several feasible configurations, including an integrated silicon hydrophone. Power consumption, performance and volume would be the prime considerations. An attractive solution would integrate all the components on a single silicon chip. The Phase I deliverable would be the documentation of the investigation, a plan for device fabrication and a waterproof package design suitable for use in a large array.

Phase II: Results of the Phase I study would be put into practice and one hundred prototype integrated sensors would be constructed and packaged for use in a test array. Single sensors would be tested and their performance and power consumption would be documented. Phase II deliverables would be the sensor design documentation, 100 packaged sensors, and test data.

N91-093 TITLE: Exploratory High Speed Optical Crossbar Switch

CATEGORY: Exploratory Development

OBJECTIVE: Design and develop a large array electro-optical crossbar switch for integration with massively parallel systems.

DESCRIPTION: Applications for image and graphic processing such as real time perspective scene generation with photo-realistic texture mapping requires either highly expensive special purpose hardware or more recently, reasonably priced massively parallel devices (e.g., a nanosecond transfer between processors and memories in topologies greater than 1CXX> nodes.

Phase I: Investigate currently existing configurations of optical switch topologies for switching a display from memory location to memory location. This will also include the study of optical computing technology including, but not limited to, Optical Supercomputing Neurocomputer (c.f. H. Szu, Naval Research Laboratory, 1988) and the Compact Iterative Optical Vector-Matrix Multiplier (c.f. L. Seiman, Ford Aerospace, 1989, Neural Networks for Defense Conference). Optical switches and computing shall be characterized according to the following: bandwidth; memory capacity (number of inter-connections); memory access speed; data transfer rate; propagation delays; resistance to noise and interference; ease and method of programmability (e.g., spacial light modulator) and adaptability; error rate; light source used; photodetector material and microstructure; lens modulation transfer function (MTF), refractive index and grinding requirements. The analyses shall include a comparison of the features of optical switching with competing linear and ring bus structures.

Phase II: Recommend and design an optical topology to support an 8x8x8 and eventually a 16x16x16 processor architecture.

N91-094 TITLE: GaAs Heterojunction Bipolar Technology Development

CATEGORY: Engineering Development

OBJECTIVE: To demonstrate the feasibility of manufacturing complementary GaAs HBT circuits.

DESCRIPTION: Advanced strategic and space systems will require extremely high speed analog functions such as A/D converters for "smart weapons". GaAs heterojunction bipolar technology (HBT) offers the possibility of high speed combined with high precision. However, power requirements for this technology are rather high. A complementary HBT approach (combined NPN and PNP transistors in a monolithic chip) would help to substantially reduce power requirements without sacrificing performance. The goal of this development is to demonstrate the feasibility of manufacturing complementary GaAs HBT circuits through process development and characterization activities. Radiation hardening to strategic and space environments should also be a significant focus in the development.

N91-095 TITLE: Laser and Light Emitting! Diode (LED) Arrays for Optical Computing

CATEGORY: Exploratory Development

OBJECTIVE: To develop laser diode and light emitting diode arrays for computer applications.

DESCRIPTION: There is a need for development of laser diode and light emitting diode arrays for use in optical computing and computer interconnects. The arrays should exhibit high radiance with low threshold or drive currents to be compatible with digital or analog integrated circuits. The diodes within the array should have the capability of being individually addressed with the capability to independently vary the optical intensity of each light emitting element. The operating wavelength should be in the 850 nm spectral region.

N91-096 TITLE: Advanced Strapdown Gyros, Accelerometers and Gravity Sensors

CATEGORY: Exploratory Development

OBJECTIVE: To explore improved sensor technology for inertial navigation and control systems

DESCRIPTION: There is a need for improved sensor to measure rotation, acceleration and gravity for strapdown inertial navigation and control systems. Novel approaches incorporation magnetic, optical, and superconducting principals require investigation. Design concepts must have the potential for meeting the severe military aerospace environment while minimizing weight and volume.

Phase I will consist of a design study

Phase II will be the proof-of-concept.

NAVAL SEA SYSTEMS COMMAND

N91-097 TITLE: Light Weight Multi-Purpose Insulation System

CATEGORY: Engineering Development

OBJECTIVE: Develop a light weight insulation material system which can be used for fire, acoustic and thermal bulkhead insulation, hot and cold pipe insulation, easy shipbuilder installation, and reduced maintenance levels.

DESCRIPTION: The target performance thresholds for this product would be: a thermal k-factor of 0.3 BTU/hr/ft^2/°F, fire insulation backface temperature should not exceed 450 °F in 1/2 hour when exposed to an

ASTM-E-119 test, acoustic properties meeting MIL-I-22023 and MIL-I-23054, pre-lagged surface compatible with today's Navy paints, self-adhesive backing, and a weight one-half that of current Navy insulations. This system should be capable of replacing the majority of systems presently used on Navy vessels while meeting safety and environmental requirements.

Phase I: Demonstrate the feasibility of a multi-purpose insulation system which can be used as a fire, acoustic or thermal insulation. Determine the extent of use for a Navy vessel. Develop small bench scale samples.

Phase II: Manufacture, test and evaluate the performance of the material in several typical Navy applications. Develop manufacturing process and necessary documentation to insure production.

N91-098 TITLE: Revision of Aircraft Carrier Weight. Vertical Center, and Space Algorithms

CATEGORY: Engineering Development

OBJECTIVE: Bring the estimation of weights, centers and required areas in the aircraft carrier synthesis model up to date.

DESCRIPTION: Phase I: Develop algorithms for estimating weight, vertical centers and required areas that generally depend on gross ship attributes available at the earliest stages of design. The algorithms should reflect the changes in standards and practices since the current algorithms were developed from historical data.

N91-099 TITLE: Feasibility Study of Scaled Surface Ship Model for UNDEX Experiment

CATEGORY: Engineering Development

OBJECTIVE: To develop and verify methodologies for resolving the following issues critical to the design and verification of ships resistant to the effects of underwater explosions: (1) scaling laws; (2) the physics of surface and bottom effects, bulk cavitation, gravity, and time; (3) feasibility of devising pressurized tank, centrifugal machines or any innovative ways to solve the problems; (4) model complexity for ideal representation of true ship characteristics; and, (5) limitations and validity of testing scaled models of ship sections.

DESCRIPTION: The Naval Sea Systems Command currently conducts full-scale at-sea underwater explosion shock trials against representative ships of the class. Trials such as these are necessary to verify that the ship is properly designed and built to withstand the effects of enemy weapons in a combat environment. It is desired to be more able to use the results of trials such as these to modify ships under design and/or construction to improve their survivability. Unfortunately these trials are by their very nature not able to be conducted until after the lead ship of the class is delivered to the fleet. It is the objective of this task to provide the capability to use scale models of ships or ship sections to verify the ability of a ship to survive underwater explosion shock prior to the construction of a completed ship. This would result in both increased fleet survivability and reduced overall program costs.

Phase I: Conduct a review of the existing material on scaling laws for model testing and determine the applicability of these laws to the environment developed by underwater detonations of high explosives.

Phase II: Based upon the physics of underwater detonations and the other concerns as noted above devise improved/automated scaling laws that could be used by ship designers/analysts to predict the survivability of critical structure, systems, or equipment based upon model testing prior to the construction of the actual ship.

N91-100 TITLE: Assessment of Reliability of Ship Structures

CATEGORY: Engineering Development

OBJECTIVE: Derive the reliability levels associated with important failure modes of ship structures, and their sensitivity to variations in materials, design criteria, and loading conditions. This is necessary for the determination of the risks associated with an aging fleet. In addition, it will provide a baseline and methodology for more reliable design of future ships, both of conventional and advanced hullforms.

DESCRIPTION: Phase I: Perform an assessment of reliability levels of several ship types selected on a basis of operational requirements, size, etc., by:

- Select ship types (a minimum of three different types)
- Collect all statistical data on loads, stresses, materials and strengths necessary for reliability assessment calculations.
- Perform a sensitivity analysis of the ship to variations in materials, design criteria, and loading conditions.
- Perform a literature search on methods of risk assessment of ship structures. 0 Define critical hull girder failure modes

Phase II: If Phase II is authorized:

- Evaluate computer codes suitable for ship reliability.
- Complete collection of statistical data on loads, stresses, strengths necessary for reliability assessments.
- Complete sensitivity analysis of the ship to variations in reliability parameters. Redefine critical failure modes for structural reliability.
- Perform analysis and estimate failure probabilities for each failure mode.
- Document the probability of failure estimates for the selected ships, and their sensitivity to variations in selected design parameters.
- Recommend minimum acceptable reliability levels for each ship type, and failure mode.
- Recommend improvements to structural reliability that have the highest payoffs.
- Provide guidelines for ship structural designers on acceptable risks associated with different failure modes, so that future structures would be designed to uniform reliability levels based on ship requirements and characteristics, and so that unconservative or over designed ship structures will be avoided.

N91-101 TITLE: Refrigeration System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype refrigeration system for potential shipboard use.

DESCRIPTION: Phase I: Concepts may use Stirling, Brayton cycle, thermal electric, vapor compression, etc. If a vapor is used it must be a non-ozone depleting substance. Target size is 1 to 15 tons of refrigeration at minus 10 degrees F while using seawater at 88 degrees F as the heat rejection reservoir. Prototypes should be designed for 1 ton capacity. Innovative approaches are invited. Size, weight, power consumption, reliability, and safety are critical parameters.

Phase II: Prototype systems shall demonstrate performance at rated conditions and operation at part load conditions. The system design shall minimize vapor leakage while being easy to maintain.

N91-102 TITLE: Fiber Optic Navigation Light System

CATEGORY: Exploratory Development

OBJECTIVE: To develop a fiber optic navigation light system that will meet the 72 COLREGS and optical requirements of UL-II04, and achieve the following:

(a) Be immune to EMI/EMP problems.
(b) Minimize topside weight high on masts.
(c) Eliminate the need for bulky shielding.
(d) Increase safety by eliminating the need for climbing masts to relamp fixtures.

DESCRIPTION: Phase I: Determine the feasibility of a fiber optic navigation light system (using commercially available fiber optic cable to transmit light to the fiber optic navigation light fixture) complying with the 72 COLREGS and optical requirements of UL-1104.

Phase II: Develop and construct a breadboard model for testing.

N91-103 TITLE: Electromagnetic Arrays for the Next Generation Ships

CATEGORY: Advanced Development

OBJECTIVE: To develop an architecture to guide the evolution of the next generation electromagnetic arrays for warships.

DESCRIPTION: Both government and industry are developing a/d converter, processor, and transmitter/receiver elements, in a fragmented way. Most of their goals, have been towards producing elements, for replacement of, or changes to, today's systems. The next generation of shipboard systems will need to integrate the functions of communications, radars, electromagnetic identification, electromagnetic countermeasures, and navigation into integrated electromagnetic arrays. The arrays will need to cover the electromagnetic spectrum. They will need to be installed, throughout the outside structure of the ships. This approach will have the advantages of more survivability, lower radar cross section, modularity for growth in capabilities, lower volume, and greater power efficiency, than current alternatives. Through these study efforts, the Navy can provide focus and leadership on the integrated architecture, and the electromagnetic elements required.

Phase I: The first phase would be an industry/government survey, for the best architectural concepts for an integrated shipboard system.

Phase II: The second phase would develop an optimum set of specifications, with the cooperation of both government and industry. The project would then transition into a demonstration phase, with two frequency bands. The demonstration would show the feasibility of covering the spectrum, in a full scale 6.4 engineering development project.

N91-104 TITLE: Reformulation/Reuse of Navy Gun Propellant

CATEGORY: Exploratory Development

OBJECTIVE: To establish a use/market for single, double and triple base propellant reclaimed from Navy propelling charges.

DESCRIPTION: Phase I: Conduct literature search into available technology to reuse/reformulate single, double, and triple base propellant reclaimed from Navy propelling charges. Investigate past commercial sales and determine ultimate use of propellant.
Explore potential uses of material as removed from the cartridge cases and by reformulation. Verify that information in literature supports continued stability of nitrocellulose and nitrocellulose/nitroglycerine based propellants if reused and proposed reformulation technology presents no safety problems. Provide recommendations for Phase II evaluations.

Phase II: Perform laboratory, bench and pilot scale testing for reformulation of the propellant. Perform valuations to validate reclaimed propellant that can best meet specification requirements and performance criteria for reuse for either military or commercial applications. Perform complete systems safety evaluations to confirm no problem exists in removal and reuse of the nitrocellulose and the nitrocellulose/nitroglycerine based propellants.

N91-105 TITLE: Software Engineering Methods for Parallel Processing Arrays

CATEGORY: Exploratory Development

OBJECTIVE: To formulate a methodological approach to the problem of taking an application from concept to a validated, optimal mapping onto an appropriate array of parallel processors.

DESCRIPTION: A customer (user) with a problem to be solved on a parallel computing system is met with a bewildering number of choices to make. There are dozens of architectures to choose from, with many available in commercial systems, boards, chip sets, and single-chip systems, with wafer-scale systems coming. Each of these is capable of implementing from one to many processing models. Examples include: SIMD, synchronous, data parallel; MIMD, synchronous or asynchronous, data-flow or control-flow, process- or application-parallel, etc. The user's problem can contain different parallelism. Merely capturing the specification of the application algorithm, which involves selecting an appropriate language, presents hundreds of choices. The user has requirements beyond the algorithmic: throughput, memory usage, result precision, latency, weight, power, size, cost, (NRE, life cycle). The usual reaction to this plethora of choices is to select a hardware solution supported by a friendly vendor, and thereby reduce the solution space dramatically. This is effective, if not optimal, but locks the user into a system that will probably not meet all of his requirements, and will not evolve with technology. The better solution would be a methodology, well supported by expert systems and tools, all of which are maintained current with technology, which can assist the user in finding an optimal mapping of his problem onto a parallel processing system which meets all of his requirements as well as possible. This methodology would support: problem and requirements capture by alternative methods appropriate to the problem/segment, with expert system guidance; reduction of the application to a standard intermediate form; (guided) selection of choices of alternative architectural and execution models to be examined in trades; performance analysis of the application on the chosen models through simulation or emulation; representation of the final solution in a language appropriate to the selected target system; validation of the solution as implemented on the target. This methodology would draw for its parts, as possible, on the broad base of academic, government, and industrial research and development. Added value would come from a systematic process, development of a formal basis for the methodology, the integration of usable products, and the development of new tools as required.

Phase I: Survey the literature and technology to ensure currency. Focus on a particular parallel architecture, which represents the most likely future direction for implementation in VLSI and WSI. Describe the taxonomy of problem- and solution-spaces. Formulate the methodology, which systematically moves from problem description to validated solution, application capture, analysis, mapping, execution, and validation. Define tools and adjunct methods, such as graphical user interfaces, databases, and AI techniques, needed to support the methodology.

Phase II: Update the literature and technology survey (annually). Refine the methodology. Acquire and/or implement prototype tools to demonstrate the methodology; distribute to Alpha users and introduce modifications based on experience.

Phase III: Produce Beta versions of the tools, distribute to testers, and incorporate experience. Produce commercial production grade tools, distribute and support.

N91-106 TITLE: Providing Full ADA Support for the UYS-2

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate the feasibility of automatically generating a complete and easily validated Ada compiler for any configuration of the AN/UYS-2.

DESCRIPTION: The UYS-2 is a system that embodies the concepts associated with dynamically distributed parallel processing. It was designed to particularly address signal processing applications which inherently contain opportunities to improve mission performance through the use of this type of processing The UYS-2 System includes "compute processors' that are functional elements intended to efficiently execute compute intensive application programs. One such processor is the Floating Point Arithmetic Processor; a second will be the Matrix

Processor. Plans call for additional computer processors, optimized to specific applications or classes of applications.

A particular configuration of the UYS-2 is tailored to a mission problem. This is partially accomplished by including one or more compute processors, of one or more varieties. That is, for example, a particular configuration might have two FP Arithmetic Processors and three Matrix Processors, because the parallel processing characteristics of the mission problem being addressed and the compute requirement of the mission both need, and can effectively use, these hardware resources. These may be placed into a variety of backplane slots.

The UYS-2 System also includes some rather sophisticated programming tools built around the Processing Graph Methodology (PGM) which enable the design of an application system to be done at a high level, expressed in graph notation, and then, mostly automatically, be translated into code strings that are executable within the various functional elements of the UYS-2. However, when one examines the hardware and software design that underlies the PGM level, one finds a structure that is basically designed to support and facilitate hand microcoding.

To support a compute processor, such as an FP AP, in the UYS-2, one must develop in hand crafted microcode a set of EMSP Primitives appropriate to support the intended applications on the machine. This is not an instruction set, as one might associate with a conventional Instruction Set Architecture machine, that remains fixed once designed; it changes, at least by extension, for each type of application of interest. When the library of EMSP Primitives (i.e., microcode macros) are developed and in place, then the process of converting PGM graphs to executable code is efficient and mostly automated. For each compute processor that one wishes to incorporate into the UYS-2, one must develop microcode similar to the set needed for the FPAP.

There are several problems with this software development methodology as follows: incorporating a new compute processor into the UYS-2 requires the development of an extensive set of microcode.

Extending the set of applications to which the UYS-2 is to be applied, and which require the support of new PGM level primitive nodes, will in general require additional microcode macros to be developed to achieve throughput objectives.

Unless the set of EMSP Primitives and the I/O operations are equivalent from one compute processor to another, the programs will be different on each process or for the same graph level primitive node. No portability from processor to processor is likely; even if portability is intended and planned, it will be very difficult and costly to verify and control.

Each new compute processor incorporated into the UYS-2 requires the development of a relatively large and complex software development support environment, including microassemblers, linkers, simulators, and debugging tools.

5. The UYS-2 system does not take advantage of high level programming languages, particularly Ada, to solve problems of software reusability, rapid development of application systems, and life cycle cost reduction. Further, UYS-2 compute processors (i.e. the FP AP) do not facilitate the use of high level languages; rather, they are designed to meet the need of the hand microcoder to partition the implementation problem into small segments in order for him to understand and be able to cope with the problem. This general partitioning strategy can lead to quite good results on a segment by segment basis, but is often very poor on a global basis. Compilers generally do a better job on large compute problems than do handcoders, due mainly to their ability to evaluate many more opportunities per unit time than the person can and their indifference to the size of the problem being addressed.

In summary, the UYS-2 problem of interest herein is to provide software tools that utilize Ada while maintaining the inherent advantages of the present programming environment, and thus gain the advantages inherent in the language, and also greatly reduce the time and cost involved in addressing both new processing elements and new applications.

The proposed solution involves the application of the JRS Integrated Design Automation System (IDAS) to provide the Ada to Microcode Compiler and Software Development Tools needed to support current and future compute processors. One of the primary functional capabilities of IDAS is the ability to automatically generate an Ada

Compiler and a Simulator for an arbitrary processor described in the VHSIC Hardware Description Language (VHDL). Using this capability, one could then automatically create the tools with which to evaluate and support the target processor directly from the normal design documentation. Thus, the UYS-2 development tools are all contained within one common environment for all of the processor types. The application code will then be portable in Ada source code form and maintainable, therefore, in Ada, for all the processors.

Another major consideration in introducing Ada into the USY -2 is that it makes the connection between the PGM Graphs and the executable code in the compute processors much more natural, direct, and maintainable. The Primitive Graph Nodes already have Ada program representations of their functionality, developed for the PGSE system.

Phase I: The first phase will be a system design and planning activity that would result in detailed specifications, design guidelines, and development plans.

Phase II: Develop the Ada integrated UYS-2 environment.

Phase III: Demonstrate an Ada compiler produced for an arbitrary AN/UYS-2 configuration, and show that it will pass the Ada Validation Suite.

N91-107 TITLE: Rapid Prototyping and Simulation with Programmable Gate Arrays

CATEGORY: Exploratory development

OBJECTIVE: To demonstrate the feasibility of rapidly determining whether or not a processor design is suitable, from a performance perspective, for its intended application(s). Related to this is the demonstration of the feasibility of rapidly constructing an operational piece of hardware that implements the functionality of the processor of interest, that performs adequately from a real time perspective, and that can be electrically connected to other hardware elements with which the processor is operationally integrated. In short, it is the problem of rapidly constructing a physically realized hardware prototype.

DESCRIPTION: Programmable gate arrays are a component technology that is potentially very useful in solving rapid prototyping problems. The technology provides a programmable hardware element that could be made to represent essentially any arbitrarily complex digital circuit. The individual gate array circuits are VLSI devices and contain several thousand gates each, organized into hundreds of configurable logic blocks. It is a very flexible, potentially useful technology.

Recent activities towards the exploitation of this technology have focused on the problem of providing "arrays of programmable gate arrays"; that is, the focus is on the problem of interconnecting the gate arrays in networks, so that one could map very large digital circuits onto the network. This will eliminate the fairly severe limitations on the utility of the technology, when applied one device at a time, and open the doors to the possibility of processor rapid prototyping.

The proposed solution to the processor rapid prototyping problem brings together two technologies in an eminently synergistic manner. The first is the programmable Gate Array (PGA) circuit technology, the second is the IRS Integrated Design Automation System [IDAS) technology.

PGA technology is being pursued by constructing large arrays of the devices, that will provide between 500,000 and 100,000 equivalent gates or 10,000 to 20,000 configurable logic blocks, that can be automatically configured to represent complex processors. This size array can be packaged onto one VME size board that plugs directly into the backplane of an appropriate hoot (e.g., SUN). The PGA board can then be driven by the hoot processor; it can be configured by it; it can receive static or dynamic input data from it; and, it can return output data to it, statically or dynamically. The hoot processor provides the environment for testing a prototype, for doing an evaluation of its suitability or comparative effectiveness.

The PGA board becomes a hardware simulator/emulator of the target processor; it provides the test bed for testing and evaluating alternatives. The PGA board can then be the actual physical hardware prototype or the configuration data can be transferred to other physical manifestations that might be more useful in a particular system environment.

IDAS technology provides the processor synthesis tools and the links to designers working in VHDL that are necessary to effectively utilize the potential of the PGA board in a significant manner.

Processor synthesis in IDAS creates processor representations that are implemented in components contained in libraries and are expressible in VHDL. The VHDL description is then processed to generate a software simulator for the implemented processor.

One will then be able to use IDAS to synthesize application specific processors, simulate and evaluate them very fast on the VGA Board, and return results to designers. The configured PGA Board, or a translated image of it, could also be used as a physical prototype for actual interconnection to other hardware such as the backplane of the AN/UYS-2.

Phase I: Construct 500,000 to 1,000,000 equivalent gates array packaged onto one VME size board that plugs directly into the backplane of an appropriate hoot (e. g. SUN). Configure and produce software on the hoot processor to provide the environment for testing a prototype, for doing an evaluation of its suitability or comparative effectiveness

Phase II: Utilize the IDAS technology to provide the processor synthesis tools and the links to designers working in VHDL that are necessary to effectively utilize the potential of the PGA board in a significant manner.

Phase III: Produce commercial production grade tools, distribute and support.

N91-108 TITLE: Electro-optical Horizon Tracker

CATEGORY: Exploratory Development

OBJECTIVE: A reliable means to locate and track the optical horizon using infrared sensors is required.

DESCRIPTION: Determination of this horizon using current techniques posses a difficulty. A means to locate and track this horizon to micro-radian accuracy is desired. This will increase the overall performance to detect and track targets for regions of military interest.

Phase I: Perform an industry survey of current and emerging horizon tracking techniques. Identify potential candidates. Construct a plan of action.

Phase II: Write a specification. Fabricate a breadboard to demonstrate the desired capability. Write a test report with recommendations. A Phase III potential for AN/SAR-8 IRST exists.

N91-109 TITLE: Hypervelocity 25mm Projectile

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to assess the feasibility of obtaining a Hypervelocity round through a "Tround," Cased Telescoped, Compacted Propellant configuration. Investment in Tround, Case Telescoped Round and Compacted Propellant Concepts have resulted in proving that there are viable benefits to be gained from Tround and Case Telescoped Round configuration. Practical application of each concept has successfully completed the demonstration phase.

DESCRIPTION: Phase I: Analyze the viability of combining the developed concepts and assess whether benefits can be derived through this synthesis. Elements of interest would encompass Kinetic energy projections, effects relative to obturation, round ballistics, to mention a few. Comparative analysis of Tround versus Case Telescoped Tround and similar analysis of compacted versus conventional propellant in Case Telescoped application is within the scope of this task

Phase II: Design, develop, fabricate and conduct test and evaluation on prototype round configuration. Demonstrate and measure experimentally obtained and/or projected results of the assessment provided in Phase I. Based on results, if proof of benefits are observed, project viability of larger calibre application.

N91-110 TITLE: Highly Sensitive Fiber Optic Acoustic Point Sensors

CATEGORY: Exploratory Development

OBJECTIVE: Develop highly sensitive point sensors that can be used to construct high gain volumetric arrays for short range high resolution or long range low resolution sonar.

DESCRIPTION: Phase I: Develop several highly sensitive point sensors each having a laser light source and a pair of light reflecting thin films arranged to form a Fabry-Pe' rot resonator. Additionally, develop demodulation electronics capable of detecting changes in acoustic fields by measuring the movement between the optical films.

Phase II: Develop a densely packed volumetric acoustic array test panel with 500 point sensors that will survive the maximum hydrostatic operating pressure experienced by a government furnished unmanned under-water vehicle (UWV).

N91-111 TITLE: Advanced Anti-Submarine Warfare Data Fusion Algorithm

CATEGORY: Exploratory Development

OBJECTIVE: Develop data fusion methods and algorithms for improved targeting of contacts for utilization in underwater combat control systems.

DESCRIPTION: Phase I: Develop non-linear, discrete tracker algorithms capable of fusing positive (detection) and negative (no detection) information from multiple sensors and platforms to provide estimates of target location in terms of probability distributions.

Phase II: Provide computer based system that can be tested at sea under realistic environments. System shall interface with multiple sensors (sonobuoys), and towed arrays from submarines and surface ships.

N91-112 TITLE: Unity Power Factor Power Supplies

CATEGORY: Advanced Development

OBJECTIVE: Current harmonics in linear rectifiers are often in excess of 10% of the fundamental. Polyphase transformers can be used to achieve current harmonics of less than 3% of the fundamental, but are heavy and large.

DESCRIPTION: Develop a three-phase, unity power factor power supply, that utilizes semiconductor components in lieu of polyphase transformers, to limit current harmonics to 3% while maintaining the isolation characteristics inherent in transformers. Upon completion of Phase I development, this project will transition to Phase II development.

Phase I: Identification of alternative methods for achieving unity power factor rectification, bench top testing and trade-off analysis of different approaches to be used for transition to Phase II development.

Phase II: Development of a 10kw demonstration unit that meets the electrical requirements of MIL-STD-1399, Section 300 and the high impact shock requirements specified in MIL-S-90I. The nominal line voltage input to this unit will be 440V, 60Hz. The nominal output voltage will be 155V dc, as specified for Navy Standard Power Supplies in NAVSEA SE-010-AA-SPN-010.

N91-113 TITLE: Remote Transfer of Optical Data

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to reduce the weight of above deck optical equipment to allow higher mounting with resultant increased system coverage and range. It has potential Phase III application to following generations of Infrared Search and Target Designation systems, such as AN/SAR-8.

DESCRIPTION: Phase I: Industry survey of existing and emerging technology and materials. Identify likely candidates. Develop a technical plan of action.

Phase II: Write a system specification and fabricate a breadboard device to assess the adequacy of the technical approach. Write a test report with recommendations.

N91-114 TITLE: Comparison of DOD Electromagnetic Interference (EM!) Specs to Commercial Specs in Order to Aid the Procurement of Non-Developmental Items (NDI)

CATEGORY: Advanced Development

OBJECTIVE: Compare current DoD EMI specs to current and near future EMI control specs and standards in order to facilitate the procurement of NDI.

DESCRIPTION: Phase I: Establish the relationship between DoD EMI specifications and standards and commercial/industrial standards. NDI, with current certification through a non-DoD authority (e.g. FCC, VDE, Etc.), can be procured with the restrictions developed under this effort.

Phase II: Develop an Expert System (rule based) database in order to aid the procuring activity responsible for EMI associated with NDI. This system will be IBM PC compatible.

N91-115 TITLE: Commercial Computer Ruggedization

CATEGORY: Advanced Development

OBJECTIVE: Provide a concept of ruggedized commercial computer technology that will withstand Marine Environment and Operations.

DESCRIPTION: Phase I: Develop the concept and provide an approach that will allow ruggedized computers to be utilized in critical systems at sea, operating under wartime conditions.

Phase II: Provide the breadboard, and test to MIL-SW-461, MIL-E-l6400, MIL-SW-1399, and MIL-S.WI to determine acceptability of the concept and provide complete unit for NA VSEA testing.

N91-116 TITLE: Electromechanical Circuit Breaker Designs

CATEGORY: Engineering Development

OBJECTIVE: Develop an electromechanical equipment type circuit breaker that will withstand high impact shock, as specified in MIL-S-90. At the completion of Phase I development, this project will transition to Phase II development.

DESCRIPTION: Phase I: Conduct exploratory development of shock hardened circuit breaker concepts that will withstand high impact shock. Concepts for shock hardening would be used for design guidance during Phase II development to build a prototype circuit breaker.

Phase II: Demonstrate prototypes for an equipment sized, shock hardened electromechanical circuit breaker that meets the high impact shock requirements of MIL-S-901. This circuit breaker will be used to replace circuit breakers manufactured in accordance with MIL-C-55629 and will be designed accordingly. The required capabilities are as follows:

Shock -as specified in MIL-S-901
Voltage -250V 60Hz, 155V dc Current -0.5A to 50A
Time/current condition -125% overload in 25 seconds
150% overload in 1 second
200% overload in 0.1 second
Size -2.5" x 3" x 3" for a 3-phase unit

N91-117 TITLE: Solid State Circuit Breaker

CATEGORY: Exploratory Development

OBJECTIVE: Develop a nonlinear conduction material and circuit breaker that exhibits low impedance characteristics when under nominal current conditions, and high impedance under fault current conditions.

DESCRIPTION: This device will operate as a conventional circuit breaker, i.e. be able to turn-on, turn-off (with minimal leakage current) and trip given a time/current condition. Also, this device will limit fault current. At completion of the Phase I development this program will transition to Phase II development.
Phase I: The nonlinear conduction material that exhibits low impedance at low current and high impedance at high current would be developed during this stage. This material will be strong enough to withstand high-impact shock as specified in MIL-S-901.

Phase II: The nonlinear conduction material will be integrated into circuit breaker architecture during this phase. The abilities to turn-on, turn-off with minimal leakage current, and to trip given a time/current condition will be demonstrated. This circuit breaker will be used to replace circuit breakers manufactured in accordance with MIL-C-55629 and will be designed accordingly. The required capabilities are as follows:

Shock -as specified in MIL-S-901
Voltage -250V 60Hz, 155V dc
Current -0.5A to 50A
Leakage current -5mA
Time/Current condition -125% overload in 25 seconds
150% overload in 1 second
200% overload in 0.1 second
Current limit -10 times rated current
Size -2.5" x 3" x 3" for a 3-phase unit

N91-118 TITLE: Mission Readiness Reporting System

CATEGORY: Advanced Development

OBJECTIVE: The objective of this task is to provide a design concept of the Mission Readiness Reporting System (MRRS). The MRRS is a system that collects, processes, and displays status information from ship equipment to determine the readiness level of major warfare areas. The design will include the following parameters:

- What is the format, content, and timing of status data sent from equipment? 0 How does the MRRS collect status data from equipment?
- What type of communication architecture does the MRRS use to distribute readiness information?
- How and where is status information displayed?

Upon completion of Phase I development, the program will transition into Phase II development.

DESCRIPTION: Phase I: Investigate and define the required status data from equipment including format, content, and timing

- Define an interface by which equipment transmit their status information to the MRRS.
- Investigate and define a communication architecture for the MRRS to collect and distribute status information.
- Investigate and select a display suitable for use in the MRRS.

Phase II: Assemble, test, and demonstrate a MRRS prototype for proof of feasibility. The prototype setup includes simulation inputs/outputs, partial communication network or data link, displays, and computer programs.

N91-119 TITLE: Fiber Optic LAN Based Integrated Shipboard IC System

CATEGORY: Engineering Development

OBJECTIVE: Demonstrate feasibility of implementing an integrated shipboard interior communication system, using a fiber optic LAN as a transmission medium, that will support both voice and data transmission.

DESCRIPTION: Phase I: Develop a top level architecture for a fiber optic LAN based shipboard interior communication system that has the following attributes: a) based on open architecture: b) uses military and or commercial standards: c) is survivable d) is modular (can be adapted to various size vessels); 3) provides both administrative and tactical services; 1) provides integration path for voice and data.

Phase II: Based on Phase I architecture, build a prototype system that demonstrates all attributes.

N91-120 TITLE: Remote Personnel Monitoring System

CATEGORY: Engineering Development

OBJECTIVE: Develop a monitoring system that would provide status (condition and position) of shipboard personnel to a command/control station. Personal monitor would have to be small and light weight. System would have to be able to operate in the shipboard battle damage environment.

DESCRIPTION: Phase I: Investigate, develop, and design a Remote Personnel Monitoring System for naval vessels. Deliverables would include copies of all investigations, feasibility studies, design drawings and cost estimates.

Phase II: Build and test a limited scale prototype system. Size of system should be sufficient to demonstrate that all Navy requirements can be met.

N91-121 TITLE: Application of High Speed Gas Chromatographv to Shipboard Magazine Sensors

CATEGORY: Engineering Development

OBJECTIVE: Develop a sensor that would provide advance warning of deteriorating or hazardous conditions in shipboard magazines.

DESCRIPTION: Phase I: Investigate the possibilities of applying high speed gas chromatography techniques to permanently mounted shipboard magazine sensors capable of detecting and providing advance warning of the following conditions:

- torpedo or missile liquid fuel leaks
- deteriorating solid fuel propellants
- deteriorating explosives and powders
- early detection of fires

This phase would include providing cost estimates for such a system.

Phase II: Build and test a prototype sensor capable of meeting all shipboard requirements.

N91-122 TITLE: Methods of Expressing Interface Design Standards *(IDS)* and Protocols

CATEGORY: Advanced Development

OBJECTIVE: Investigate methods for expressing IDS/protocols in such a manner that they cannot be misinterpreted

DESCRIPTION: Phase I: Shall consist of investigating whether cost effective and feasible methods for expressing an IDS/Protocol in a clear and concise manner (i.e. mathematical or scientific expressions) exists.

Phase II: Would consist of translating or developing an IDS (Protocol) using the methodology from Phase I efforts. Comparison of a side by side implementation of the clear (Phase I) expressed IDS Protocol and a standard version would be a proof of concept. The Measure of Effectiveness would be the delta between the implementation and validation times of the two versions.

N91-123 TITLE: Minefield Planner Workstation Software

CATEGORY: Advanced Development

OBJECTIVE: Apply operational observables to software for a minefield planning workstation which will transition in Phase III to the CAPTOR Improvement line (PE 0603601N-S2024).

DESCRIPTION: Phase I: Perform research to determine how observations of transits by mine countermeasure (MCM) vessels or other non-target traffic through a minefield impact MCM tactics and how this information can be applied to designing mines and planning minefields. The results of this research will be incorporated into a software package that can be used to plan or design a minefield to remain effective for a specified length of time.

Phase II: Incorporate the Phase I software package into prototype workstation software for planning and evaluating countered minefields. The resulting workstation software must accommodate scenarios including up to 200 transits of non-target vessels at each of five or more minefield target places. This software must also incorporate such concepts as: ship counters, multiple target place configurations, and multiple-class multiple-signature target traffic. During the second portion of Phase II, additional software will be developed for planning MCM operations and will incorporate all the aforementioned capabilities of the minefield planning software. All of the workstation software must allow installation and operation in desktop PC compatible computers using only commercially available co-processors and within commercially available memory and storage limits.

N91-124 TITLE: ASW Search Planning

CATEGORY: Advanced Development

OBJECTIVE: Develop rapid techniques for optimizing ASW system lineup and search plans based on real time tactical information. This capability is required to support the APP Program and the ASW Tactical Decision Aid. Acoustic performance prediction programs have traditionally modeled sonar system performance providing insight to tactical decision makers for optimizing system lineup and search plans prior to arriving on station. Parallel processing computers and neural networks offer the potential for using real time tactical information and generating revised recommendations. Improving the trade-off between run time and accuracy for existing APP applications may also be possible.

DESCRIPTION: Phase I: It is expected that Phase I would provide an in-depth report on analytical methods/procedures developed which demonstrates feasibility of technique.

Phase II: Provide a computer-based system which could be tested at-sea under realistic conditions.

N91-125 TITLE: Sensor Data Correlation/Classification

CATEGORY: Advanced Development

OBJECTIVE: Provide an approach to heuristically correlate sonar, ESM, visual, and other sensor data to provide classification and threat assessment. This is needed to support the ASW Tactical Decision Aid and various combat control systems. Assessing the threat to own-ship in a multi-target environment is a complex problem that requires the ship or submarine commander to analyze the enemy sensors and weapons that can be employed. The first step in that process is developing a picture of enemy forces present in the area based on own-ship sensor data and various intelligence sources. A tactical decision aid that heuristically correlates sonar, ESM, visual, and other sensor data and provides classification and threat assessments would greatly ease the burden on the ship/submarine commander.

DESCRIPTION: Phase I: It is expected that Phase I would provide an in-depth report on analytical methods/procedures developed which demonstrates feasibility of technique.

Phase II: Provide a computer-based system which could be tested at-sea under realistic conditions.

N91-126 TITLE: Advanced Targeting Algorithms

CATEGORY: Advanced Development

OBJECTIVE: Develop the methodology/algorithms to aid in the tracking/targeting process on a long-range passive contact. These algorithms are needed for the SFMPL, ASW Tactical Decision Aid, and various combat control systems. The current methodology of employing JASA/MPKAST/MTST algorithms have limitations. A novel approach is needed which would extend their methodology toward a common algorithm/approach or devise a new methodology.

DESCRIPTION: Phase I: It is expected that Phase I would provide an in-depth report on analytical methods/procedures developed which demonstrates feasibility of technique using synthetic data.

Phase II: Provide a computer-based system which could be tested at-sea under realistic conditions.

N91-127 TITLE: Acoustic Towed Array Motion

CATEGORY: Exploratory Development

OBJECTIVE: Towed acoustic arrays have motions that can cause acoustic contacts that appear to "wander" when actually the array is "wandering". If the array motion is known then the actual behavior of the acoustic contact can be calculated. The Navy desires a method to calculate actual acoustic motion by calculating array motion. The Phase I proposal will develop an approach based on a hypothetical array of 100 feet in length, a single heading and depth sensor, and consisting of 20 hydrophones. The offeror must demonstrate an in depth knowledge of towed array motion and acoustic processing.

DESCRIPTION: Phase I: The results of Phase I are a computer based simulation of sensor position based upon sensor motion and a comparison with known motion.

Phase II: If Phase I shows the array motions can be correctly calculated, Phase II would demonstrate the technique at sea with an actual array in a Navy supplied test bed.

N91-128 TITLE: Torpedo Acoustic Processing

CATEGORY: Exploratory Development

OBJECTIVE: Torpedo signatures differ significantly from surface ship and submarine signatures. Most of the effort in detecting and tracking acoustic contacts has concentrated on other than torpedo signatures. An acoustic detection and tracking system is desired that is specifically tailored to the torpedo characteristics. The offeror must demonstrate experience in both acoustic signal processing and torpedo acoustic characteristics and possess a SECRET clearance.

DESCRIPTION: Phase I: Demonstrate the process in a laboratory based system with a limited acoustic data set provided by the Navy.

Phase II: Integrate this system into a Navy test system for laboratory and at sea testing.

N91-129 TITLE: Active Noise Cancellation

CATEGORY: Exploratory Development

OBJECTIVE: Shipborne noise is coupled into hull mounted sonar sensors through the mechanical mounting. Traditionally this noise is reduced with damping material and isolation mounts. Recent advances in noise control have used active methods for noise cancellation.

DESCRIPTION: A method is desired that would replace the passive mounting fixtures with active mounts. This method must demonstrate superior noise control when compared with or coupled with the passive isolation system. The offeror must possess expertise in active noise cancellation and should demonstrate an understanding of the noise mechanisms associated with sonar arrays.

Phase I: Demonstrate the technique in a laboratory environment.

Phase II: Demonstrate the technique at sea in a Navy supplied test ship.

N91-130 TITLE: Acoustic Dynamic Range

CATEGORY: Exploratory Development

OBJECTIVE: The dynamic range of current acoustic sensor systems make it impossible to detect small signals in the presence of large signals. Dynamic range is specified in dB or number of significant bits. A processing system is desired that has a minimum of 20 bits dynamic range and a minimum frequency range of 0-200Hz; larger ranges are desired if possible. The system will be used for sonar signal processing. The offeror must possess expertise in

acoustic signal processing, sonar characteristics, and be knowledgeable in what limits the dynamic range of a system.

DESCRIPTION: Phase I: Fabricate an acoustic channel that would digitize the acoustic output of a hydrophone. This system would be tested in an acoustic tank to measure dynamic range. The Navy will provide the test facilities if not available at the contractor's facility. It is important that the basic sensitivity of the system not be above the ambient level of sea state zero.

Phase II: If Phase II is authorized, fabricate a system to be demonstrated at sea in a Navy test bed.

N91-131 TITLE: Passive Torpedo Detection/Classification Algorithm Development

CATEGORY: Advanced Development

OBJECTIVE: To develop, implement and test an optimum or near optimum algorithm for the automatic detection/classification of all current torpedoes by means of their related noise.

DESCRIPTION: Phase I: Evaluate current techniques for automatic detection/classification of passive torpedoes. Identify nes signature driven processing requirements resulting from weapon propulsion plant evolution. Develop realistic models of submarine self noise backgrounds. Implement software realizations of proposed processing schemes for detection/classification. GF1 weapon and self noise data will be required.

Phase II: Exercise the software processing implementations against recorded submarine self noise data to determine false alarm rate and against recorded weapon/classification. The final composite processing algorithm will be tested at sea against a variety of weapon types.

Phase III: Transition of this effort should provide an input to the new sonar intercept program (NSIS). In this context detection/classification is intended to denote detection of torpedoes as a class (i.e.: rejection of non-torpedoes) and does not imply classification as to type.

N91-132 TITLE: Application of Expert Systems in Submarine Combat Systems

CATEGORY: Exploratory Development

OBJECTIVE: To apply expert systems technology to submarine doctrine management. At present, management of submarine weapons employment doctrine is largely a manual task. During time critical functions, the weapons control operator is overloaded by a combination of doctrinal and weapons preparation tasks. Automation of doctrine analysis using rule-based or other artificial intelligence techniques could significantly reduce the manual workload. Such an approach would include a conversational interface between the expert system and the operator to allow "If Then" directives such as "if a contact moves within a specified range, alert the operator to perform a specified action." In addition, this expert assistant would exploit recently available computing resources (e.g. desk-top computers, parallel processors) such that it would run in parallel with the Fire Control System thus avoiding additional loading on the FCS resources.

DESCRIPTION: Phase I: Should identify operator intensive applications which could be mitigated by this approach. Analysis should be performed to establish selection criteria and candidates chosen.

Phase II: Should provide a prototype of the system implementing one or more application for proof of concept.

N91-133 TITLE: Application of Advanced Processor Architecture to Submarine Combat Control and Acoustic Systems

CATEGORY: Exploratory Development

OBJECTIVE: Identify areas of improvement in future systems through technology infusion. Assess current and future combat control and acoustic applications and determine the use of evolving processor architectures (e.g. parallel processors, RISC processors, etc.).

DESCRIPTION: Phase I: Should explore the feasibility of utilizing advanced processor architectures within the CCS and acoustic systems.

Phase II: Should refine the concepts identified during Phase I, and provide ana1yses/modeling to support proposed approaches.

N91-134 TITLE: ASW Targeting Solution Integration

CATEGORY: Advanced Development

OBJECTIVE: Provide a technique to determine a "best" range/solution estimate from a set of targeting solutions based upon various sensor data and algorithms. This technique is needed to support the ASW Tactical Decision Aid and various combat control systems.

DESCRIPTION: A time/range plot is maintained by the Submarine Combat Control System to illustrate contact range history for various target range solution estimates. A method is needed to consolidate this information into a "best" contact range estimate based upon the current environment, tactical situation and available sensor data. A knowledge based TMA aid could assess the uncertainties associated with various techniques and sensors, correlate solutions with available intelligence, and present to the user a candidate "all-source/best" solution.

Phase I: It is expected that Phase I would provide an in-depth report on analytical methods/procedures developed which demonstrates the feasibility of the technique using synthetic data.

Phase II: Prototype computer-based system which could be tested at-sea under realistic conditions.

N91-135 TITLE: Submarine Countermeasures Against New Technology Active Sonars

CATEGORY: Exploratory Development

OBJECTIVE: Develop new methods which can be used to counter detection attempts using the new technology active sonars.

DESCRIPTI0N: New technology active sonars represent an increasingly dangerous threat to the US submarine fleet. Jamming and other countermeasure strategies are needed to render this technology ineffective. Innovative techniques for jamming, or other counter measure techniques for making these sonars ineffective, should be proposed and methods for evaluation of these techniques against existing and future sonars identified.

Phase I: The threat will be examined and its operational impacts assessed. Methods to nullify this threat will be identified as well as methods for their evaluation.

Phase II: The most promising techniques will be evaluated as appropriate via the most suitable methods proposed.

N91-136 TITLE: Submarine Combat System Operator Training Workstation Concepts

CATEGORY: Advanced Development

OBJECTIVE: Explore innovative methods of training combat system operators.

DESCRIPTION: Techniques should include methods for building operator confidence through interaction with simulated and real world data of varying complexity. New technology submarine combat systems present operators with a complex set of fire control, sonar system, and environmental operating parameters. Recent advancements in workstation technology and training systems invite innovative methods for the development of an affordable trainer. Workstation based techniques which present the operator with an interactive learning environment which can build confidence and measure effectiveness are needed.

Phase I: Examine various concepts for feasibility of implementation and plausibility of effectiveness.

Phase II: Utilize standard desktop hardware and software to demonstrate operator performance enhancements.

N91-137 TITLE: High Frequency Sonar Windows

CATEGORY: Engineering Development

OBJECTIVE: Reduce insertion losses and increase strength to withstand under-ice operations of high frequency sonar windows.

DESCRIPTI0N: High frequency, high strength sonar windows are required for submarine applications at locations that make them highly susceptible to damage from impact of objects in the water. During arctic operations they are also exposed to ice loads and fast changing temperature extremes associated with surfacing through the ice. Current designs call for epoxy resins reinforced with glass fibers. Graphite reinforced plastic windows with foam cores have proven to be too frail for arctic operations.

Phase I: Investigate new acoustic materials for use in high frequency sonar window applications.

Phase II: Fabricate several composites and conduct testing. Select materials and reinforcement for use in Kevlar dome and windows. The contractor will be expected to deliver the required procurement specification for inclusion in the system procurement solicitation for Phase III.

N91-138 TITLE: Expert Systems in Engagement Planning

CATEGORY: Exploratory Development

OBJECTIVE: To apply Knowledge-Based Systems (KBS) to the increasingly complex problem of planning the employment of sea-launched cruise missile.

DESCRIPTION: At present, the engagement plans of sea launched cruise missiles are confined to single route to the target. For a salvo launch, all missiles must fly the nominal route. Nevertheless, the time required for the weapon control system operator to prepare the plan is approaching the limits of the tactical window of opportunity. Future missions will require not only geographic dispersion of multiple missiles, but also time-of-arrival control, coordination with other launch platforms, and careful selection from an expanding array of missile variants. For these and other reasons, some of the decisions presently made by the operator will of necessity be made by the Fire Control System. Prior deterministic implementations of such logic have proven to be expensive, error-prone, and operationally inefficient. Therefore, Rule-Based, Knowledge-Based, and other non-procedural approaches should be investigated for applicability to this problem. These approaches should take advantage of the projected availability of new computing resources aboard launch platforms such as parallel processors, desk-top computers, etc.

Phase I: Explore the feasibility of using KBS and/or other expert systems approaches to the projected engagement planning challenge.

Phase II: Development of a prototype on a desk-top computer similar to those available on launch platforms.

N91-139 TITLE: Sonar System Software Migration

CATEGORY: Exploratory Development

OBJECTIVE: To identify and develop innovative techniques which support the migration of sonar system application code to next generation processing systems.

DESCRIPTION: Processing requirements for next generation sonar systems require use of parallel distributed processing systems, with these new systems come new languages and programming methodologies. Without the use of automated techniques for migrating existing applications to these new systems, the transition will be time consuming and costly. Techniques and computer-assisted implementation of these techniques are sought which will support the migration of existing, functionally correct software to such systems. Particular attention should be paid to the migration of SPL based systems to new languages such as Ada/ECOS.

Phase I: Define the problem and identify, analyze, and compare alternative techniques.

Phase II: The most promising techniques will be evaluated by demonstrating software migration using portions of existing sonar system application code.

N91-140 TITLE: Alternative Means of Communication with Deployed Submarines

CATEGORY: Exploratory Development

OBJECTIVE: To explore the feasibility of providing a secure alternative means of communication with deployed submarines.

DESCRIPTION: New methods for submarine communications will be required as current networks become saturated with data being transmitted from multiple users. An alternate means of communications with submarines needs to be developed which limits the submarines's exposure during transmission/reception of radio communications.

Phase I: Should explore the feasibility of alternatives communications methodologies for submarine application.

Phase II: Refine and prove the concepts identified during Phase I through analysis and/or modeling.

N91-141 TITLE: Trident Command and Control Over-the-Horizon Communications

CATEGORY: Exploratory Development

OBJECTIVE: To provide the capability for TRIDENT submarines to receive over-the-horizon targeting (OTH-T) communications data.

DESCRIPTION: TRIDENT submarines do not currently receive all of the OTH data that is available to other fleet elements. Alternative methods for obtaining and processing this data onboard TRIDENT submarines as a stand-alone capability should be explored.

Phase I: Should explore the use of state-of-the-art technologies to provide stand-alone capability.

Phase II: Should provide a prototype of the concept defined in Phase I.

N91-142 TITLE: Long Term Storage Impact on Traveling Wave Tube Life

CATEGORY: Advanced Development

OBJECTIVE: To provide information on maximizing traveling wave tube life (DECOYS).

DESCRIPTION: Active electronic off-board countermeasures (OCMs) are considered the most effective EW technique to protect ships of the fleet against the anti-ship cruise missile (ASCM) threat. OCMs operating at high powers require microwave tubes, such as magnetrons, crossed-field amplifiers, or TWTs as the source; TWTs are often the tube of choice for OCMs requiring broad bandwidth in addition to high power. In turn, TWTs require thermonic cathodes as the source of electrons for the power tube beam. OCM TWT must not only be capable of providing the required power-bandwidth performance, but also be able to function quickly after long shelf storage and brusque handling.

Recent attention to the use of TWT-based OCMs after long shelf-storage has indicated that the cathode is a key factor in successful OCM use. Accordingly, to achieve a better understanding of cathode properties contributing to more effective OCMs several technical issues must be fully understood. How sensitive to fabrication/processing techniques are the fast-warm-up properties of thermonic emitters? Is one cathode vendor able to produce cathode assembly, better cathode materials, or improved fabrication/processing? After extended shelf life, how sensitive are cathodes to poisoning from gases found in the tube as a result of tube processing or from other sources? Although several recently completed and ongoing studies are contributing to the overall understanding of this problem, an objective evaluation based on sound methodology would contribute to reliable and affordable TWT -based OCMs.

Phase I: Would begin with the collection and review of all available data and information on TWT operation after long shelf life storage. The data and information shall derive from the Services, TWT manufacturers and vendors, and cathode manufacturers and vendors. For non-operable TWT, the cause of failure shall be clearly identified; for operable TWTs, cathode type, cathode vendor, cathode turn-on time, measurement technique, and other relevant factors, shall be clearly identified and reported in order to prioritize the susceptibility of TWT cathodes to poisoning or failure after long shelf storage. A ranking of cathode by type, vendor, application, etc. shall be the result of the Phase I effort.

Phase II: Would entail a laboratory evaluation of the ranked cathodes from Phase I to identify the major factors associated with cathode fabrication/processing that contribute to long TWT shelf life. The methodology should address the effect of residual gases, such as CO^2, Cl, H2O, etc., on cathode reactivation times. The final report should clearly link "cause and effect," and include a plan to incorporate the top-ranked cathode materials and fabrication/processing techniques into production TWTs.

N91-143 TITLE: Microwave Alter

CATEGORY: Research

OBJECTIVE: Development of a microwave tunable filter suitable for use in radar transmit/receive modules.

DESCRIPTION: Many modem radar and communications concepts employ microwave transmit/receive (T/R) modules. It is desirable to use a T/R module with a large bandwidth. However, using broadband modules without filter selectivity results in I susceptibility to receiver images. Additionally, selectivity permits higher power amplifier efficiencies. It is desired that an innovative tunable filter be developed and demonstrated for T/R module use. Such a filter would have Phase III applicability in an array of commercial and military equipments.
Such a filter should have characteristics of the following order:

Frequency:	1 to 20 Ghz (One filter type need only cover a 60% bandwidth)
Bandwidth:	Less than 10% of center frequency with 60 dB suppression
Power Handling:	Greater than 30 dBm
Tuning Response:	Less than 10 microseconds
Insertion loss:	Less than 0.5 dB

Size:	Compatible with a single element T/R module
Power:	Less than 250 milliwatts

Phase I: Propose potential filter concepts for Phase II construction and evaluation.

Phase II: Perform detailed design, build, and test of candidate filters.

N91-144 TITLE: Microwave Propagation

CATEGORY: Research

OBJECTIVE: Quantitatively verify existing computer program microwave propagation models.

DESCRIPTION: Propagation of microwave energy at altitudes below several hundred feet is effected by several factors including frequency and air refractivity. This phenomena is commonly referred to as ducting and can result in enhanced or reduced microwave energy at a given range. Computer program models have been developed which predict duct associated propagation. However, the validity of the models has not been verified. Phase III work is expected in commercial communications applications.

It is requested that a comprehensive verification of the models be made. This verification at a minimum would consist, of microwave energy measurements as a function of frequency, altitude, sea state, and refractivity profile. The resulting data would be reduced and compared with computer program model predictions.

Phase I: Prepare a comprehensive test plan.

Phase II: Conduct tests and prepare the required reports.

N91-145 TITLE: Carbon Dioxide Reduction and/or Removal Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype carbon dioxide reduction and/or removal system for use on submarines.

DESCRIPTION: The Navy desires a concept or system which is capable of reducing respired CO2 to O2 as a byproduct. The Navy is also searching for an alternative concept or system for CO2 removal CO2 can be reduced directly from the submarine atmosphere or from a pure stream. Conversion efficiency should be greater than 90%. Phase I will consist of defining CO2 reduction concepts and conducting initial tests of systems. Currently CO2 is removed by absorption utilizing monoethanolamine. Other gases, particularly O2 and N2 are not affected. Size, weight, power consumption, reliability, and safety are critical parameters.

Phase I: Define a concept and conduct initial testing of systems capable of removing 18 lbs/hr at an inlet concentration of 0.35% CO2 in air.

Phase II: Combine these concepts where feasible and build a prototype system for testing. The Navy may choose to build individual systems.

N91-146 TITLE: Development of Smoke Filters

CATEGORY: Exploratory Development

OBJECTIVE: To develop a filtering device for cleaning up a submarine's atmosphere following a fire.

DESCRIPTION: Submarine fires are characterized by thick toxic smoke, reducing visibility and impeding the ability of the crew to fight the fire and maintain ship control. This dangerous situation has been experienced several times on U.S. and Soviet submarines, with the most recent incident being the Mike class Soviet SSN in 1989. Overboard ventilation cannot be relied upon as the only effective means of removing fire gasses because of the susceptibility to acoustic and non-acoustic detection and the inability to guarantee surfacing during under ice operations.

Phase I: Define concepts and conduct initial testing of filters capable of removing particulate matter and gasses from a submarine fire.

Phase II: Build and test a full scale prototype smoke filter.

N91-147 TITLE: Modeling Shipbuilding Contract Changes

CATEGORY: Exploratory Development

OBJECTIVE: Develop a personal computer (PC)-driven mathematical model to forecast the cost and schedule effects of individual ship construction contract changes.

DESCRIPTION: Flow chart and prototype a PC-driven model, hosted on application software commercially available in the United States, that predicts the cost and schedule impact (increase, decrease. no change) of individual ship construction contract changes. The model must be capable of accommodating the full range of potential changes, including addition, deletion, modification, interruption or acceleration of work processes or material. It must predict the core cost of the change as well as the impact of delay and disruption on a contract for construction of a single ship. For both Phase I and Phase II, the Navy wishes full rights in technical data for the flow charts, source code and object code developed.

Phase I: Develop a personal computer (PC)-driven mathematical model to forecast the cost and schedule effects of individual ship construction contract changes.

Phase II: Expand the model to accommodate any shipbuilding program assuming the provision of contractor selected data commonly available to the Navy, including multi-ship construction program.

N91-148 TITLE: Cold Weather Logistics Over-the-Shore (LOTS) Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Identify cold weather LOTS improvement concepts, establish feasibility, develop and test prototype systems

DESCRIPTION: Phase I: Identify hardware improvement concepts to reduce icing and personnel hazards on causeways, lighterage, and ships involved in cold weather LOTS operations. Establish concept feasibility, systems should be portable, retrofittable, and easy to install and use.

Phase II: Develop and test prototype systems to quantify performance improvement (spray reduction, ice removal or prevention, or personnel protection).

N91-149 TITLE: Optical Fiber Neutron Dosimeter

CATEGORY: Exploratory Development

OBJECTIVE: Device which uses the change in optical transmission to measure neutron radiation

DESCRIPTION: Phase I: Test candidate fibers to select ones with high sensitivity to neutrons and linear response.

Phase II: Construct prototype dosimeter with chosen fiber test for adherence to requirements for Neutron Dosimetry System.

Phase III: Develop a production model for Navy use.

N91-150 TITLE: NAVSEA Integrated LSA Process Model

CATEGORY: Engineering Development

OBJECTIVE: To develop a NAVSEA Integrated LSA Process Model.

DESCRIPTION: A process model is developed by identifying the "external agents" which would be any activity or organization responsible for creating, using, reviewing, maintaining or authorizing ILS data; the "data flow" which traces the flow of the data through the ILS support systems; the "data stores" which represent a logical file or collection of data and would be identified as the required ILS products; and the various ILS support "process" which transform the data and result in some type of value added data. The process model would use a Computer-Aided Software Engineering (CASE) tool which facilitates modeling development to identify and document the Integrated LSA process. This model would be unique to any other since the objective is to identify the information flow among LSA and all ILS elements.
The utility of an integrated LSA process model would be the identification of redundancy within the ILS support process, to provide a common baseline to serve as the acknowledged point of departure for all ILS guidance and policy implementation and to support the development of the Computer Aided Logistics Support Integrated Work Breakdown Structure Database (CALS IWBSDB.

Phase I: Deliver the documented, integrated process.

Phase II: Use the process defined in Phase I to develop and demonstrate a computerized program of the process.

N91-151 TITLE: C2 Trusted Automated Information System (AIS)' Security Accreditation INIT/CDEV Support for Small Computer System Interface (SCSI) Micro-computers Equipped with a Local Area Network (LAN)

CATEGORY: Engineering Development

OBJECTIVE: Design, develop, test, evaluate and submit for accreditation by the National Security Agency (NSA) Computer Security Association; INIT/CDEV routines hosted on a SCSI-based, LAN-equipped micro-computer necessary to support all AIS requirements comprising a 'CZ Trusted Automated Information System' per DoD 5200.28-STD (orange book), and providing:

Criteria, per DoD 5200.28 STD	**Additions to DoD 5200.28-STD**
Discretionary Access Control…….	Add: 'No Trespass' warning upon boot; membership control for groups of users; and control access to SCSI/LAN peripheral(s) by groups.
Object Reuse……	Include: SCSI and LAN peripherals containing memory/storage elements; e.g.: disks, scanners, printers, etc) all micro-processor Cache RAM.
Identification and Authentication…	Add: an authorized users list; non-vocabulary passwords for each user; and group-unique keyboard procedures.

Audi…….	Export the event log in LOTUS or EXCEL format (a user option). Record each access to SCSI/LAN peripherals.
System Architecture……	Interrogate the SCSI/LAN networks; recognize authorized peripherals; log all responses.
System Integrity……...	Deny access to unauthorized SCSI/LAN peripheral(s). Provide operator security messages if unauthorized peripherals are detected.
Security Testing……...	Recognize and log every INIT and CDEV present at boot-up; Provide access to authorized INITs and CDEVs only

In addition to the INIT/CDEV support, the Contractor shall plan, outline, draft, edit, and submit for comment and review and revise as directed; the following documentation supporting the 'C2 Trusted Automated Information System' accreditation:

Criteria per DoD S200.28-STD	**Documentation Comment**
Security Features User's Guide……	Include a performance and micro-computer resource requirement(s) description of each 'C2' Security feature.
Trusted Facility Manual……...	Include an operational guide to each 'C2' Security feature.
Test Documentation……	Include daily and other periodic confidence tests for use by organizational level security personnel.
Design Documentation……..	Include: all system analyses; flow charts & Kepner-Tregoe diagrams; and source code with detail comments referencing the page & paragraph of the micro-computer manufacturer's hardware and software technical manuals.

Exception to SBIR Technical Data Rights Contractual Consideration: Relevant proposals shall; 1) provide the Government with unlimited royalty free rights in data for software and documentation either developed or delivered under Contracts resulting from this Topic and; 2) shall not propose any existing software or documentation for government use or delivery unless unlimited royalty free use has been granted to the Government prior to the proposal date.

DESCRIPTION: Phase I: Deliver an Alpha-test version of the INIT/CDEV supporting the first four security criteria. Provide alpha-test typed drafts of the 'Design Documentation', 'Trusted Facility Manual', and 'Test Documentation' as appendices to the final report, and concurrently with the alpha-test version of the INIT/CDEV. Phase I offerors are advised that only two micro- computers are contemplated in this solicitation: the IPM/PC (and compatibles) and the Apple Macintosh-II (x, cx, ci, and fx models); for each computer type, multiple awards are contemplated in Phase I, and selection of a Phase II contractor may be based upon competitive criteria including evaluation of the delivered alpha-test Init/Cdev version. Phase II proposals by any Contractor not delivering an alpha-test INIT/CDEV shall be returned as; not relevant.

Phase II: Task I: Prepare, submit and revise as necessary a Beta-test version of the Init/Cdev as necessary to meet the requirements of DoD 5200.28-STD and all 'C2' security criteria, and prepare, revise and deliver the 'C2' documentation concurrently with the Beta-version INIT/CDEV. Receive and maintain a complete log of all Beta-test comments received on the INIT/CDEV and the documentation, and annotate each comment with the action taken, date of patch/modification, etc.

Task II: Upon written authorization of the Contracting Officer, prepare, submit and revise as necessary a Delta-test INIT/CDEV version and the 'C2' documentation necessary to obtain 'C2 Trusted Automated Information System' accreditation from the NSA Task II may not be authorized for any contractor not delivering a satisfactory Beta-test INIT/CDEV version, nor for any contractor having Beta-test comments not resolved and satisfied to the satisfaction of the Contracting Officer's Technical Representative.

NAVAL SURFACE WARFARE CENTER

N91-152 TITLE: Advanced Multiple Target Recognition Systems

CATEGORY: Exploratory Development

OBJECTIVE: To develop an intelligent multiple target recognition system.

DESCRIPTION: In tense situations, when a wealth of sensor information is obtained from several potential targets, conventional approaches for correlation of this information is time consuming and may result in faulty decisions. An intelligent decision making system can be used in conjunction with sensors and weapons to defend against threats. In the case of multiple targets, the system must discriminate among friendly, non-hostile, and hostile targets and to engage only the hostile targets. Combined artificial neural networks and expert systems techniques and parallel computer architectures can play an important role in decision making and prioritizing targets for engagement.

Phase I: Investigate new approaches to a multiple target recognition system that is capable of autonomous recognition of multiple targets using multi-sensor information. The system will utilize both the qualitative and judicative reasoning process of human experts, as well as the capabilities of most probabilistic techniques. The result of the Phase I effort should be a report detailing the contractor's methodology for solving the problem and providing a detailed discussion of a proposed system design.

Phase II: Create a brassboard/simulation of the contractor's solution demonstrating the real time, improved capability.

N91-153 TITLE: RF/IR Dual Mode Sensor Integration/Fusion Exploratory Development

OBJECTIVE: To develop and demonstrate techniques and algorithms for combining RF doppler and IR tracker outputs in order to minimize each sensor's limitations and complement their performance.

DESCRIPTION: Both RF doppler and IR trackers being employed on missiles against air targets have their own particular errors and limitations. For example, RF doppler trackers are susceptible to glint, polarization, multipath, jammers and multiple target confusion. IR trackers are susceptible to hot spot offset (e.g. plume tracking), background clutter, IR decoys, and multiple target confusion. Most of these problems only exist in one tracking regime at a time, e.g., RF multi path does not affect IR tracking, IR background clutter does not affect RF tracking, RF tracking, etc. Even multiple target confusion becomes resolvable. Multiple identical IR target signatures would usually appear as distinctly different RF doppler signatures. Techniques and algorithms are needed to determine when to use RF or IR tracking in a dual mode tracker in order to minimize tracker degradation or loss of track. In addition, for a more advanced dual mode tracker, outputs of both sensors could be combined in order to maximize the tracker's accuracy task.

N91-154 TITLE: Application and Radiometric Characterization of Coatings

CATEGORY: Exploratory Development

OBJECTIVE: To develop a method of coating various materials to alter the infrared emittance of the material.

DESCRIPTION: Currently, most heat transfer measurements on models being tested in wind tunnels are made using coaxial thermocouples. These thermocouples are imbedded in the wall of the model. This method has shortcomings in that the model must be fabricated from specific materials, the number of thermocouples is generally limited (usually less than 50), and there is a constraint on material thickness (measurements could not be made on leading edges). These restrictions limit the number of models that can be readily tested.

Experiments indicate that infrared (IR) thermography can be used to make surface temperature measurements of a wind tunnel model. The advantage of IR thermography is that data can be obtained for up to 10 points on the model. The disadvantage is that the model surface emissivity must be known, and is often not easily determined.

It is therefore necessary to develop the capability of putting a coating on tunnel models to prepare them for IR thermography testing. This coating should be less than 20 um in thickness and have an emissivity greater than 0.85 for radiation in the 8-12 um wave band. The coating(s) should adhere to models made of a wide variety of materials, especially 17-4 PH (condition A) stainless steel and aluminum.

N91-155 TITLE: Guidance Algorithms for High Performance Missiles

CATEGORY: Advanced Development

OBJECTIVE: Develop and successfully demonstrate via simulation (at end of Phase II) of data fusion and target sorting algorithms suitable for anti-air high performance homing missile applications.

DESCRIPTION: The need exists for innovative approaches for combining data from multiple sensors and establishing multiple track files for homing missiles. Possible sensors are RF active and/or semi-active, IR, and ARIJ both in and out of band. The processing must be done in real time on board the missile and be able to successfully accomplish this task in the expected multiple target environment. This environment includes multipath effects, both standoff and self screening deceptive techniques, target maneuvers, and the potential use of decoys. The algorithms must be compatible with current or near term state-of-the-art sensor technology.

N91-156 TITLE: High Power Density Actuators CATEGORY: Advanced Development

OBJECTIVE: Successful fabrication and demonstration of an actuator that achieves rates up to 1000 degrees/second in the presence of up to 2000 in-lbs of torque that is suitable for a high performance missile tail fin servo.

DESCRIPTION: The need exists for a small high power density electro-mechanical actuator suitable for implementing in small anti-air missiles. These missiles may be no more than 9" in diameter with the actuators to be located in the annulus around the exhaust nozzle. In order to meet the missile performance requirements, actuator rates up to 1000 degrees/second may be expected in the presence of up to 2000 in-lbs of torque. Flight times are typically less than 20 seconds and the primary power source will be thermal batteries. It is recognized that these requirements stress the traditional electro-mechanical system approaches and therefore an innovative approach to missile actuation is required.

N91-157 TITLE: Optical Neural Networks for Automatic Target Recognition

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate an advanced optical neural network system to support a wide range of military real time pattern recognition applications.

DESCRIPTION: Neural nets provide high speed and fault tolerant associative memory, target classification and data or feature extraction from partially obscured or degraded sensor information. Actual physical realizations of neural networks require a highly interconnected and parallel architecture. Optical neural network implementations

can exceed most, if not all, of the present capabilities of electronic or software based implementations. Using optics it is potentially possible to obtain up to 1 Giga I association per second, 1 Giga interconnections per cubic centimeter of optical materials using holographic interconnects and 10 to the 18th (Exa) interconnects per second. Optical systems can also provide weight, volume and power advantages over electronic systems, which make them suitable for use in relatively small mobile platforms, such as RPV's and missiles. In addition to processing radar, IR, and video sensor information, such a system could also be used for spread spectrum communications, which cannot be implemented at this time due to the limitations of digital pattern recognition systems. Innovative neural network system I concepts using new, optically implementable paradigms or novel architectures, and/or advanced device/materials applications are sought.

N91-158 TITLE: Integrated Photodetectors for Optical Signal Processing

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate advanced photodetector devices, with onboard preprocessing and high speed AID conversion, for use in optical signal processing systems.

DESCRIPTION: Ultra-high speed optical signal processing systems still require a photodetector or sensor at the image plane, to sense and record the output. This creates a bottleneck at the optical interface because the parallel processed optical information I, has to be converted to digital bit streams. Major improvements in two dimensional output detectors are necessary in terms of spatial sampling, resolution, temporal sampling, dynamic range, geometric fidelity, image preprocessing, buffering and AID ", conversion, to improve data output. Offerers should consider an integrated device approach which includes the detector array and on-chip processing, such as analog time integration or filtering, and A/D conversion.

N91-159 TITLE: Aerodynamic Activated Metal Decoy

CATEGORY: Advanced Development

OBJECTIVE: Activated metals and aerodynamic decoys are in engineering development. This task will investigate innovative approaches to marrying these engineering technologies.

DESCRIPTION: The MJU-27/B IR decoy uses activated metal as its IR element. The MJU-20/B and MJU-29/B are examples of aerodynamically stable decoys. This task will investigate innovative approaches to marrying the underlying technologies of these devices to conceptualize an aerodynamic activated metal decoy. Contractor will require access to classified information; therefore, personnel and facility clearances at the SECRET level are required for Phase I and Phase II. NWSC SBIR office will provide required specifications.

N91-160 TITLE: Methodology for Predicting Fragment Induced Damage to Operating Rocket Motors

CATEGORY: Exploratory Development

OBJECTIVE: Develop methodology to predict the damage resulting from warhead fragments striking operating rocket motors.

DESCRIPTION: Methodology shall be developed to predict the failure of an operating rocket motor attacked by warhead fragments. The rocket motors of interest include both end-burning and center-burning. For the end-burning, impacts on both the gaseous and solid sections of the motor are of interest. For the center-burning, the thickness of the propellant shall vary from close to the maximum thickness (unburned) and close to the minimum (completely burned). Of particular interest is the dual-thrust end-burning motors. This type of motor burns at a higher pressure during launch. As a result, at the time of encounter, the motor is not as close to its burst. The primary fragment variables are impact, speed, size and pattern density.

Phase I: The effort would involve postulation of the failure mechanisms, a predictive methodology and a general test plan.

Phase II: The effort would involve specific test planning, conduct of the tests and finalization of the model.

N91-161 TITLE: Post-Intercept Trajectories of Missile Debris Fragments

CATEGORY: Exploratory Development

OBJECTIVE: To develop prediction methods to characterize the post-intercept behavior of fragments of antiship cruise missile threats.

DESCRIPTION: To better defeat modern antiship cruise missile threats, Navy surface ships must have detailed information about the post-intercept behavior of the individual components of the threat. Details of the most-likely motion characteristics of, the various missile components after break-up are needed to rapidly verify the possibility of the elimination of the threat. It is, also important to know the impact region or footprint of the various threat components to assess the likelihood of damage to the targeted ship or others in the vicinity. An analytical method applicable to current and future threat configurations is desired.

Phase I: Define a computational approach for the prediction of the post-intercept behavior of antiship cruise, missiles, develop and demonstrate the methodology for several classes of modern threats, and describe various approaches to validate the prediction methodology.

Phase II: Define the methodology developed in Phase I and apply it to specific Navy problems, develop the methodology into a computer code including pre- and post-processing capability, and validate the prediction method with available experimental data. The final computer code will be documented and delivered to the Navy complete with user training course and post-delivery support.

N91-162 TITLE: Integrated Computing Environment for Vulnerability Modeling

CATEGORY: Exploratory Development

OBJECTIVE: Develop an integrated computing environment for vulnerability modeling on a high performance graphics. workstation.

DESCRIPTION: Air Threat vulnerability assessment data is used in ordnance design and weapon system effectiveness analysis. This data needs to be produced much more quickly to be responsive to the weapon design and analysis process. The vulnerability modeling process involves the development of computerized geometric models, shotline analysis of the geometric models, the implementation of penetration equations into the shotline codes, and a variety of other ancillary tasks. Much of the software for vulnerability modeling dates back to the days of batch machines and punched card input. The entire process would benefit greatly by integrating the various computer codes onto a high performance graphics workstation utilizing modern database techniques, graphical user interfaces, and such. Considerable time and cost can be saved with a surface energetic state-of-the-art process.

Phase I: Literature, and NSWC hardware survey, overall concept development and preliminary system design

Phase II: Software development, demonstration and documentation

N91-163 TITLE: Ergonomic Replacement for Naval Console Trackball

CATEGORY: Exploratory Development

OBJECTIVE: Develop a replacement for the trackball which is currently utilized on many of the consoles aboard Navy ships.

DESCRIPTION: Recently published reports on currently available hardware indicates that a mouse, graphic tablet, isometric fingertip joystick and touch-sensitive screen are the better means for pointing and manipulating data on a display than a trackball. To enhance and increase the response time for a shipboard Navy operator on a display, the track ball as a data-entry-port/cursor manipulator needs to be examined and re-evaluated, and possibly replaced/upgraded, for today's needs and concern.

Phase I: The use of a trackball consumes a large quantity of a fire control operator's time. This area is ripe for the incorporation of new ergonomic principles and state-of-the-art technologies for the Navy. Conversely, a bad user interface may make things so difficult for the operator that the system is inefficient and unusable.

Phase II: Develop an effective user-system interface that makes the system not only easier to learn but also easier and more efficient to operate.

N91-164 TITLE: New High Surface Energetic Materials for Use in Slapper Devices

CATEGORY: Exploratory Development

OBJECTIVE: Synthesize new high surface area energetic materials to replace the explosive HNS for use in slapper devices.

DESCRIPTION: The explosive hexanitrostilbene (HNS) is a thermally stable explosive that easily meets the requirements listed in Weapon Specification 32972 for slapper performance. HNS is expensive to make; furthermore, the procedures used currently to make HNS result in waste products that require extensive processing before disposal.

Requirements: (1) a candidate replacement must function normally in slapper devices, with a minimal change in hardware configuration; (2) the candidate replacement must be less expensive to make than HNS; (3) the by-products produced by the synthesis of the candidate replacement must be disposable in an environmentally safe manner with a minimum of costly pre-processing; (4) the candidate replacement must be less sensitive than the explosive Tetryl in all sensitivity tests.

Phase I: Effort should be directed toward identifying the commercial source or the method of synthesis of candidate replacements. Small quantities of these candidate replacements shall be purchased and methods devised to make those materials that cannot be purchased. Twenty grams of each of the promising candidate replacements shall be forwarded to NSWC for characterization and evaluation in slapper devices.

Phase II: Effort shall be directed to the large scale preparation of candidate replacements selected by NSWC; methods should also be devised to reduce costs. Additional research will be required to optimize the slapper performance of these materials. Sufficient quantities of the candidate replacement explosives shall be forwarded to NSWC for evaluation.

N91-165 TITLE: Infrared Propagation Near the Sea-Air Interface

CATEGORY: Exploratory Development

OBJECTIVE: Develop an analytical model for infrared propagation at altitudes less than 100 feet shall be assembled.

DESCRIPTION: The development of a model of the optical propagation in the atmosphere above the sea-air interface and its verification through experimental measurements. The surface Navy must have the ability to detect and track targets such as cruise missiles at very low altitudes. Near the sea surface, the propagation is often affected

by the high humidity, aerosols, and temperature gradients. Refractive as well as scintillation effects are often seen in the visible region of the spectra. Infrared imagery can also be drastically affected by the high humidity conditions at sea and some ducting may occur

Phase I: Must include a design or breadboard system for conducting measurements over water ranges.

Phase II: Optical measuring equipment should be assembled and experiments be conducted over water ranges. Empirical data will be compared with the model developed during Phase I.

N91-166 TITLE: Weapons Control Icon Development

CATEGORY: Exploratory Development

OBJECTIVE: To develop standardized icons for use in Naval weapons control systems.

DESCRIPTION: Significant research and development is currently being done commercially on personal computer systems using icons for menu selections as opposed to typewritten commands. Icons are familiar objects or commands represented by small pictures. Use of icons is based on the principle expressed in popular literature as; "recognition is generally easier than recall". Icons developed and used on personal computers have been shown to be extremely easy for the user to understand, easy to train in minimal time, and very easy to recall. Due to the tremendous success of icon-based personal computer system menus, research should be conducted on applying similar principles to weapons control. Designers must first understand who their users are and what their needs are.

Phase I: Develop and test a set of standardized candidate icon designs and describe them in language and diagrams appropriate for military standards and specifications.

Phase II: In an environment where accuracy and speed are critical, each innovation which increases the probability of a successful mission completion must be explored, developed, and implemented. Designers must study the respective cognitive, behavioral, anthropometric, and attitudinal characteristics, as well as the mission to be accomplished, and validate (and modify as necessary) the candidate icons and icon design descriptions developed in Phase I.

N91-167 TITLE: Coated Boron Combustion Studies

CATEGORY: Exploratory Development

OBJECTIVE: To measure combustion reaction times (10 (-4) to 10(-6_) seconds) of 0.1 micron or less thickness aluminum or magnesium coated boron at temperatures up to 2500 degrees K.

DESCRIPTION: Ignition delays during metal combustion are detrimental to metal fuel performance. Ignition of uncoated boron particles is inhibited by the formation of a boron oxide layer which places a physical barrier between the metal and oxidizer. It is postulated that two-stage ignition occurs with boron, because the rate of oxidation is slowed by the oxide formation, with subsequent evaporation of the oxide layer and reheating. Aluminum or magnesium coated boron particles may permit the coating metal to react first, which may provide the heat necessary to raise the temperature of the underlying boron above the boron oxide volatilization temperature; therefore it is of interest to study the combustion of thinly (0.1 to 0.01 micron) coated small (diameters less than 5 microns) boron particles at temperatures up to 2500"K, expansion ratios of up to five to one, and reaction time resolution from milliseconds to microseconds.

Phase I: Research should focus on the ability to determine the parameters described in the above objectives.

Phase II: Research should further develop the experimental techniques to characterize expanded combustion conditions. In addition relate changes made in coating thickness and particle size to the observed changes in particle reactivity.

N91-168 TITLE: Production of Aluminum Powder with Aluminum Fluoride Coating

CATEGORY: Advanced Development

OBJECTIVE: To produce fine particle size aluminum powder with a passivating coating of aluminum fluoride rather than aluminum oxide.

DESCRIPTION: The heats of detonation of aluminized explosives and propellants are, in general, considerably higher than for non-aluminized materials. It has been suggested that, in order for aluminum to deliver energy in an explosive or propellant, the temperature of the aluminum must be above the boiling point of the oxide coating that protects the surface of an aluminum particle. It is possible that the substitution of a fluoride coating in the production of the aluminum powders to be used in explosive or propellant formulations would lead to more rapid shedding of the protective coating and hence earlier participation of the aluminum in the detonation. If this earlier participation were to occur, it might make it feasible to use aluminized materials in applications that are usually reserved for ideal explosives, thus making higher energy explosives available for metal driving applications.

Phase I: Should consist of an effort to produce fine particle (5 micron) spheroidal aluminum with a thin passivating coating of aluminum fluoride rather than aluminum oxide. The aluminum thus produced should be characterized as to the thickness, perfection and stability of the coating in the presence of moisture. Gram-sized samples of the material produced should be provided to the Navy for evaluation

Phase II: If the feasibility of producing AIF3 coated aluminum is demonstrated, Phase II should address the scale-up of the process and delivery of several pounds of the material to the Navy for incorporation into explosive formulations.
It should also include plans to compare the kinetics of the reaction of the A1F (3) coated aluminum with various oxidizers (such as O2, H2O, and/or CO2) at high temperatures to that of commercially available aluminum of comparable particle size.

N91-169 TITLE: Coating of Anhydrous Lithium Perchlorate (LP)

CATEGORY: Exploratory Development

OBJECTIVE: To produce anhydrous lithium perchlorate coated with an inert material that will reduce the hygroscopicity of the LP.

DESCRIPTION: Many explosives and propellants contain ammonium perchlorate (AP) as an oxidizer. Calculations have indicated that replacing the AP with lithium perchlorate (LP) could lead to significant enhancements in performance in these materials. However, the use of lithium perchlorate presents many problems, among them being the hygroscopicity of LP and the sensitivity it confers on some formulations

Phase I: A study of coating anhydrous LP with a thin coating of some material that will (1) reduce the hygroscopicity of the coated LP and (2) not make it more sensitive to impact than uncoated anhydrous LP. Attention should be paid to the thickness and perfection of the coating. Samples of the coated material should be provided to the Navy for evaluation.

Phase II: Scale-up of the process for coating the LP and production of several pounds of the coated material for evaluation by the Navy.

N91-170 TITLE: Technologies to Accelerate Heterogeneous Reactions Producing Energetic Material

CATEGORY: Exploratory Development

OBJECTIVE: To accelerate the rates of heterogeneous reactions used in the synthesis of high energy compounds by means other than bulk elevated temperature.

DESCRIPTION: Many valuable high energy compounds are synthesized using heterogeneous reactions which are very slow under reaction conditions amenable to scale-up. Examples are thermally stable polynitropolyphenyls which require high temperature Ullman reactions for their synthesis, synthesis of aliphatic fluoronitro compounds by exceedingly slow displacement reactions with potassium fluoride, and synthesis of polycyclic and cage aza compounds by amidealdehyde condensations via highly insoluble intermediates. Acceleration of these reactions by heating is often not feasible on a large scale because products or intermediates are not stable and/or the hazards involved are prohibitive.

Phase I: Alternative methods to accelerate such reactions are to be identified and demonstrated experimentally.

Phase II: Feasible methods will be scaled up and used to prepare multi-kg quantities of specified high energy compounds.

N91-171 TITLE: High Temperature Boron-Titanium Chemistry with Water

CATEGORY: Exploratory Development

OBJECTIVE: To determine high temperature reaction rates of boron and titanium to the intermetallic with subsequent measurement of reaction rates and products of the intermetallic with water.

DESCRIPTION: The adiabatic flame temperature of the combination of boron and titanium to the corresponding intermetallic is predicted to be in excess of 3000 degrees K. The offeror should have an understanding of this reaction and be able to determine high temperature reaction rates to form the intermetallic with subsequent measurement of the reaction rates and products formed when the hot intermetallic and unreacted metals are reacted with water. Of interest are the conditions for ignition of the metals, reaction rates and physical form of the pre-ignited metals. Measurement of the reaction rates of the hot intermetallic and unreacted metals with water are important as well as corresponding products formed.

Phase I: Effort should be directed towards experimentally proving the feasibility of igniting the boron-titanium mixtures, and understanding the chemical reactions between the intermetallic, unreacted metals and water and measuring the reaction rates via the formation of products.

Phase II: Efforts should further develop an understanding of the chemistry involved of the above described reactions and expand experimental methods to include mass balances on the reactants and products with alternate mixing techniques.

N91-172 TITLE: Predicted Tactics of Adversaries

CATEGORY: Exploratory Development

OBJECTIVE: The development of a tactical database, drawn from intelligence data and historical observations, suitable for use in surveillance planning.

DESCRIPTION: Surveillance planning systems are being developed to assist tactical commanders in the allocation of search assets. These systems have the capability to produce technically correct search plans based on previous contact data, unsuccessful searches and estimates of adversary tactics or intentions. This task addresses the problem of determining what those tactics are. Estimates should come from several sources: historical, recent intelligence, contact data and the judgment of the commander. The tactics may deal with either surface contacts, air contacts or both (submarines will be considered in Phase II).

Phase I: Produce a definitive paper study demonstrating the feasibility of building such a database for the prediction of tactics and intentions. The study should clearly show the sources of the data and the methodology and algorithms by which the predictions are made.

Phase II: Produce a full scale prototype with most of the capabilities in place sufficient for operational support to a battle group.

N91-173 TITLE: Militarized All-Optical Non-Moving Fiber Optic Switch

CATEGORY: Research

OBJECTIVE: Develop a highly reliable fiber optic switch to be used in fiber optic data transfer networks.

DESCRIPTION: Optical by-pass switches are important components for fiber optic data transfer networks. These switches can be made more reliable by using optical materials for the switching mechanism (no moving parts) and by activating the switch optically (no EMI).

The switch will employ crystals that are optically bistable so that there will be no optical-to-electrical conversion at the switch. The switch must be totally optical and have a switching speed faster than one microsecond. Signal transmission and switch activation must both occur for wavelengths of 850 and 1300 nanometers. The switch must be compatible with multimode and single mode optical transmission systems. The entire package (including fiber to crystal interfaces) must be ruggedized to withstand shock and vibration as well as other military environmental tests.

Phase I: A feasibility study and possible prototype of the switch mechanism would be the product.

Phase II: A device passing all applicable military specifications would be the result of a Phase II contract.

N91-174 TITLE: Optically Driven Quartz Crystal Shutter for Use in Sensors

CATEGORY: Research

OBJECTIVE: The development of a crystal shutter for use in all-optical sensors. Current research into optical sensors (pressure, temperature, velocity, etc.) has produced designs that rely on piezoelectric crystals which convert incident light energy to electric current.

DESCRIPTION: Materials research is sought to replace these piezoelectric crystals with a crystal oscillator that is driven at its resonant frequency by use of optic radiation. A double-ended tuning fork quartz crystal oscillator which will not allow discrete components such as diodes or photocell arrays to be located adjacent to the quartz crystal is needed. The optical radiation must be supplied by commercial LEDs or laser diodes which operate at 1300 nanometers. The optical radiation will be delivered to the quartz crystal via a 62.5 micron optical fiber. The unstressed resonant frequency of the quartz crystal oscillator will range from 10 to 100 Khz depending on the crystal dimensions.

Phase I: Produce candidate quartz crystals having the required resonant frequencies.

Phase II: Build and test up to 10 different quartz crystals having resonant frequencies of 10n Khz where n =1, 1,2, 3 ---10

N91-175 TITLE: Biocorrosion/Biodeterioration/Biofouling of Coated Metals

CATEGORY: Exploratory Development

OBJECTIVE: To understand and prevent the observed corrosion/deterioration of protected metals in cooling systems.

DESCRIPTION: Microbiologically influenced corrosion (MIC) studies of nylon coated, epoxy coated, and polyurethane coated metals used in marine seawater and atmospheric marine environment have been undertaken using aerobic and facultative anaerobic (sulfate-reducing) bacteria which have been found in Naval systems. The observed synergistic attack of chloride ion and microbial attack on these coatings (and possibly the newly exposed metal surface) is being studied using electrochemical, physical/structural, and microbial techniques. Proposals are sought for understanding the processes of algal, protozoan, fungal and other attacks of these coatings using microbial, electrochemical, and physical/chemical methods.

N91-176 TITLE: Optical Time Domain Reflectometer (OTDR) for Network Use

CATEGORY: Research

OBJECTIVE: Develop an OTDR that can be automatically switched into a fiber optic network for diagnostics and built-in-test capabilities.

DESCRIPTION: Fault location in a fiber optic network is a major portion of corrective maintenance time. It is desired that the fiber optic network administrator (computer) have available an OTDR that could be automatically switched into the network to determine if (and where) a cable/connector break is responsible for service interruption. The major characteristics for this OTDR would include:

- All circuitry in a single hybrid microcircuit suitable for installation on a printed circuit card. -Operation at 1300 nm for 62.5/125 micron fiber.
- Resolution of 1m over a distance of 2 kilometers.
- Electrical output of analog or digitized OTDR trace.

Phase I: A successful Phase I contract will conclude with a feasibility study for this equipment along with a breadboard prototype system.

Phase II: If Phase II is authorized, will conclude with several advance development models suitable for testing to applicable Navy standards for electronics and fiber optics.

N91-177 TITLE: Ceramic Ferrules for Fiber Optic Connectors

CATEGORY: Engineering Development

OBJECTIVE: Establish a U.S. manufacturer of ceramic ferrules for use in fiber optic connectors.

DESCRIPTION: Ferrules are the most important element of a fiber optic connector, providing the mechanism for the precise alignment of the optical fibers. Ceramic ferrules are preferred over other materials (e.g. stainless steel, plastic) for their precision, environmental stability, and ease of assembly. There are only a few manufacturers of ceramic ferrules worldwide, none of which are located in the U. S. or other NATO countries.

Phase I: A feasibility study detailing the requirements for establishing a manufacturing facility would be the product of Phase I.

Phase II: If authorized, Phase II would consist of exploratory development of a manufacturing facility.

N91-178 TITLE: Low Halogen. Flame Resistant Cable Jacket Material

CATEGORY: Research

OBJECTIVE: To develop a low halogen flame resistant cable jacket material suitable for Navy applications.

DESCRIPTION: The cable jacket materials shall be applicable for use in both high fiber count cable designs as well as low fiber count cable designs. The cable jacket material shall contain less than 2% halogens by weight and shall meet the following requirements:

Acid Gas Generation:	<2 oz by weight
Smoke Generation:	Dm <225 according to ASTM-E-84
Flame propagation:	flame spread time product <27.5 m.min after 10 min in UL-910 tunnel test
Fungus Resistance:	Grade I MIL-STD-810
Water Absorption:	<3.9 mg/sq cm of material surface area
Fluid immersion:	24 hrs in the following fluids;
	Fuel Oil (33-37 deg C)
	JP-5 (20-25 deg C)
	Isopropyl Alcohol (20-25 deg C)
	Hydraulic Fluid (48-50 deg C)
	Lube Oil (73-77 deg C)
	Coolant (Monsanto Coolanol) (20-25 deg C)

The tensile strength and elongation shall not change more than 50% from the initial values.

Phase I: A preliminary evaluation of all candidate materials would be the result of a Phase I contract.

Phase II: If authorized, Phase II would consist of the full scale development and testing of best candidate materials determined in Phase I.

N91-179 TITLE: Investigation of the Rechargeable Lithium Cobalt Oxide Cell

CATEGORY: Exploratory Development

OBJECTIVE: Develop and evaluate a rechargeable lithium cobalt oxide (Li/LixCoO2, methyl formate) cell that can deliver fifty, 100 Wh/lb cycles at the C/6 rate and have a shelf life of 5 years.

DESCRIPTION: The Navy is investigating the feasibility of using Li/LixCo°2 for powering underwater vehicles. This system is very attractive because of its high theoretical energy density (500 Wh/lb) and high operating potential (4 volts). Two challenges confronting the Li/LixCoO2 technology now are improvement of the system's charge retention capability and further advancement toward achieving a densified thin cathode. Successful resolution of these two areas will permit this technology to move from laboratory cells to hardware.

Phase I: Efforts will focus on determining the amount of lithium that can be intercalated or deintercalated in the C002 structure without adverse effects on rechargeability. Voltage limits during charge and discharge will be established in order to determine if this system should be cycled to a predetermined capacity or voltage endpoint. Cells will be stored under various temperatures and state-of-charge to assess charge retention. If the system is found to lose charge excessively, the source of this failure will be investigated. A further objective is to increase the cathode density, with the overall goal of achieving a low cost process capable of producing thin, rugged, flexible electrodes.

Phase II: Investigations will refine and expand progress made in Phase I and demonstrate these improvements in prototype hardware cells. Interactions between the hardware cell components and the C002 system will receive fuller evaluation with respect to cycle life and charge retention. Cathode investigations will continue to maximize density and minimize thickness.

N91-180 TITLE: Maneuvering Reentry Body Aerothermal Analysis Computer Program

CATEGORY: Exploratory Development

OBJECTIVE: Development of a computer code to predict shape change and internal temperature distributions for advanced maneuvering reentry body configurations.

DESCRIPTION: Future missions of the Navy's Submarine Launched Ballistic Missiles may require the development of advanced, high-performance, maneuvering reentry bodies (MaRB's). The external configuration of such a MaRB will probably be a complex, nonaxisymmetric shape in order to obtain the desired aerodynamic performance. The severity of the reentry heating environment will probably require the use of ablative materials on all external body surfaces. To assess the aerodynamic and, structural performance of such a MaRB, it will be necessary to determine the instantaneous shape of the body and the, temperature distributions within components such as nosetips, leading edges, heatshields, and control surfaces at any point in the MaRB's trajectory.

A computer program is therefore sought which can be used to predict surface shape change (due to thermochemical ablation and hydrometeor erosion effects) and in-depth temperature distributions for complex MaRB configurations.

It is expected that a Phase I effort will assess the current state-of-the-art in this area, identify an approach for constructing the desired computer code, and carry the code development at least to the point where the viability of the approach can be demonstrated.

Completion, validation, and documentation of the code will take place during a Phase II effort. At the conclusion of this phase, the code will be installed and demonstrated on the NSWC VAX computer, and NSWC personnel will receive instruction in the use of the code.

N91-181 TITLE: Realizing the Potential of Computer Aided Software Engineering (CASE) for Real Time Embedded Computer Systems

CATEGORY: Exploratory Development

OBJECTIVE: CASE can be viewed as a combination of methods and tools for developing and maintaining software systems.

DESCRIPTION: Case attempts to cover the complete software life cycle by providing automated support for requirements analysis, specification, design, implementation, maintenance, reverse engineering, quality assurance, project management and documentation. While current CASE products have demonstrated the potential for some automation of the entire software / development process, considerably more needs to be done to effectively exploit the potential of CASE --especially for complex real time embedded computer software. Innovative ideas are sought in important technology areas that can contribute to CASE, including (but not limited to) developments methods, CASE infrastructure, CASE repository, tool integration, user interface, AI (Expert Systems and Neural Nets), executable prototyping, and performance engineering.

Technologies that can help CASE products reach their full potential (i.e. automate as much as possible the entire software development process) are sought. While investigations may proceed within the context of a particular CASE tool, it is desirable for that technology to be applicable across a wide spectrum of CASE products.

Phase I: Investigate innovative approaches that will lead to significant automation of the software development process and determine the feasibility.

Phase II: If feasibility is shown, develop a prototype system which demonstrates the utility of the approach.

N91-182 TITLE: Simultaneous Focusing Multi-Spectral Infrared Detectors

CATEGORY: Exploratory Development

OBJECTIVE: The design and fabrication of multi-spectral response infrared detectors with common optical areas.

DESCRIPTION: Infrared detectors have wide applications in missile guidance, surveillance, and smart annunitions. Their advantage over other sensor types is that they are passive and less susceptible to counter measures. Within the infrared spectrum, multicolor detection is highly desirable; as it can offer clutter rejection, target discrimination and background elimination capabilities through signal processing schemes. Current multi-color detector technologies require the placement of detectors on separate, though contiguous areas of a common substrate. Incoming signal is not fully utilized since the effective area of each detector is reduced.

This solicitation calls for a scheme in which the optical areas of the "colored" detectors are coincident so that the incoming optical beam focuses simultaneously on all of them. The detectors should preferrably be photovoltaic, semiconductors photon counters. Advances in modern technologies for the growth of multi-layer heteroeptaxies involved semiconductors and insulators should be incorporated. Semiconductor bandgap engineering concepts and practices should also be elements of the detector design. Direct bandgap materials of the II-V, the II-VI, and the IV-VI family are appropriate.

Phase I: Conceptualization of the detector structure. Feasibility studies should be carried out. Prototype demonstration is highly desirable.

Phase II: Design, fabrication, and characterization of actual detectors. Performance standards should also be established. Demonstration of two-dimensional, two color, small element array should be included.

N91-183 TITLE: Automated Die Bond Inspection System

CATEGORY: Advanced Development

OBJECTIVE: Study the feasibility and implement a design for an automated system that will inspect die bonds and other parameters on miniature electronic systems such as the Underwater Digital Signal Processor (UDSP).

DESCRIPTION: Introduction and purpose -Manual inspection on miniature computer systems with hundreds of die bonds is time consuming, expensive and subject to human error. Automated robotic vision systems have developed to a state where many inspection steps could be automated, saving time and money and increasing the quality of the hardware.

Phase I: A study would investigate the feasibility of an automated robotic vision system specifically designed to inspect die bonds, chip placement and orientation, and even die wire connectivity on miniature computer systems. Several approaches would be compared and the most promising would be used for a preliminary design.

Phase II: Prototype of the automated inspection system outlined in Phase I would be designed and built using the most advanced technology available. Deliverables would include a complete design analysis, a design documentation package, and a prototype suitable for test and evaluation, using several UDSP furnished by the Navy. The contractor will participate in the test and evaluation tests to guarantee the system is working at full capability and provide timely modifications as needed to optimize system performance.

N91-184 TITLE: Prototype AAW Data Fusion and Command Support System (PADCS)

CATEGORY: Exploratory Development

OBJECTIVE: The development of a prototype control system to aid the embarked Anti-Air Warfare Commander in Aegis air defense functions.

DESCRIPTION: The need for a system to assimilate new sources of offboard/SCI information, merge them with currently available organic assets, and use the information to provide decision support. The system will perform functions of data input, track management, decision support and tactical display. The offboard sources will be analyzed in real time to identify I&W or other alerts. A tract management function will merge the contract data into

a track database, provide amplifying information from intelligence databases, do ELINT processing as needed, and perform other contact/track management functions. The tactical display function will provide a continuous and easily assimilable presentation of the AA W situation. A composite AA W Decision Support Sub-system (ADSS) will include tools to assist command in asset management, battle monitoring and assessment, sensor management, communication assessment, cover and deception effectiveness, screen/formation assessment, readiness assessment and replenishment planning, as well as detailed I&W. The system will function, for the most part, at the GENSER level.

Phase I will produce a detailed Type A or similar document describing functionality of the system. In addition, a demonstrable prototype of at least some of the functions should be provided.

Phase II will produce a full scale prototype suitable for laboratory demonstrations. At least some of the functionality should be able to be demonstrated in an at-sea exercise.

N91-185 TITLE: Data Processing and Interpretation of ECM/ESM Contacts

CATEGORY: Exploratory Development

OBJECTIVE: To develop a system that will (1) process remote and local (OTH/organic) ECM and ESM reports, and (2) provide tactically significant information to a platform or mission commander.

DESCRIPTION: ECM/ESM reports contain a large amount of potentially important data, but not in a form that is readily usable by a tactical commander. Individual reports are best processed and assessed within the context of previous reports, the current tactical situation and intelligence databases. Processing would encompass (1) contact/tract correlation using (for example) hypothesis methods, (2) database management of received and internally generated data and (3) issuance of queries to intelligence databases for supporting information.

Tactical assessments would call upon sub-modules that would (for example) perform pattern matching based on historic activity, analysis of current activity trends, development of hypotheses based on known or suspected capabilities, and prediction of future events and deployment of assets to either detect or counter such events.

The need is for a system that will accept reports and perform such processing and assessments in a semi- automatic mode of operation. The information provided to the user would include alerts, early earnings, current and predicted situation status, asset deployment or similar information. The information would be provided in an assimilable format for the tactical commander to support the decision making process and provide targeting data. The human interface capability would provide detailed background and supporting information as requested by the user and support "what if?" type of queries.

The Phase I product will be, at a minimum, a full description of the algorithms and design to be used. Preferably, a working prototype will be produced demonstrating at least some of the significant functionality.

In Phase II, a working prototype will be produced with all of the functionality needed for a comprehensive field evaluation.

N91-186 TITLE: Development of High Power Microwave Technology for Microsecond Pulses

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this research is to develop new and innovative technology for high power microwave production for microsecond pulselengths and to carry out an experimental demonstration.

DESCRIPTION: High power microwave production using electron beam accelerators has typically been limited by the accelerator pulse length. Currently a new type of intense relativistic electron beam accelerator capable of producing microsecond pulselengths has been developed and is in operation. This accelerator located at NSWC can

produce a microsecond long, 3 MeV, 1 kA electron beam pulse. The objective of this work is to develop technology to produce microsecond long high power microwave pulses and demonstrate it using this electron beam. The successful offeror must decide on a concept which is based on an application of these high power microwaves which is of interest to the Navy, such as electronic warfare, missile defense, radar, communications, or some other proposed application.

In Phase I of this work, the concept will be refined using fully electromagnetic particle in cell computer simulations with the parameters of the electron beam mentioned above. By using proper scaling laws, these simulations should be r extended to the eventual parameters. A complete set of drawings for the high power microwave tube should be produced to be used with the NSWC accelerator. A complete description of appropriate diagnostics for this experiment should be produced. These diagnostics should be able to verify the proper operation of the tube.

In Phase II of this work, the microwave tube should be produced and tested on the NSWC accelerator in cooperation with Navy scientists. The proper diagnostics package must be procured. In this Phase, the electron beam will need to be extracted into the tube, and the diagnostics must be used to verify the operation of the tube. The contractor will have to develop an experimental task plan and coordinate this work with Navy scientists.

NAVAL AIR DEPOT/ NORTH ISLAND

N91-l87 TITLE: Superconducting Josephson Array

CATEGORY: Advanced Development

OBJECTIVE: To develop a 10-volt superconducting voltage standard referenced to time and frequency

DESCRIPTION: The 10-volt Josephson Array is a superconducting chip that acts like a frequency to voltage converter. The accuracy of the output voltage depends upon how well you can measure the input frequency. Since frequency is the most accurate measurement known to man, the application of the Josephson Array allows the use of DC volts to achieve equal or more accurate frequency measurements compared to current methods.
The DC voltage measurement is the basis for most other electrical parameters, i.e. AC volts, current, capacitance, and resistance. An increase in the ability to accurately measure DC volts will cause increased accuracies of varying proportions in the other measurement areas as well.

A prototype 10-volt junction is presently operating at the Navy Primary Standards Laboratory at North Island. The work described in phases I and II is needed so that this technology becomes the routine method for DC voltage traceability in the Navy Metrology Program.

Phase I will be a study addressing the items listed below:

1. Identify critical components, provide redundancy and increased reliability to reduce down time.
2. Improve the error analysis routines in the system software.
3. Improve the capability to produce reliable 1- and 10-volt arrays, and transfer this technology to private industry.
4. Increase the operating temperature of the device for 4 degrees K to around 77 degrees K, or simplify the logistics and technical problems encountered when operating at 4 degrees K.

Phase II will be a conceptual development effort. It will target the most difficult technical problems identified in Phase I and develop breadboards or working models to demonstrate that these problems can be overcome.

N91-l88 TITLE: Centrifugal Filtration of Corrosive Process Solutions

CATEGORY: Engineering Development

OBJECTIVE: To develop the technology and equipment to centrifugally filter corrosive process solutions used at aircraft maintenance activities. If successful, this technology would extend process solution lives by extracting harmful particulates, sludges and residues.

DESCRIPTION: Historically, large volume process solutions are prematurely dumped due to contamination build-ups that cannot be simply filtered out. The high temperatures and corrosive nature of these solutions preclude the use of standard filtration methods. Centrifugal filters are dynamic devices that spin out the contaminants from the solution. The cleaned solution is returned to the process tank and the separated hazardous waste is drawn off into disposal drums. Conservative estimates show that removal of contaminants from alkaline cleaning solutions and electroplating baths can at least double and in many cases quadruple solution life. For example, a 1600 gallon tank of a highly concentrated, chelated alkaline scale conditioner over $22,000 to make up and over $2,500 to dispose of it twice a year. Although the existing centrifugal filters work well on fairly neutral, benign solutions, the technology has not been demonstrated on high temperature corrosive solutions.

Phase I should consist of a study outlining the approach which will be undertaken to achieve the technology required to develop the centrifugal filter designs for all high temperature corrosive process solutions identified by the preparing activity.

Phase II should utilize technology developed in Phase I to actually build and deliver to the government a high capacity, efficient corrosive solution centrifugal filter system that is skid or wheel mounted for portability. The government will test the filter on the variety of corrosive solutions that was identified in Phase I.

NAVAL AIR DEPOT/NORFOLK

N91-189 TITLE: Advanced Aircraft Wire Marking Systems

CATEGORY: Advanced Development

OBJECTIVE: To identify advanced technologies which could be used to permanently identify aircraft electrical system wires.

DESCRIPTION: Currently automated Ink Jet and Nd:YAG Laser systems are being used to mark aircraft electrical wiring with identification information prior to incorporation into aircraft wire harnesses. Both systems have problems associated with them which could be eliminated with the use of an advanced technology. Wire identification is in the form of alphanumeric characters and bar codes. The information is placed on wire outer insulation coatings every three inches. Current Ink Jet wire markers can cause smeared markings and fade over a period of time causing problems in reading the markings. Nd:YAG Laser systems have problems with control of heat input. Too much heat input causes burning and scorching of the insulation and damage to the wire core. ND:YAG Laser marking has not been approved for use by the Navy on aircraft wiring.

Phase I should consist of a study identifying advanced technologies which could be applied to legibly marking aircraft wires without damage to the insulation and wire core. The advanced technologies identified should be technologies that have been proven reliable and could be integrated into an automated production environment. Test data supporting the study should be included. The most promising technologies should be identified and ranked according to feasibility. Nd:YAG Lasers and Hot Stamp should not be studied.

Phase II should provide an automated system which can be integrated into an automated aircraft wire manufacturing facility for testing.

NAVAL AIR DEVELOPMENT CENTER

N91-190 TITLE: Miniature Radio Frequency (RF) Decoy Thermal Battery

CATEGORY: Advanced Development

OBJECTIVE: Increase the reliability of the present miniature RF decoy's thermal battery while maintaining present power density and outputs.

DESCRIPTION: Currently miniature RF decoys are powered by short duration thermal batteries which provide multiple voltages with short initiation times. Durations are measured in seconds and initiation in msec. Critical performance requirements strain power density constraints which can lead to a possible short-circuit which is unsatisfactory. This effort will be directed at increasing the reliability/reproducibility of thermal batteries.

Phase I will require the contractor to deliver designs for a higher reliability battery for the GEN-X (Generic Expendable Decoy).

Phase II will require the contractor to deliver a prototype battery to be installed for testing with the GEN-X. Selected contractor must have personnel and facility clearance of Secret during Phase II. Drawings and specifications are available by contacting the SBIR office.

N91-191 TITLE: Optical Neuron

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the possibility of developing an optical neuron on a chip.

DESCRIPTION: Neural networks have the potential to provide adaptation to changing or uncertain dynamic characteristics of high performing aerospace vehicles and ever-improving performance through dynamic learning. An optical neuron would provide I the neural network with inherent electromagnetic immunity.

Phase I: Develop and design an optical neuron on a chip.

Phase II: Fabricate the neuron and test it. Some of the necessary technologies for this task will be:
..on-chip optical waveguides
..passive optical multiplexing
..passive optical threshold detection
..optical summation with optically variable gains on each input

N91-192 TITLE: Tactical/Operator Aids

CATEGORY: Advanced Development

OBJECTIVE: To identify and develop tactical and operator decision aids to enable effective S-3B integration and utilization of the new active sonobuoy, the Air Deployable Active Receiver (ADAR), and Expendable, Reliable Acoustic Path Sonobuoy (ERAPS).

DESCRIPTION: Tactical decision aids are not currently available to assist the operator in tactical planning for optimum buoy deployment and depth selection. Also, operator aids do not exist for classification and tracking of active acoustic contacts/detections. The purpose of this project is to develop tactical decision aids to assist S-3B operators in the tactical planning for optimum deployment of ERAPS and ADAR sonobuoys, and to develop operator aids for effective classification and tracking of active acoustic detections.

Phase I: Study to define feasible approaches to providing operator aids as a part of S-3B tactical mission program software.

Phase II: Develop rapid prototype software to implement the most feasible, practicable approach identified during Phase I.

N91-193 TITLE: Complex Radar Target Signature Augmentation

CATEGORY: Advanced Development

OBJECTIVE: Provide radar target capability to replicate the following threat characteristics: scintillation, glint, jet engine modulation (JEM), polarization.

DESCRIPTION: Expendable radar targets used in weapon test and evaluation or proficiency training vary in their capability to replicate threat characteristics for accurate assessment of engagement end games, complex radar signature simulations are required. Digital RF memory technology is particularly applicable to high fidelity simulations of this nature. Features for target augmentation include scintillation, lint, JEM, and polarization components as a minimum.

Phase I: Should focus upon requirements determination of a technical approach and draft specification. Delivery: Specification.

Phase II: Fabricate a brassboard prototype suitable for integration on an aircraft for concept demonstration and test. Delivery: Prototype hardware.

N91-194 TITLE: Small Baseline Vector Scoring

CATEGORY: Advanced Development

OBJECTIVE: Provide accurate non-cooperative vector scoring from target platforms offering small baseline dimensions.

DESCRIPTION: Current vector scoring approaches rely upon trilateration techniques which require large dimensions (baselines) between antennas in order to achieve acceptable accuracy. However, a requirement exists to provide small scale targets as well as very high speed with vector scoring capability. In neither case is a large enough baseline available to satisfy the demands of current scoring systems.

With the advent of recent digital processing techniques applied to general non-cooperative scoring problem, it now appears possible to employ measurement techniques based upon radar return from several antenna elements spanning very small baselines. The development of this technology is expected to handle even such extreme cases as equipping missiles with vector scoring capability.

Phase I: Study to determine alternate methods of achieving vector scoring data from small baseline targets. Delivery: Study.

Phase II: Construction of a feasibility model of a vector system. Delivery: Prototype hardware.

N91-195 TITLE: Data Compression Applied to Doppler Scoring Signals

CATEGORY: Engineering Development

OBJECTIVE: Telemeter several wideband Doppler signals produced by multi-antenna scoring systems through a narrow band telemetry channel.

DESCRIPTION: As the requirement for more complex airborne measurement systems increases, it is apparent that the amount of Doppler information produced increases in direct proportion. As this increased amount of data requires transmission to the ground, wider telemetry bandwidths are required. Due to high usage it is increasingly difficult to obtain wide bandwidth allocations. If this situation is not addressed, the capability of future airborne systems might well be limited by simple telemetry channel capacity. Fortunately, there is a great deal of redundancy

in the Doppler signal generated by the passing projectile which makes such signals natural candidates for various types of data compression techniques. Due to the unique chirp and statistically non-stationary nature of these Doppler signals, conventional data compression techniques will have to be substantially modified to be effective, Compression techniques must be developed to function in the very low signal to noise ratio environment that is characteristic of scoring Doppler signals and through a telemetry channel experiencing frequent data dropouts.

Phase I: Investigation and trade-off of various methods of compressing large amounts of Doppler data into 19 narrow telemetry bandwidths. Delivery: Study.

Phase II: Develop working algorithms and prototype hardware to prove feasibility. Delivery: Prototype hardware with software.

N91-196 TITLE: Three Dimensional Radar Imaging for Scoring! Applications

CATEGORY: Engineering Development

OBJECTVE: Develop three dimensional radar images of missiles passing a suitably equipped airborne target thus providing missile identification and orientation information.

DESCRIPTION: A great deal of progress has been made in the area of Doppler signal processing with broad application to scalar and vector missile scoring. These techniques appear to have promise in the area of three dimensional radar imaging of, objects passing near a drone target aircraft equipped with a multi-antenna vector-type radar sensor. The resulting radar image will be a quasi-optical three dimensional rendition of the projectile at a predetermined position in its trajectory within the neighborhood of the target aircraft. Major features such as control surfaces, nose, tail, and other abrupt discontinuities are expected to be visible. Since the image will be constructed in a coordinate (x,y,z) system referenced to the target aircraft, it will reveal attitude of a missile with respect to the target.

Phase I: Demonstrate the imaging capability using simulated Doppler data. It will be necessary to determine what type of display device would be suitable to present such an image to the user. Delivery: Demonstration.

Phase II: Perfect the algorithm to operate in a timely and automatic fashion. The results of the process will then be interfaced to the selected three dimensional display device. The entire system will be extensively tested using flight test data gathered on a suitable Doppler scoring radar. Delivery: Prototype hardware with software.

N91-197 TITLE: Reconfigurable Infrared Detector Assembly for Dual Function Optical Scanner

CATEGORY: Advanced Development

OBJECTIVE: To develop passive electro-optical sensor for air ASW and surveillance.

DESCRIPTION: The Navy's infrared imaging equipment provides moderate to high spatial resolution of scenes and targets as low to moderate thermal sensitivity. However, some naval applications such as tactical oceanography. and ASW require very high thermal sensitivities. Accordingly, new infrared line scan imaging equipment is needed to provide, simultaneously, high spatial resolution of targets and high thermal resolution of the scene. Critical components needed for such a device are dual function optical scanner and electronically reconfigurable detector assembly. Such devices and components are not currently available. In FY-90, the DON's SBIR Topic entitled "Dual Function Optical Scanner" (Topic No. N90-371) will lead to the development of the dual function optical scanner. This effort will develop an infrared detector assembly to convert the infrared radiation from the Dual Function Optical Scanner into both a high resolution mode and a high sensitivity (order-of-magnitude increase over existing sensors) mode video simultaneously. Some key characteristics of the detector assembly are: (a) Mercury Cadmium Telleride detector array (8-12 um infrared band) electronically reconfigurable for high resolution or high sensitivity, (b) close cycle cryogenic cooler (77 K) and dewar assembly, (c) preamps and circuitry for signal

conditioning, digital scan conversion, and generation of dual mode (i.e. high resolution and high sensitivity) video output.

Phase I: Design the complete detector assembly.

Phase II: Proceed upon approval of the Phase I design package. The detector assembly will be fabricated from the design package developed in Phase I.

N91-198 TITLE: Synthetic Generation of Dynamic Infrared Scenes

CATEGORY: Advanced Development

OBJECTIVE: To develop model based synthetic infrared scenes for sensor prediction and mission planning.

DESCRIPTION: The need exists in the Navy and Special Warfare missions to accurately simulate the target scene areas as seen through the actual infrared sensors (e.g. Forward Looking Infrared (FLIR), and Infrared Linescanner (IRLS) through the corresponding displays aboard the mission aircraft. The requirements of this effort are: (a) develop end-to-end model based image train analysis software and sensor performance prediction (i.e. linking target and background characteristics, atmospheric models, platform stability, sensor parameters, and display characteristics), and (b) generate dynamic background scenes and the ability to super-impose a variety of moving targets (e.g. tanks, trucks, boats, aircraft, etc.) on selected backgrounds as seen by the infrared sensors aboard the mission aircraft. Sample digital imageries of selected backgrounds and targets will be provided by the government in ATRWG formats.

Phase I: Design the algorithms along with the Program Performance Specification (PPS) for Sun 4 image processing work station.

Phase II will follow upon the approval of Phase I design and definition and will include the PPS software implementation.

N91-199 TITLE: Optical Film Reader and Digital Image Processor

CATEGORY: Advanced Development

OBJECTIVE: To develop a low cost optical film reader and digitizer to enhance film processing capability aboard naval platforms.

DESCRIPTION: The Navy uses large quantities of film for recording everything from photographic and sensor reconnaissance imagery to high speed scientific data recording. Most film readers and imagery analyzers are large cumbersome light tables and processors used to observe and convert the imagery to electronic data. In many applications the imagery must be processed and stored in digital format for further processing and usage. Some do not preserve geometric fidelity and scale because of distortion in devices that convert the imagery to electronic data. This film reader and digitizer shall attempt too reduce this operation to an all electronic system about the size of a low cost electronic workstation. The unit shall contain a film transport, optical reader, digitizer, image-processing computer workstation, and high resolution monitor. Some of the key characteristic for the reader/digitizer include: Ability to handle a large variety of film formats from 35 mm to 9 inch cut film and roll film 10 to 2000 ft.; Resolution of 250 lines/inch at 1X magnification up to 5,000 lines/inch at l0X magnification; field-of-view 5 X 5 inches at 1X; magnification continuously variable or at least 5 discrete points; transport speed 0 to l0/sec. with a fast wind or rewind speed; digitization to 12 bits with ability to reduce down to 6 bits. Large magnetic or optical storage> = 600 Megabits for playback storage; analog and digital output; a 17 inch 1280 X 1024 monitor.

Phase I: Study would include design of the work of the reader digitizer and required components.

Phase II: The sample reader and digitizing processor including required hardware and software would be fabricated from the design package developed in Phase I.

N91-200 TITLE: Off-board Electronic Countermeasures (ECM) for Subscale Targets

CATEGORY: Advanced Development

OBJECTIVE: To provide subscale target vehicles such as the BQM-74C with a capability to decoy approaching RF guided missiles. Such a capability would provide more realistic ECM environment for weapons evaluation and for fleet training, and serve to reduce target vehicle losses during these exercises.

DESCRIPTION: Certain types of RF guided missiles are relatively immune to on-board jamming systems. Decoys dispensed or towed behind the aircraft are required to seduce the missile during its terminal phase of flight. While this need is being satisfied for full-scale targets through current manned aircraft developments, it remains an unfulfilled requirement for the smaller sub-scale targets due to size and power constraints. A small towable decoy needs to be developed for this application.

Phase I: Preliminary design and layout of the decoy utilizing Monolithic Microwave Integrated Circuits (MMIC) and Very High Speed Integrated Circuits (VHSIC) technology for miniaturization. Antenna, transmit/receive isolation, electronic payload, power, and software requirements as well as towline/towbody dynamics will be addressed during this phase. Delivery: Design documentation.

Phase II: Final design and fabrication of the Phase I concept will produce a flyable prototype for evaluation Delivery: Prototype hardware.

N91-201 TITLE: Compliant Non-Aerosol Topcoat

CATEGORY: Exploratory Development

OBJECTIVE: To develop an exterior paint that complies with air-pollution regulations and can be applied from a non-aerosol container for aircraft and equipment touch-up by fleet personnel.

DESCRIPTION: Phase I: The contractor shall demonstrate that a clear, one-component topcoat formulated with the binder under development can be sprayed from a non-aerosol container to a smooth, uniform film. The maximum concentration of volatile organic compounds shall be 340 grams/liter; and the applied film shall meet the performance requirements of specification MIL-L-81352.

Phase II: The contractor shall develop pigmented formulations, evaluate their physical and chemical properties, arrange for service tests by fleet personnel, and prepare a draft specification.

NAVAL UNDERWATER SYSTEMS CENTER

N91-202 TITLE: Combined Combat System Models

CATEGORY: Advanced Development

OBJECTIVE: To develop a single analytical model of complex electronic systems. The model is intended to evaluate concurrently the tactical performance, reliability, maintainability, and life-cycle cost.

DESCRIPTION: Performance, reliability, maintainability and life cycle cost are complementary in system design but there is no model that effectively manages the tradeoffs that must be made among them. There are computer models for estimating the tactical performance of combat systems in the face of a postulated threat. There are other models for evaluating the reliability, maintainability, availability and repair parts requirements of various system

architectures. Similarly, there are models that estimate the cost of development, testing, installation and life-cycle support. All these models are unique and independent of each other. Procurement of complex electronic systems must consider all these interrelated and often conflicting factors simultaneously. Linking the outputs of these models is now done subjectively, if at all. What is required for effective combat procurement is a single model that combines performance, RMA, and cost considerations so that optimum integrated decisions can be made.

Phase I: Evaluate existing models that estimate performance, RMA and life-cycle. The feasibility of modifying these models to have system performance reflect RMA and life-cycle cost should be estimated. Techniques for combining the available models or rationale for the development of a new model, or combining shell, should be presented along with estimates of computational power required and an estimate of the model's accuracy and efficacy.

Phase II: Develop a working model that combines at least tactical performance, RMA, and life-cycle cost.

N91-203 TITLE: Shape Memory Alloy Materials Development for Actuators

CATEGORY: Exploratory Development

OBJECTIVE: Develop shape memory alloys with properties, stock sizes and configurations which are not currently available.

DESCRIPTION: The Navy is currently developing quiet self contained actuator technology which utilizes shape memory alloy materials. At present the Navy is using a nitinol (Ni- Ti) alloy which is available as wires with diameters of 0.003-0.010 inch (0.08- 0.25 mm). Future applications of this technology are limited by the load capacity, the life cycle duration, and the cycle frequency of these wires. The cycle frequency is primarily limited by cooling rate. To mitigate these limitations, the Navy is interested in the development of shape memory alloy materials with any or all of the following properties:

- Alloys which transition from austenite to martensite and back to austenite over a narrow temperature range (as low as 1°C).
- Alloys which transition at high temperatures (up 150° C).
- Alloys with life cycles of 10-100 million cycles without degradation of performance and strength
- Alloys with working strengths up to or exceeding 40,000 psi.
- Wire stock with diameters up to 0.1 inch (2.5 mm).
- Stock in other configurations with large surface to volume ratios such as foil, flat stock, or wire rope.

N91-204 TITLE: Submarine Electronic System Power Supply

CATEGORY: Exploratory Development

OBJECTIVE: Develop new methods for supplying power to submarine electronic systems that are not affected by the loss of one AC buss.

DESCRIPTION: Submarine electronics get their motive power from the ship's power distribution system. The deletion of 400 Hz power generation equipment and the unavailability of DC for electronic service make all current and future systems rely on 60 Hz sources. The submarine AC power distribution system is split between port and starboard and offers reliable power if the electronic system can accept interruptions caused by switching from one (failed) side to the other (operating) side. Existing systems cannot always accept the fault. There is no room in electronic cabinets for sufficient energy storage to carry through the interruption. Generation and distribution of auctioneered DC has been attempted and presents substantial difficulties in terms of weight, volume, cooling, electrical stability, electromagnetic noise, and reliability. New methods of power supply are required to support combat system electronic systems.

Phase I: Offer a method of power supply that is not affected by the loss of one AC source bus. Power availability, small size, and low conducted and radiated emissions are important considerations that must be estimated for the proposed power supply method. Electrical performance shall be quantified with brass board demonstration results

Phase II: Scale up the concept to hardware with a capacity of approximately 10 kw-hr

N91-205 TITLE: Workstation Architecture for Submarine Combat Systems

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate the costs, benefits, and implementation implications of a combat system architecture based on the computerized workstation.

DESCRIPTION: Phase I: Submarine combat systems have used a central main-frame computer and terminal like display units. Systems under development have been placing less reliance on the central computer by placing processors of various capacity in the display units to support processing remote from the central elements of the system. The central processors support data management and system control. Connections between the central processor and the displays have been variously dedicated, redundant, and cross-strapped. The quantifiably optimal system architecture is required for future systems. These systems have wide variations in operability, modifiability, testability, reliability, and availability architecture model that satisfies the performance requirements for submarine combat systems. The model required must include attributes with variability to demonstrate the sensitivity of the architecture to the degree of centralism, workstation processing capacity, redundancy of interconnections, complexity of development, difficulty of testing, and cost.

Phase II: Identify the adjustments to the existing combat systems required to attain the benefits of the optimum architecture.

NAVAL AIR ENGINEERING CENTER

N91-206 TITLE: Arresting Cables Network

CATEGORY: Advanced Development

OBJECTIVE: To utilize all four of the current arresting engines during arrestment. If successful, then each individual current arresting engines would not be worked to its limit. This would improve the life and efficiency of each arresting engine. The entire arresting capability could almost increase by four fold.

DESCRIPTION: Arresting cables network would connect all four of the pennant cables via grid like structure. There would be four (or more) of these network cables and they would run perpendicular to the pennant cables. The aircraft arresting hook will hit one of the pennant cables, which in turn would pull on the network cables. This in turn would pull on the other three awaiting pennant cables. All four of the arresting engines are now utilized.

Phase I should consist of cable and geometry studies, and the effect of cable friction; this includes how the network cables are to be attached to the pennant cables and which different cable materials are best suited. With sufficient data collected, feasibility could be demonstrated.

Phase II should produce a working product of the network cables, scaled down if necessary, delivered to the Navy for testing. If any alternations are made to the pennant cables, the modified pennant cables are also to be delivered to the Navy for testing.

N91-207 TITLE: Feedback System for Weapons Loaders

CATEGORY: Exploratory Development

OBJECTIVE: To develop a system which can potentially be retrofitted to existing and proposed weapons loaders (installation/removal equipment). The system would provide "real-time: feedback of weight being lifted and proximity of load to the aircraft.

DESCRIPTION: Weapon and store loading onto Navy and *USMC* aircraft is currently performed with a wide variety of armament support equipment including: manual bomb hoists, powered bomb hoists, weapons loading trailers, non-propelled weapons loaders and powered weapons loaders.

Hoist loading equipment generally is more advantageous since the lifting of the load is controlled with respect to the aircraft. "Push-up" weapon loading equipment generally suffers from the inability of the equipment or operator to automatically compensate for finite adjustment and/or may damage the various aircraft. Due to the severity of the sea states encountered by the ships on which they are deployed, aircraft movement can occur during the loading task. Some aircraft have WRA's which are bolted to the airframe and require precise movements of the installation/removal device. "Push-up" loaders may require multiple personnel to guide the installation of stores onto/into aircraft. The current propelled "push-up: *USMC A/S32K-l* and Navy AERO 47 Weapon Loaders do not have a feedback system. The current non propelled "push-up" Navy ADU-400, AERO 33, MK 7 Weapon Loaders do not have feedback systems.

Phase I: 1) Survey existing sensor systems available "off-the-shelf' and new systems "in-work", 2) Research reports generated by various government activities and commercial vendors, 3) Conceptualize systems that can be adapted to nonpropelled and propelled weapon loaders.

Phase II: Build a breadboard system that can be adapted to the aforementioned loaders.

N91-208 TITLE: Automated Repairman or Autonomous Repair/Rescue Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: To provide automatic repair/rescue service needed for disabled autonomous vehicles performing aviation support services aboard ships.

DESCRIPTION: The Navy is contemplating the utilization of autonomous vehicles to perform seaboard aviation support functions. In line with these advanced concepts, an autonomous repair/rescue vehicle is envisioned to be necessary to offer "emergency" repair services to any aviation support vehicle that might become disabled. The purpose of this effort is, therefore, to determine the feasibility and establish the requirements for such a repair/rescue vehicle.

Phase I: Determine the feasibility.

Phase II: Produce repairman or autonomous repair/rescue vehicle.

N91-209 TITLE: Advanced Materials for Wire Rope Construction

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the use of ion implantation on wires and alternate rope core materials to extend loading capacity and service life of existing arresting gear cables. If successful, this technology would also be applicable to other wire rope industries.

DESCRIPTION: Today's best high strength wire rope is constructed with extra improved plow steel. This materials is unsurpassed for its combination of strength, ductility, wear resistance and fatigue behavior. The only avenue for improving this wire material is to enhance its resistance to wear and fatigue with a surface coating. Ion implantation is a new and expanding technology which is capable of altering the surface chemistry of high strength engineering

materials. It is a unique process in that elements are actually implanted in the material so disbonding is impossible. The process can also be accomplished at near room temperature which will not degrade the wires mechanical properties.

Phase I would consist of feasibility studies to examine the probability of applying elements to wire surfaces by ion implantation to increase fatigue and wear resistance. Single wires will be ion implanted and laboratory tested. The evaluation will entail tests for bending fatigue, abrasion resistance and susceptibility to notching from contact with other wires as well as the routine mechanical properties (UTS, YS, %E, %RA). All tests will include a sample of untreated wire. Increased performance of treated to untreated wires will be an evaluation factor for Phase II.

Phase II would require the construction of actual wire rope samples. This will involve adapting existing ion implantation equipment to treat several spools of extra improved plow steel needed to produce a reel of arresting gear cable. For evaluation purposes the existing construction of purchase cables shall be used for testing. Several samples shall be made with a hemp core. Alternate core materials shall also be included for testing. These samples will be tensile tested and tested in a sheave cycle tester for fatigue life and wear resistance as compared to the existing construction.

NAVAL CIVIL ENGINEERING LABORATORY

N91-210 TITLE: Energy-Absorbing Ship Mooring Configurations

CATEGORY: Exploratory Development

OBJECTIVE: Develop and validate new hardware and configurations to provide energy absorption for shallow water ship moorings. This proposed task is to investigate alternative mooring configurations and hardware to maximize the amount of energy absorption in Navy moorings, especially for moorings in shallow water and/or hard bottom materials (e.g., rock, coral).

DESCRIPTION: It is common for moored shi~ to exhibit oscillatory behavior at single point moorings. This behavior, referred to as "fishtailing," or, "kiting," results in very large hawser tensions as the mooring system restrains the vessel at each end of its swinging. In many moorings, particularly shallow water moorings, this is a serious problem, because the mooring system does not have a large reserve of geometric or material stiffness to absorb these tension spikes. Failure of either the mooring system or the vessel bow structure is not uncommon in these cases. If the mooring system fails, there is the potential for both the loss of the vessel (and its contents) and for environmental damage. On the other hand, if the mooring system capacity is too high, the failure will occur at the bow of the vessel; this possibility is increasing because of the recent trends to trade-off structural weight on combatants to maximize the weapons-related weight. This type of failure results in lost operational time and costs due to shipyard repairs. New moorings are required that will absorb these large tension spikes and therefore minimize the chance for system failures.

Phase I: Refine the new alternative mooring concept(s) submitted in the SBIR proposal; contrast the energy absorption characteristics and advantages of the new concept(s) versus presently used Navy and commercial mooring configurations; and recommend a small-scale testing program for Phase II to validate the concept(s). This test plan shall include the mooring configurations and site conditions selected for testing, and an outline of the recommended tests including the purposes for each. The Phase I report shall also include a summary of the findings regarding their expected impact on existing mooring operations (e.g., failures) and design (more efficient use of materials).

Phase II: Model-scale tests to validate the behavior of the proposed mooring concept(s). Multiple configurations, site conditions, vessels, and excitations shall be tested and their characteristics reported. The final Phase II report shall summarize the research, and present recommended configurations for further Navy consideration.

NAVAL AIR PROPULSION CENTER

N91-211 TITLE: Non-Intrusive Fuel Flow Measurement System

CATEGORY: Exploratory Development

OBJECTIVE: To assess the current state-of-the-art and develop fuel flow measurement techniques which produce high accuracy fuel flow measurements with zero pressure.

DESCRIPTION: The Navy wishes to investigate non-intrusive fuel flow measurement techniques which produce a zero pressure drop across a device while providing high accuracies. Current devices generate pressure drops which interfere with normal engine/fuel system performance. Our requirements are for a device which measures various aircraft fuels with viscosities ranging at from 0.4 to 12 centistokes within the limiting fuel temperature range of -60 to + 160 degrees f. Accuracies of +/- 1.0% Of reading or less are desired. The techniques should be capable of being incorporated into a device capable of a flow turndown ratio of at least 50 to 1. The flow operating ranges should be suitable for aircraft propulsion systems (small unmanned aerial vehicles to tactical aircraft).

It is anticipated that investigation into candidate fuel flow measurement concepts would be divided into two a phases. First, conceptual designs would be generated and validated through theory and analytical assessment and/or testing. Second, based on successful results of the first phase, fabrication of proof of concept designs and experimental verification of the approach would be made.

N91-212 TITLE: Innovative (UAV) Unmanned Aerial Vehicles VTOL (Vertical Takeoff and Landing) Propulsion Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Develop VTOL propulsion concepts which provide optimum propulsion efficiency throughout the UAV regime.

DESCRIPTION: Operation of unmanned aerial vehicles (UAV's) from small naval ships requires vertical takeoff and landing (VTOL) capability because of limited deck space and large operating radius because of the long engagement distances of modern weapons. Current state of the art in VTOL propulsion yields either good vertical takeoff performance with poor high speed flight characteristics or good high speed flight characteristics with excessive power requirements for vertical takeoff. Innovative concepts are desired which would provide a lightweight propulsion system with high propulsion efficiency (thrust specific fuel consumption) throughout the 0 to 200 knot flight regime.

It is anticipated that investigation into candidate concepts would be divided into two phases. First, conceptual designs would be generated and validated through theory and analytical assessment and/or testing. Second, based on successful results of the first phase, fabrication of proof of concept designs and experimental verification of the approach would be made.

N91-213 TITLE: Improved Corrosion Susceptibility Prediction by Real Time Optical Measurement Technology

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this research is the development and construction of a non-intrusive integrated optical system. The system will be capable of measuring the real time sodium mass flux into turbo-shaft jet engine during corrosion susceptibility tests.

DESCRIPTION: Current sodium mass flux measurements are time consuming, laborious and lead to multiple errors such as handling contamination, improper sample analysis, etc. The utilization of state-of-the-art optical technology will eliminate the forementioned difficulties, increase measurement accuracy and provide a measurement technique which does not interfere with the flow process being measured.

Phase I - The first phase of the proposed research will be a feasibility study. The study will: 1) specify the optical methodology most suited for measurement sodium mass flux; 2) include a detailed description of the methodology; 3) analyze the capabilities of the proposed methodology with the support of analytical data and experimental evidence where possible; 4) discuss the methodology in terms of implementation and 5) describe the development and construction of a "breadboard" prototype instrument (Phase II).

Phase II - The prototype instrument discussed in Phase I will be constructed and tested according to pre-set guidelines. The tests will determine the effectiveness of the proposed methodology under Navy specified conditions. With the validation of the prototype instrument, the development of an instrument capable of withstanding the Navy test environment will be investigated and described.

N91-214 TITLE: Innovative UAV Engine Noise Suppression Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Develop lightweight, low volume noise suppression concepts capable of rendering an unmanned aerial vehicle (UAV) inaudible under tactical operating conditions.

DESCRIPTION: Present UAVs have decreased covert capability and survivability due to the significant aural signature of their internal combustion engines. The purpose of this project is to develop innovative noise suppression concepts capable of operating on 2-stroke, 4-stroke, and Wankel engines.

The concepts should be of minimum weight and volume. They shall be capable of reducing the sound level to less than 60 dB at a distance of 1000 ft throughout the engine RPM and power range. This should be achieved with no more than 2% power loss.

It is anticipated that investigation into candidate concepts would be divided into two phases. The Phase I effort shall include a comparison of proposed conceptual designs to the current state-of-the-art. These designs shall be validated through theory and analytical assessment and/or testing. Based on successful results of the first phase, the Phase II effort shall include fabrication of proof of concept designs and experimental verification of the approach.

N91-215 TITLE: High Speed Diesel Fuel Injection Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To increase the maximum injection rate of diesel-type fuel injectors, thus permitting engine horsepower growth through increased operating RPM.

DESCRIPTION: Advanced lightweight unmanned aerial vehicle (UAV) engines require diesel-type, high pressure direct injection. Current state-of-the-art direct injection is capable of approximately 6(XX) injections per minute. This limitation inhibits growth of engine horsepower through RPM increase. Innovative concepts are desired which would permit significantly higher injection rates than the current state-of-the-art. It is anticipated that investigation into candidate concepts would be divided into two phases.

Phase I: Conceptual designs would be generated and validated through theory and analytical assessment and/or testing.

Phase II: Based on successful results of the first phase, fabrication of proof-of-concept designs and experimental verification of the approach would be accomplished.

NAVAL AIR TEST CENTER

N91-216 TITLE: Real Time Helicopter Blade Element Tail Rotor Model

CATEGORY: Exploratory Development

OBJECTIVE: Development helicopter blade element tail rotor and tail rotor interference models for use in operational flight trainers. A market exists for these models wherever helicopter pilots are trained using simulators.

DESCRIPTION: Army and Navy helicopters have experienced problems with loss of tail rotor effectiveness under certain slow speed approach-to-landing flight conditions. Current operational flight trainers (OFT) do not have adequate fidelity to predict all low-speed flight conditions leading to loss of tail rotor effectiveness. Pilots are not able to use OFTs to practice recovery from loss of tail rotor effectiveness under controlled conditions. Improved tail rotor models, including flow interference models, are required. The tail rotor model should include effects of main rotor, fuselage, and external stores interference for steady and turbulent ambient winds. The tail rotor model should be developed in modular form for real time applications. It should have a format suitable for incorporation into existing OFTs with blade element main rotor models.

Phase I requires research and summary of the relevant characteristics of existing tail rotor models and tail rotor interference models, and existing technical and operational data on helicopter tail rotor airflow problems at low airspeeds; and specification of the blade element tail rotor model and tail rotor interference models, including the interface with existing main rotor blade element models.

Phase II will require development and installation of the helicopter blade element tail rotor model and associated interference models on a specified simulator, and verification and validation of the models.

N91-217 TITLE: Portable Simulator Evaluation Package

CATEGORY: Engineering Development

OBJECTIVE: Develop a portable simulator evaluation package to speed-up, reduce cost, and help standardize Operational Flight Trainer (OFT) and Weapon Systems Trainer (WST) acceptance testing.

DESCRIPTION: A portable laptop personal computer (PC), with proper interface cards, could be used to record a minimum of 48 channels of either analog or digital data from the simulator. A standardized set of criteria data, plus tolerances, could be to stored in the PC using current software packages like MATLAB. The simulator test data could be compared to the stored criteria data in real time or at a later date as required. Simulator data could also be sent via modem to other activities to help confirm the status of simulator development.

Phase I requires definition of PC hardware and OFT/WST interface options for the portable simulator evaluation package and specification for procurement; and definition of software requirements and review of Navy OFT/WST criteria data format and criteria data tolerances.

N91-218 TITLE: Automated Forward Looking Infrared (FLIR) Resolution Measurement

CATEGORY: Engineering Development

OBJECTIVE: A device to read FLIR displays and automatically measure maximum resolution and minimum resolvable temperatures. A large market exists for this capability with developers, producers and users of imaging systems, both military and civilian.

DESCRIPTION: Measuring maximum resolution and minimum resolvable temperature of FLIR systems is labor intensive and subjective. Typically, five persons read the display and their readings are averaged, as persons see differently. A system is needed to automatically read the various sizes and types of displays and measure standard four bar, seven to one aspect ratio targets of varying size and delta temperatures. The measurement capability shall be comparable to the human eye with an accuracy of better than .01 degree Celsius delta temperature. The system

should be transportable between laboratory, hangar and flight environments. The system must automatically select different delta temperatures and spatial frequencies once a measurement is made.

Phase I: Requires a conceptual study and specification of the system.

Phase II: Requires the production of a prototype for test at the Naval Air Test Center.

N91-219 TITLE: Test and Evaluation of Tactical Expert Systems

CATEGORY: Exploratory Development

OBJECTIVE: To develop the capability to test airborne tactical expert systems by researching current activities in the field, establishing an expert system workstation, and developing test methodologies.

DESCRIPTION: Expert systems are emerging from research laboratories and being applied in a wide range of fields, including defense applications. In particular, the Naval Air Development Center is developing algorithmic decision trees to automatically optimize defensive electronic countermeasures in tactical aircraft such as the F/A-ISC/D. These algorithms, which coordinate on-board and off-board expendables, may form the knowledge base of an expert system. The Naval Air Test Center is tasked with testing such systems. However, methods for test and evaluation of airborne tactical expert systems are not well defined. A need exists at the Naval Air Test Center for increased expertise in this rapidly developing field both in expert systems and their test and evaluation.

Phase I will consist of research into all present activities and active progress in the area of tactical expert systems. Transfer of this information will be via seminars and technical discussions. The technical problems of testing expert is systems will be addressed, in particular, the system's limitations, degraded modes, and execution speed. Recommendations will be made of suitable hardware and software to produce a workstation for the test and evaluation of expert systems.

Phase II will develop a computer workstation capable of testing and evaluating tactical expert systems. The workstation will consist of an expert system shell to enable engineers to become familiar with the design and operation. In addition, the workstation will incorporate a testing shell to facilitate evaluation of the expert system.

N91-220 TITLE: Video-Based Data Reduction System for Task Analysis

CATEGORY: Engineering Development

OBJECTIVE: A system to extract and reduce task analysis data from video tape containing multiplexed simultaneous views from several cameras. A market exists for this system with every government agency and military or civilian system developer that is engaged in human factors test and evaluation.

DESCRIPTION: Aircrew actions during flight and ground evolutions are recorded on videotape for man-machine integration testing. The extraction of data from the video tapes for analysis to determine tasks, time lines of mission events, crew actions, activity records and other crew workload information is a slow process requiring many hours of skilled operator time. Video multiplexing, which allows simultaneous recording from several cameras on the same tape, expands the recording method to multiple crew applications; but it compounds the problem of data reduction. A system is needed which, by employing automation techniques for the extraction of task analysis data from multiplexed video records, will reduce operator skill demands, reduce data turn-around time, and increase the utility of the data for further reduction by computer task analysis techniques.

Phase I requires research of the relevant technologies and specification of the system including hardware, software, and procedures.

Phase II will require production of a fully documented prototype system and demonstration tests at the Naval Air Test Center.

N91-221 TITLE: Incorporation of Artificial Intelligence in Sea Control Helicopters

CATEGORY: Advanced Development

OBJECTIVE: To study the application of artificial intelligence to assist aircrew with automatic detection and classification of air, surface and sub-surface threats. The contractor will apply existing artificial intelligence principles and technologies to integrated ship/air anti-submarine warfare weapon system.

DESCRIPTION: Integrated systems have become increasingly complex. The addition of advanced acoustic, non-acoustic ASW equipment, and target detection and tracking equipment will place an increased workload on air ASW crewmen. The use of artificial intelligence will help to decrease operator workload through automatic monitoring of sensor systems for detection and classification of air, surface and sub-surface targets.

The contractor will research applications of artificial intelligence to the air ASW mission. The deliverable will be a recommended approach to design of an integrated system incorporating AI.

N91-222 TITLE: Integrated Passive Targeting Equipment

CATEGORY: Engineering Development

OBJECTIVE: There is a need for providing the LAMPS MK III aircrew with a passive, integrated targeting system for day/night target classification and weapon targeting. The contractor will survey existing passive targeting systems and technologies available worldwide and will compare alternatives with respect to performance and cost.

DESCRIPTION: The LAMPS MK III will have anti-surface warfare capability with the integration of the Penguin missile. The current targeting method requires the aircrew to radiate the target using the active APS-124 radar system, exposing the aircraft to potential hostile fire. The passive targeting technology should also provide the aircrew with a method for classification of the intended target.

The contractor will provide a detailed comparison of alternatives and a plan to conduct integrated system testing in a Navy LAMPS MK III helicopter.

NAVAL WEAPONS SUPPORT CENTER/CRANE

N91-223 TITLE: Nonlinear Optical Materials

CATEGORY: Exploratory Development

OBJECTIVE: Production of nonlinear optical material(s) having optimum characteristics for use in photonics and opto- electronics applications.

DESCRIPTION: There is a need to produce sensitive (i.e. low excitation energy), high speed optical quality materials for use in photonics and opto-electronics applications. Optimum nonlinear optical materials are required that have been previously available. These applications include, but are not limited to, beam steering and rapid beam deflection/diffraction, optical bistability, optical computing including optical implementation of neural networks (optical neurocomputers), nonlinear optical signal processing, image processing, image understanding, real time (dynamic) holography for reconfigurable interconnects and routing networks, image storage, phase conjugation including phase conjugate interferometry, four-wave mixing, two-wave mixing, beam coupling (i.e. non reciprocal energy transfer), etc. The optical materials for these applications are required to have large optical nonlinearities and reasonably fast response times and may be inorganic, organic, or a combination thereof, such as organometallic

compounds. The best material(s) may depend upon a particular application, for example at a particular desired wavelength; however, it is expected that a representative optical material will be demonstrated at the end of the Phase I effort. The Navy has an in-house optical diagnostic facility capable of observing and evaluating important material parameters required for photonics and opto-electronics research, and will assist the contractor in determining relevant parameters for the materials produced during this effort. For

Phase I: Identification of potential candidate material(s) together with preliminary fabrication and demonstration of a candidate material will occur.

Phase II: Refinements to, optimization of, and production of the nonlinear optical material(s) in Phase I for use in photonics and opto-electronics applications will be achieved.

NAVAL OCEAN SYSTEMS CENTER

N91-224 TITLE: Adhesives for Fiber Optic Payout Bobbins

CATEGORY: Engineering Development

OBJECTIVE: To develop an adhesive optimized for high speed fiber optic payout bobbins.

DESCRIPTION: The use of an optical fiber as a high-bandwidth data link between a missile and its controlling platform offers tremendous advantages over microwave and wire technologies. The optical fiber must be precision wound onto a bobbin, placed on the missile, and paid out at high speeds without breaking and with minimum excess optical losses. An adhesive must be developed that can hold the fiber onto the bobbin. The adhesive must exhibit long shelf life, predictable shear strength, minimum degradation at low temperatures, and compatibility with current polymer coatings on fibers. Further, the adhesive must be cost effective and must be wound on payout bobbins. The adhesive must be applied uniformly and without bubbles or any other types of defects, which can prevent precision winding and generate microbending losses. A method of applying the adhesive to the bobbin (or the fiber) must also be developed, tested and demonstrated on wound bobbins. Shear strength measurements will be especially useful in modeling the dynamics of the frictional, aerodynamic, and mechanical forces during a high speed payout.

Phase I: The adhesive formulation shall be developed and laboratory tests conducted on the adhesive to evaluate its performance.

Phase II: 20 payout bobbins will be wound with the new adhesive and subjected to environmental and aging tests. Finally, the bobbins will be tested using laboratory payout machines.

DAVID TAYLOR RESEARCH CENTER

N91-225 TITLE: Development of Shipboard Plastics Waste Processor

CATEGORY: Advanced Development

OBJECTIVE: To develop a shipboard plastics waste processor (PWP) for densifying and sterilizing plastics waste generated aboard ship to comply with existing and anticipated worldwide environmental restrictions on disposal of plastics at sea.

DESCRIPTION: Phase I: Navy ships produce a wide range of waste plastic items and materials, including food contaminated plastics. Identify technology and equipment options for shipboard processing of plastics waste to significantly reduce its volume and render it sanitary and odor-free for extended on-board storage, convenient off-loading, and potential shoreside recycling. Conduct a detailed technical tradeoff study of the identified options, taking into account: waste management requirements; Navy shipboard constraints; safety, health, and habitability

issues; and shore handling of processed waste. Select preferred option(s) and identify tentative system configuration and expected performance.

Phase II: Select most promising approach to shipboard processing of plastics waste based upon Phase I results, state of the art developments, and Navy guidance. Design and fabricate a breadboard model PWP and determine concept feasibility. Propose system modifications and evaluation strategy necessary for further development.

N91-226 TITLE: Unmanned Surface Craft Demonstrator

CATEGORY: Advanced Development

OBJECTIVE: To demonstrate an unmanned surface craft concept using HYBRID technology.

DESCRIPTION: A need exists to provide an unmanned surface craft with high speed (40 to 50 knots) in rough water, long range at high speed, high payload capability along with superior motions in waves at a reasonable cost. Technology has progressed to the point where it is particularly feasible for a small craft, such as an unmanned decoy. A HYBRID consists of a marriage of conventional monohull /planing hull, hydrofoil craft, hovercraft, SES, and SWATH as needed. An automatic control system can be used to maintain a stable platform in waves. The expected payoffs for small craft and ships of the HYBRID design are:

a. Large reduction in roll, pitch and heave in rough water.
b. Improved hydrodynamic efficiency at speeds greater than about 20 knots with relatively low speed gradation in waves. Ship does not have to slow down; in fact, it is preferable to maintain high speed.
c. Favorable flow conditions around the HYBRID provide the potential for improved propulsive efficiency compared to conventional craft and ship propeller arrangements.
d. Produces a very small wake, thereby significantly reducing surveillance signature relative.
e. Potential high fuel fraction combined with hydrodynamic and propulsive efficiencies provide greater range and endurance at high speeds.

Phase I: The contractor is to provide a design for a HYBRID craft to demonstrate HYBRID technology. This phase of the proposed effort would consist of design and generation of engineering drawings suitable for fabrication and assembly of a HYBRID.

Phase II: The contractor would fabricate and/or procure the various components required, assemble, perform at-sea trials of a small HYBRID craft, and provide technical data.

N91-227 TITLE: Development of Decentralized Actuators

CATEGORY: Advanced Development

OBJECTIVE: To develop linear and rotary actuators capable of operation independent of a central hydraulic plant.

DESCRIPTION: The Navy is pursuing the concept of decentralizing submarine hydraulic systems. To do this to the fullest extent possible, alternative technology actuators (e.g. electromechanical, electrohydraulic, etc.) are required to operate various pieces of equipment. Linear actuator force/travel requirements range from 500 lb/0.1254 in to 75,000 lb/20 in which actuation times ranging from one to six seconds. Rotary actuator torque/travel requirements range from 260 Ib-in/90 deg to 300,000 lb- in/180 deg with actuation times ranging from 1/5 to 8 seconds. Quiet operation and minimal size/weight are important attributes.

Phase I: Provide a preliminary design for evaluation.

Phase II: Construct prototype units for testing from those concepts that indicate promise from Phase I.

N91-228 TITLE: Development of Innovative Hydrophobic Membrane for Membrane Distillation Application

CATEGORY: Research

OBJECTIVE: To develop a novel tubular hydrophobic membrane for application in membrane distillation (MD) plants on Navy ships.

DESCRIPTION: The Navy seeks development of a hydrophobic membrane for MD. It shall be in a tubular configuration in the 3 to 4 mm diameter size range with a minimum water flux of 24 gal/sq ft/day when operated on a seawater feed of 212 deg F. The water entry pressure shall be no less than 10 psi when operated at these temperatures.

Phase I: Demonstrate the ability to develop this membrane.

Phase II: Optimize the development of the Phase I membrane and produce the membrane for testing. Long term testing to demonstrate performance capabilities will also be conducted.

N91-229 TITLE: Development of Gas Generators for Submarine Ballast Blowing

CATEGORY: Advanced Development I

OBJECTIVE: To develop a gas generator ballast tank blow system that is regenerable at sea.

DESCRIPTION: Confidential level Security Clearances may be required for some GFI during the performance of this topic.

The Navy is interested in a compact, fast acting gas generator to produce ballast tank blow gas which is non-toxic, non-corrosive, and non-explosive when mixed in air. It is also desirable that this system be renewable from on board resources.

Phase I: Review and compare all appropriate types of gas generators which could be developed for submarine ballast tank blow. Requirements for design and safe operation of candidate systems will be identified, along with advantages and disadvantages of the concepts.

Phase II: Perform laboratory experiments to develop two chosen concepts and develop prototype designs. Ship P impact analyses will be performed using the SSN 688 as the baseline. Scale models will be constructed from one concept for testing in the DTRC ballast blow facility.

N91-230 TITLE: Development of Magnetic Cooling Air Conditioning

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype magnetic cooling AC plant for potential shipboard use.

DESCRIPTION: The Navy seeks development of an air conditioning concept that provides cooling via the magneto-caloric effect.

Phase I: Seeks innovative approaches combined with testing of appropriate portions of the system to prove the concept.

Phase II: Build a prototype of the Phase I system in the 3 to 10 ton capacity range. The target system D requires 200 tons of cooling. Size, weight, power consumption, reliability, materials of construction, and safety are critical parameters.

NAVAL RESEARCH LABORATORY

N91-231 TITLE: Milli-meter Wave Chaff

CATEGORY: Advanced Development

OBJECTIVE: Radar reflective material which can be used for airborne self-protection of tactical aircraft in the Milli-meter wave portion of the electro-magnetic spectrum.

DESCRIPTION: Currently the U.S. Navy uses metallized glass chaff for airborne self-protection of tactical aircraft. This effort will investigate innovative approaches to provided that same self-protection into the milli-meter portion of the electro-magnetic spectrum. The material should be capable of being packaged in the standard U.S. Navy expendable cartridge; i.e., 5-13/16" length by 1-5/8" diameter. Access to classified information will be required; therefore, contractor must have personnel and facility clearance at the SECRET level. Specifications may be obtained from the NRL SBIR office.

N91-232 TITLE: Ultra-Wideband Low-Loss Radio Frequency Link

CATEGORY: Research

OBJECTIVE: To extend the radio frequency range of flexible-line links from 18 to 220 GHz

DESCRIPTION: The Navy is interested in new technology and ideas which could provide low loss, lightweight communication links between microwave/millimeter wave airborne electronics systems subassemblies that are remotely located with respect to each other. These links should be flexible and easily stored in confined spaces when not in use. Goubau and Fiber-Optic lines are examples of current technology that tend to meet all requirements except the extension to millimeter waves. The Goubau lines have excessive loss at millimeter waves and fiber-optics transducers are too loss at millimeter waves. Goubau lines also suffer from RF leakage which limits their application to taut (straight) lines. The fiber-optics type of approach is therefore preferred. However, the Goubau line type of approach should not be excluded from this research.

Phase I: Should be directed towards an assessment of current technological limits (material, physics, fabrication, etc.) as well as possible new promising technologies and materials for broadband links

Phase II: Should be directed towards building a prototype link capable of operating up to 220 GHz (goal which has long life and can survive in an airborne military environment.

N91-233 TITLE: Highly Integrated Multi-Band Receiver

CATEGORY: Research

OBJECTIVE: The radio goal of this topic is to provide the Navy with a small and compact receiver to cover K-band through W-band and above.

DESCRIPTION: The problem is that of intercepting signals over a very broad RF band for the ultimate purpose of detecting and analyzing/identifying them. The primary focus of this topic is the receiver front-end that captures the signals rather than on the signal processing. However, new and innovative approaches may not make signal processing easily separable from the reception process e.g. acousto-optical processing. If a base-band approach is taken, however, no processing beyond formation of the base-band is desired for this topic since analytical processing is already available. Current receiver technology tends to separate microwave and the shorter wavelength millimeter wave technologies resulting in hybrid receiver assemblies larger than desired. New technologies are sought, or at

least a top-down design approach is sought, that will integrate the K-band to above W-band (2000Hz) receiver functions efficiently for small packaging.

Phase I: Study that examines various receiver front-end approaches and how they would interface with processing form signal analysis. Trade-offs will be made that minimize size and cost and provide an acceptable probability of signal intercept. The deliverable of this phase is a report on the study that shows how the best receiver approach was selected.

Phase II: Provide a breadboard of the receiver front-end including, also, any high-risk features of processing required for signal analysis. A basic performance test will be conducted by the contractor according to the contractor's test plan as approved by the Navy. The breadboard will be delivered to the Navy for further tests.

N91-234 TITLE: Broadband W-Band and Higher RF Medium-Power Amplifier

CATEGORY: Research

OBJECTIVE: The goal of this proposed effort is to develop a medium-power, broadband, W-band and higher RF amplifier that is suitable for airborne applications

DESCRIPTION: The US Navy is interested in new ideas which could overcome the severe constraints of helix RF circuit technology in vacuum devices at millimeter waves. Previous efforts have resulted in very narrowband (radar bandwidth) devices which are very expensive, have short lifetimes and have extremely tight manufacturing tolerances. These devices are not suitable for future naval systems. Specific goals for the subject device are 9) instantaneous bandwidth covering W-band and to as high as 220 GHz, 2) power output of 200W CW, 3) gain of 50 dB, 4) overall efficiency of 30 percent, 5) device-operating-voltage less; than 15KV with periodic permanent magnet focusing, 6) potentially integrable with devices that result in continuous coverage down to 18 GHz and, if possible, 7) total coverage form J-band to 220 GHz in a single device/envelope.

Phase I efforts should be directed towards a theoretical analysis of the most promising RF structure and device concept. The analysis should include all the engineering trade-offs with the advantages and the disadvantages carefully documented.

Phase II efforts should be directed towards the fabrication and cold test of the RF structure and electron beam transmission. A complete brassboard prototype of the cold test device should be delivered to the US Navy for laboratory testing.

NAVAL TRAINING SYSTEMS CENTER

N91-235 TITLE: High Definition TV Projection Via Single Crystal CRT Faceplate Technology

CATEGORY: Advanced Development

OBJECTIVE: To perform research for the design and construction of high performance full color video projection system using single crystal phosphor faceplate technology.

DESCRIPTION: Single crystal phosphor faceplates have been the object of research directed toward producing high resolution, high brightness video projection CRTs. Improved video projection systems are needed for use in applications ranging from flight simulation displays to command and control displays. Current research of Ce: YAG single crystal phosphors has promise of producing a 3 inch diameter CRT faceplate capable of outputting 2000 lumens of light across a wavelength range of 470-670 nanometers (peak output @ 530 nm) and displaying up to 4000 scan lines per frame. Further research is required for improvement in the light output efficiency and schemes for color delivery in order to design and construct a full color high performance video projection system. Successful completion of this effort should result in a color video projection system with increased brightness and resolution from a smaller physical footprint and at a lower cost than current high performance video projectors.

Phase I: Consists of a study on the methods of further increasing the light output and provision of a full color display system. An area of specific interest is methods for growing larger single crystal boules, on the order of 4 to 5 inch diameters, to be used in making substrates for the epitaxial growth of single crystal phosphor faceplates. Larger faceplates lead to increased net light output and/or reduction in electron beam current required. Also, study and evaluation of projector electronic/optical/mechanical design for using single crystal CRTs to their best advantage in a full color video projection system is required.

Phase II: Use Phase I results in the construction of a deliverable full color single crystal CRT projector to the government for testing in a visual simulator application.

N91-236 TITLE: Low Cost Head/Helmet Mounted Display for Simulation

CATEGORY: Advanced Development

OBJECTIVE: To design and develop low-cost visual display system that is either head or helmet worn. The final system will be binocular, full color, 1000 line minimum resolution, 60 by 90 degree minimum instantaneous field of view, and light weight.

DESCRIPTION: Head/helmet mounted display systems, when coupled with a head attitude sensor, have many applications in simulation and training. Past wide field of view display systems have been both costly and heavy. Technology has progressed enough to offer a lightweight, low-cost version. The final system should be easy to use and be aesthetically pleasing. The display would have applications in deployable training systems, low-cost flight simulators, and table top training systems. The display would afford the user some of the benefits of a larger dome display when space or other factors did not allow for its installation

Phase I: The offeror will perform a preliminary concept design with conformance to the specifications stated above. The offeror will also show ability to construct a prototype of said device.

Phase II: The offeror will finalize display design and construct a prototype.

N91-237 TITLE: Low Cost System for Verification of the Cuing Fidelity (Motion/Visual/Instrumentation) of a Total Simulator

CATEGORY: Advanced Development

OBJECTIVE: To satisfy the requirement for a low cost system that will verify that a simulator has met "end-to-end" cue fidelity requirements in it's visual, motion, and instrumentation subsystems

DESCRIPTION: There is currently no unified system or procedure that verifies that a simulator has met design requirements for cuing fidelity in its visual, motion, and instrumentation subsystems. Generally, pilot feedback and selected testing of some hardware is the only quantitative measure of the total dynamic behavior of the simulator.

Phase I: Design a compact test and evaluation system made up of off-the-shelf hardware and easily deployable to any site. The design shall emphasize simplicity of operation and not require intensive training. The end product for Phase I will be a detailed report with all specifications for the integration of a prototype test and evaluation package.

Phase II: Will be directed towards the integration of prototype hardware, and the demonstration and evaluation of the system's performance. The end product would be portable off-the-shelf test hardware that could be used anywhere in the fleet to assure that trainers are not accepted until cue fidelity has been verified.

N91-238 TITLE: Subject Matter and Peda202ical Experts for Training Device Curriculum Development and Control

CATEGORY: Advanced Development

OBJECTIVE: To embody general teaching principles in a teacher expert system that will query subject matter experts for principles, examples, performance indicators and qualification thresholds, then to conduct and refine the course of study. This I expert system teacher would be re-used to develop curriculum for various new training devices or for modifications to existing 70 devices.

DESCRIPTION: The teacher of a class of students often is restricted in the amount of individual attention given to each student's needs, and therefore attempts to optimize for the class. A teacher with a single student selects a teaching strategy based upon an inference of the student's learning stage from an evaluation of the student's performance. Teaching is carried out by generation of examples and explanations, and verified by generation of questions and problems. Speed and accuracy are often used to measure progress. The teacher must also create the syllabus. Student weaknesses are diagnosed by inference from the errors students make, then exercises are selected to remediate the weakness. Finally, the teacher must allow the student some degree of control, as well, by allowing the student to ask questions. Training device technology will benefit from expert systems which can gather required subject matter from the domain expert, tailor a course of instruction to individual students, and refine the course materials over time. Gathering the domain includes rules for common error and misunderstandings of students, facts and their relationships, procedures of the domain, examples, theory, and practice. If the domain contains abstractions, then sufficient basis concepts or common sense examples are needed to draw analogies. A hierarchy of concepts is needed so that the teacher can choose top-down vs. bottom-up, and breath vs. depth teaching strategies.

Phase I will identify pedagogical features, identify requirements for gathering of domain information and select an expert system shell.

Phase II should assemble the expert system then demonstrate curriculum development and control for an aviation command and control task.

N91-239 TITLE: Low Cost Automatic Scenario Generator (ASG)

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to determine the system characteristics and demonstrate the feasibility of a low cost automatic scenario generator (ASG) for aircrew training systems such as CV-WST, F-14D, A-12.

DESCRIPTION: The ASG would replace the current non-automated scenario generation process, significantly reducing the time and effort to create scenarios, and therefore increasing the overall productivity of training systems. In selected cases, an ASG could lead to self-paced student shipboard training.

Phase I: Provide a report to describe and assess the current scenario generation process. The study will evaluate, quantify, and describe the latest hardware/software technology (e.g., expert systems, Ada, microprocessors) to automate the scenario generation process and yield a product called an automatic scenario generator (AS G) for aircrew training systems.

Phase II: Consists of three products a-- detailed task analysis of the scenario creation process, a detailed system/hardware/software requirements report, and a feasibility demonstration of an automatic scenario generator to be delivered to the government for testing.

NAVAL WEAPONS CENTER

N91-240 TITLE: Monopulse Radome Error Compensation in the Presence of Aperture Blockage

CATEGORY: Exploratory Development

OBJECTIVE: To determine the technical merit and feasibility of a fixed but robust, or adaptable compensation technique for the radome error compensation of a monopulse antenna in the presence of a large aperture blockage.

DESCRIPTION: Radomes which have large aperture blockages exhibit large target spatial errors to the radar tracking system. These errors, if not compensated by subsequent signal processing, have a detrimental effect on tracking performance. The intercept homing performance of the carrying platform is subsequently affected. Current techniques have focused on platform specific solutions. These solutions have not identified critical problem parameters, signal processing, evolving technology, or algorithmic designs, which, if not impeded by platform constraints, would successfully correct the radome aberrations caused by the blockage.

Phase I: Conceptual studies will be presented for evaluation.

Phase II: Evaluation to prove feasibility, and determine the best approach(es). Then development and testing of the algorithm(s) determined from the best approach(es).

N91-241 TITLE: Digital Computer Modeling of Directed Energy Weapons (DEWS)

CATEGORY: Engineering Development

OBJECTIVE: To develop a digital computer model of tactical directed energy weapons (DEWs) and integrate the model into existing one-on-one and many-on-many simulations and models used to assess aircraft and weapons survivability.

DESCRIPTION: The threat to aircraft and weapons systems now includes DEWs such as laser range finders and laser target designators. This threat is not being considered in most on-going survivability analysis for three reasons:

1) Although the potential for directed energy threats is well established both in terms of effectiveness and feasibility, few tactical weapons have been fielded. The practical nature of the threat is unknown.
2) The damage mechanisms of DEWs are difficult to quantify because they are a function of parameters such as: exposure duration, directed energy transmission frequency, atmospheric conditions, and target field of view, as well as target s shape and material characteristics.
3) Key vulnerable components of many aircraft and weapon systems are the eyes of the personnel involved in be operating the system. It is difficult to quantify the effect of directed energy attacks on vision and the impact of a wide spectrum of vision degradation. Regardless of whether a tactical weapon is fielded and despite the difficulty in determining the effectiveness, Pk, of such weapons against a wide range of targets; the presence of thousands of pseudo-weapons on the modern battlefield requires that aircraft survivability be addressed in the context of directed energy threats.

Phase I: Models addressing the physics of the propagation of directed energy are available. It remains to combine such models with models that address the characteristics of a DEW system and the interaction of directed energy on a specific set of targets. Research should focus on the characterization of a weapon system to the extent that the practical utility of DEWS is addressed. The research should also provide survivability analysts with a model that accurately determines the energy reaching various target components. It would then be up to the analysts to devise a test to determine the effect the specified energy would have on the target.

N91-242 TITLE: 6-Inch Integrated AerofI11rust Vector Control (IYC)

CATEGORY: Engineering Development

OBJECTIVE: Design and build an innovative, high performance, and light weight integrated (common actuators for Aero and thrust vector control (TVC) Aero/TVC)) packaging scheme for a 6-inch tail-control missile. The main product from this feasibility study would be the linkage design that connects the control actuation system with TVC and control fins. The blast tube and nozzle designs are not required for this development.

DESCRIPTION: Currently, small diameter Air-to-Air missiles (5 to 6 inches) with Thrust Vector Control do not exist in the U.S. inventory. The agility of a missile of this size would be greatly enhanced with Aero and Thrust Vector Control. In order for a integrated Aero/TVC to improve the performance of a small diameter missile the system must be fast, stiff, accurate, light-weight, and fit into a small envelope. This system should have a minimum bandwidth of 35 Hz because of the airframe response of a small missile. The control linkage has to be stiff and allow minimum dead time or backlash. This would prevent possible problems with flutter. The system should have repeatable accuracy of 5% of the commanded position. This system must be designed with high priority given to the weight. This system has to fit in an envelope that is constrained by a 6-inch outside diameter missile, a 3-inch outside diameter blast tube, and nozzle assembly that has an outside slope of 15 degrees and an outside exit diameter of 5.25 inches. Also, this system must be any type of TVC that can provide a minimum of ±7.5 degrees of thrust vector angle with less than 5% thrust loss. A movable nozzle system would be acceptable. The integrated control actuation system should be common to both the Aero and TVC system. The system that controls the missile fins should provide ±5 degrees, have a minimum slew rate of 600 degrees/sec at 1/2 maximum operating torque, and provide a maximum operating torque of 1200 in-lbs. This system must include the control actuation power supply. The maximum length of the blast tube is 8 inches.

Phase I: Phase I should consist of a feasibility study that identifies and analyzes a prototype design.

Phase II: A bench model will be developed and built during Phase II. Also, during Phase II the model will be evaluated for performance.

N91-243 TITLE: Electro-Rheological Fluid Damper

CATEGORY: Exploratory Development

OBJECTIVE: Develop an active damper for missile control fin actuation systems using electro-rheological fluid.

DESCRIPTION: Electro-rheological fluids are fluids which exhibit a change in viscosity when exposed to an electrical field. The purpose of this project is to demonstrate that this technology can be used to provide active damping for a missile flight control actuator. The project should include detailed design, fabrication of a demonstrator unit, and extensive performance testing.

N91-244 TITLE: Biometal Actuation

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the feasibility of using biometal in various deformable skin actuation schemes.

DESCRIPTION: Biometal is a Nickel/Titanium alloy which changes shape when heated and has excellent shape memory properties. Missile designers have proposed flight control actuation schemes in which the skin or either a control fin of the missile body itself would be deformed to produce the desired aerodynamic forces. Potential advantages of deformable skin systems include reduced radar cross section, and reduced cost and increased reliability since there would be fewer moving parts.

N91-245 TITLE: Spherical Boron Slurry Particles

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate a process for producing low ($5.00 to $10.00 per pound) spherical boron particles 2 to 5 microns in diameter using B203 as a raw material.

DESCRIPTION: Boron slurry fuels have the highest energy density product of any known fuel, however, the present price of amorphous boron is unacceptable and the fuels made from it have unacceptably high viscosity.

Phase I: Should be directed towards the development of a method to process spherical boron particles 2 to 5 microns in diameter using B203 as a raw material. The result of Phase I will be a production of laboratory scale quantities of the material and a report outlining the approach that will be undertaken in Phase II with sufficient data to demonstrate the feasibility of producing the particles at a low cost.

Phase II: Shall address the large scale preparation of the spherical boron particles prepared in Phase I. 200 pounds of the material should be synthesized and forwarded to the government for testing.

N91-246 TITLE: High-Energy Fuel Gel Scale-up and Production

CATEGORY: Exploratory Development

OBJECTIVE: To define and document procedures or processes for preparing one to five hundred gallon batches of high-energy gelled ramjet fuels.

DESCRIPTION: High-energy fuel gels are currently being evaluated by the Navy for advanced long-range air breathing missiles. This includes the preparation in the laboratory of liter size batches of the gels for chemical and physical properties related tests. However, for fuel control and combustion tests, multi-gallon size batches are needed.

Phase I: A report outlining procedures and/or processes for preparing gel formulations identified by the Navy.
Phase II: Delivery of one to five hundred gallon batches of gelled fuel manufactured in accordance with procedures and/or processes developed under Phase I.

Specifications will be provided by the Naval Weapons Center SBIR office.

N91-247 TITLE: High Voltage Switch For Slapper Detonators

CATEGORY: Advanced Development

OBJECTIVE: The objective of this work is to design, fabricate and conduct qualification tests of a high voltage switch to be used in safety-arming devices.

DESCRIPTION: High voltage switches that are currently available for use with slapper detonators are either very expensive, have a limited lifetime, or have a very low breakdown voltage. It is desired to find a switch that is repeatable for at least 100 full current discharges into a 5 milliohm load with no evidence of "stalling". "Stalling" is defined as a condition whereby the discharge waveform "stalls", i.e., stops rising for a short time before continuing to the peak discharge current. Stalling can result in failure to fire the slapper detonator.

It is desired to receive proposals for both vacuum and gas-filled switch concepts. Specific requirements for the switch are:

Electrical:	1.	Static Breakdown Voltage: 5 kVdc
	2.	Peak Current: 6.0 kA (pulse)
Size:	1.	Volume: 0.2 cubic inch °
Cost:	1.	$30 (100 each)
	2.	$24 (1,000 each)
	3.	$18 (10,000 each)

N91-248 TITLE: Adaptive Contact Sensor

CATEGORY: Advanced Development

OBJECTIVE: The objective of this work is to design, fabricate and conduct qualification tests of an adaptive contact sensor to be used in guided missiles.

DESCRIPTION: Current contact fuzes used in Navy guided missiles have a fixed firing threshold. The fixed firing threshold is intentionally fixed at a level that is certain to never fire before reaching the intended target, but will provide reasonable assurance that the contact sensor will provide a firing signal when the missile hits its target.

Safety is not an issue as the warhead safety-arming device ensures that the missile reaches a safe distance from the launcher before the warhead can be fired. The challenge here is to formulate a firing system that will measure the flight background environment during flight and adjust the firing threshold to obtain the maximum sensitivity to target impacts. Basic requirements for the device are as follows:

Shock:	1.	The sensor shall contain a transducer that will sense when the missile contacts the target.
	2.	The sensor shall be capable of operating during and after a shock of 20,000 gravity units with a pulse duration of 0.5 milliseconds.
Size:	1.	Volume = 0.6 -0.8 cubic inches
Cost:	1.	$435 (100 each)
	2.	$320 (1000 each)

N91-249 TITLE: Optical Fiber Guidance Payout Tension and Torque Measurement System

CATEGORY: Engineering Development

OBJECTIVE: To design and fabricate a magnetic levitation system to measure the real time tension and torques generated by an optical fiber. When complete, the measurement system will provide a test bed for measuring, identifying and characterizing minute fiber adhesive forces; fiber guidance payout forces and validating coefficients for analytical models from a static or rotating payout system.

DESCRIPTION: The test bed will consist of: magnetic bearings, mechanical design data acquisition and data reduction systems. These subsystems will be integrated into a highly accurate fiber payout tension and torque measurement system (TTMS). The tension and torque measurement system requires the following: (1) Relative collection of tension and torque data, (2) Vibration rejection to ensure true force and torque data, (3) Sampling rates sufficient to detect nonlinear dynamic loads, (4) Precise calibration procedures and hardware, (5) Axial tension fidelity from 0 to 2500 gm, (6) Centerline torque fidelity from 0 to 2500 gm-cm, (7) 0-2% resolution at 500 Hz, 2500 gm, and (8) Compensation for off-axis payout angles and rates.

The system must be capable of operating in static, free, and open and closed loop controlled- spinning bobbin mode. Both a high speed digital servo controller and a high speed, high-resolution data acquisition system are required for force control and data measurements. The data acquisition system must be able to quickly and efficiently acquire and analyze data.

The magnetic measurement suspension system is an ideal concept for the measurement of the bobbin multidimensional forces when decoupled from the measurement axis. The complete system will provide six degree-of-freedom (6-DOF) measurements of bobbin forces and torques up to the frequency of the measurement sensors.

Phase I: Design and development effort to demonstrate the approach.

Phase II: Development of a government data package, and the fabrication of a measurement system for delivery to the government for testing per the approach outlined in Phase I and a standard government bobbin configuration.

N91-250 TITLE: Development of Prototype Multiple Aircraft Range Display System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype state-of-the-art graphics display system for real-time display of data from a flight test. This task will include development of software for use on existing available hardware. This data will include positions of multiple aircraft. Location of multiple threat weapon system configurations and other test resources, multiple weapon flyouts. aspect angles, and threat weapons effectiveness. The prototype user will have the capability of selecting different display screens and editing displayed information.

DESCRIPTION: Development Phase I: (1) establish detailed requirements for the Prototype Multiple Aircraft Range Display System; and (2) research hardware and software already available which could be modified to perform this task or could be used to partially satisfy the requirements for the task. Different displays may be required for test managers, test conductors, and military observers. Human engineering factors are an important facet of this development.

Phase II: Develop a prototype system based on the requirements defined in Phase I and user feedback. Impact: Results of development of this prototype will be used to define the requirements for the new Code 644 range display system.

N91-251 TITLE: Coupling of Optical Fibers to Detectors in Evacuated Dewars

CATEGORY: Exploratory Development

OBJECTIVE: To determine the feasibility of using optical fibers to simplify optical designs in multi-detector sensor systems. If this research is successful it would significantly reduce the cost of cooled sensor systems and would be procured and installed in anti-air missile systems.

DESCRIPTION: Some sensor systems require mounting the detectors in evacuated dewars. In order to provide full azimuthal coverage, this currently requires several detectors mounted in multiple dewars. Generating the desired field of view also requires having detector element shapes which are difficult and expensive to produce and whose effectiveness is reduced by the detector shape. By accepting the incoming energy into appropriately shaped fiber bundles, which are then coupled to a single array of more efficiently shaped detectors in a single dewar, the optical complexity and expense of these systems can be greatly reduced.

Phase I: Would be a study examining the approach which will be used to meet the requirements addressed above with sufficient data to demonstrate feasibility and make a well grounded selection of technology to be used.

Phase II: Should use the approach outlined in Phase I to produce one detector system and deliver it to the government for testing.

N91-252 TITLE: Neural Network Controlled Automatic Gain Control for Low Cost IR Sensors

CATEGORY: Exploratory Development

OBJECTIVE: To produce a low cost hybrid infrared/neural network sensor with on-chip automatic gain control. If successful, the developed technology demonstrates the feasibility of combining low cost IR sensors with neural network processors to produce low cost smart sensors.

DESCRIPTION: The most overwhelming factor limiting the widespread use of imaging IR sensors in various applications is the inability to deal with the volume of information produced by these sensors. Neural networks, because of their parallel nature, have the ability to deal with the large volume of information produced by these sensors. The bottle neck in today's technology is the interface between the IR imaging sensors and the neural

network processors. The purpose of this project is to remove the integration bottle neck and demonstrate feasibility using an automatic gain control (AGC) problem.

Phase I: Should integrate an existing IR focal plane array sensor with neural network hardware to solve the AGC problem.

Phase II: Should expand the complexity of the problem focusing on resolution, connectivity, and related issues to produce a more generic sensor package.

N91-253 TITLE: Magnetically Supported Ultraprecision Bearing Development

CATEGORY: Advanced Development

OBJECTIVE: To develop and demonstrate the capability to produce a magnetically supported bearing for ultraprecision rotary motion usable in a variety of seeker, scanner, or other optical/mechanical applications where a precise, small, low noise, low friction, low consumable, and very stiff bearing is required.

DESCRIPTION: As higher speeds and more precise motions are employed, the dynamic limitations of ultraprecision ball or angles, roller bearings become apparent. Stiff bearings and structures can be achieved with gas static bearings but with the penalty of gas g consumption, which will limit run times in remote applications. A magnetically supported rotary bearing could in principle be designed to fill this need with the low power electricity supplied from existing system sources. As a demonstration, the following bearing shall be designed and demonstrated:

Specifications for demonstration of representative technology:

Overall diameter less than 8"
Clear aperture 6"
Thickness less than 2"
Dynamic performance up to rotation rates of 100 Hz:
Stiffness to axial or radial deflection greater than 5 x 105 lbs/in
Radial and axial run out less than 3 x 10-6 in
Electrical power consumption shall be less than 10 W

Specific provision for integral torque motor drive and high resolution encoder shall be made for test purposes. Special attention should be made to be able to scale the design, both larger and smaller than the nominal design, especially to miniaturization without sacrifice of stiffness or accuracy.

N91-254 TITLE: Active Matrix IR Scene Generation via Polysilicon Integrated Circuit Sources

CATEGORY: Advanced Development

OBJECTIVE: To develop and demonstrate dynamic IR scene generation hardware capable of rapid update times and near/mid/far IR operation utilizing polysilicon integrated circuit infrared sources in an active matrix array geometry.

DESCRIPTION: Broadband infrared sources utilizing integrated circuit (IC) technology have been demonstrated. Such devices make use of common semiconductor photomask/etching methodologies to yield an extremely simple and compact, glowbar-type resistive silicon strip. These integrated circuit infrared (ICIR) sources may be fabricated in the form of large matrices of single source elements. Each of the single element sources may be driven by on-pixel electronics as in a focalplane array (FPA) or may be energized by an active matrix addressing scheme (active matrix addressing shall be used in this introductory device). The use of polysilicon bridge material opposed to thin metal films affords higher operating temperatures (1000 º K) and thus better spectral dynamic range in the short to mid-infrared. The similarities between ICIR and focal plane array construction permits ready transfer of

manufacture technology and use of existing microelectronics industry equipment and infrastructure. An ICIR's inherently small size, weight, cost, and power requirements make it ideally suited to both laboratory and field ruggedized test sets.

Specifications for demonstration device include:

linear array of at least 8 pixels
1000 Kelvins or greater operating temperature
1/10 watt or less total dissipation power
20 x 20 x 0.8 micron minimum bridge dimensions

N91-255 TITLE: IR Conical Scan Tracker In The Loop

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of RF seekers with aperture blockage

DESCRIPTION: Many of the IR seeker designs for multispectrum guidance use a free gyro seeker with conically scanned arrays of detectors. The performance of these seekers needs to be tested in a cost effective manner in the laboratory. A simulation system capable of injecting signals into the signal processor which simulates the outputs from the conically scanned arrays is needed. The simulator must provide real time, time domain input signals which represent the target and a variety of background, countermeasures, and noise in the conically scanned coordinates. The objective of this initiative is the definition, design, and demonstration of a tracker in the loop capable of testing conical scanned seekers. The inputs must represent images in any of the IR spectrums from I to 12 microns. The ability to dynamically control the inputs in real time based on a missile simulation of the geometry is required. The system will be integrated with existing missile simulation computers to provide a test facility for conically scanned IR seekers for multispectrum guidance.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design and develop a simulation system capable of injecting signals into the signal processor which simulates the outputs from the conically scanned arrays.

N91-256 TITLE: Efficient Optical Surface Finishing of Ultrahard Dome Materials

CATEGORY: Exploratory Development

OBJECTIVE: To significantly reduce the cost and improve the producibility and surface quality of ultrahard dome materials such as sapphire and spinel.

DESCRIPTION: High performance missile domes will require ultrahard materials such as sapphire, spinel, or diamond. Such materials are presently fabricated using diamond abrasive grinding and polishing. This process is slow and very expensive and results in substrate subsurface damage, which directly limits optical and rain erosion performance. It may be possible to employ chemical/mechanical or ion beam techniques to this finishing process. High material removal rates and excellent finishes have been reported on sapphire on small, flat surfaces. If this or similar processes can be scaled and applied to steeply curved surfaces, it is likely that the objectives of this effort can be realized. To demonstrate progress a dome shall be fabricated of sapphire or spinel starting from a near net shape blank in less than 40 hours of fabrication time. Assuming that the ongoing SBIR effort in dome blank fabrication is successful the combined effort could result in very real and significant reduction in dome cost.

Suggested demonstration dome dimensions and specifications are as follows:

Figure irregularity shall be 2 fringes maximum at 6328 A over any 2" aperture on each surface. Rms roughness measured using a WYKO profilometer or similar instrument < 15 A rms, over a scan length of 0.25 mm. Typical IR dome dimensional tolerances apply to wedge, centration of surfaces and radii match.

N91-257 TITLE: Polishing of Poly-Crystalline Diamond Films

CATEGORY: Exploratory Development

OBJECTIVE: Develop polishing techniques to provide optical quality finishes for poly-crystalline diamond films on flat and curved surfaces.

DESCRIPTION: Poly-crystalline diamond films grown by plasma enhanced chemical vapor deposition offer a means to protect infra-red window and dome materials in severe environments. Diamond deposited in this manner tends to have large grain size and random crystal orientation which contributes to reduced optical performance because of scatter. Polishing of the growth surfaces will be necessary to reduce the scatter effect. Optical quality finishes of about 25 A RMS roughness or better will be needed. This types of surface finish is necessary for poly-crystalline diamond-coated flat and curved surfaces up to two inches in diameter.

N91-258 TITLE: Anti-Reflection Coatings for Use on Diamond Films

CATEGORY: Exploratory Development

OBJECTIVE: The aim of this program is to develop materials and deposition processes to fabricate optical thin films to provide anti-reflection (AR) coatings for poly-crystalline diamond films in high temperature, oxygen-containing environments.

DESCRIPTION: The durability and extremely high thermal shock resistance of poly-crystalline diamond offer a means to protect IR window and dome materials from erosion and environmental attack while improving optical performance, thermal shock resistance and lifetime. Optical quality coatings that can be deposited and adhere to diamond must be developed to provide useful AR coatings that can survive extreme environments. The AR coating should be optimized for transmission in the 8-12 /µ region. Ideally, it should retain good transmission from the ultraviolet to millimeter wavelengths. A secondary function of the AR coating is to protect the diamond from oxidation by the atmosphere at temperatures up to l000°C. Deposition techniques supplying dense, uniform films will be needed. An emphasis will be placed on the ability to scale the processes. Reflectance and be transmittance will be used for optical property measurement. Mechanical properties such as stress, adhesion, and thickness uniformity using optical microscopy and scattered light analysis of the films will be determined.

N91-259 TITLE: Switchable Electrically Conductive Polvrners

CATEGORY: Exploratory Development

OBJECTIVE: Develop air-stable polymer films that can be electrically switched between electrically conductive and non-conductive states.

DESCRIPTION: Free-standing electrically conductive films are required for microwave shielding. The ideal film can be switched rapidly between conductive and non-conductive states by an electric current. It will be air-stable in both states, or may have a non-conductive coating that protects it from air. It should be switchable 10^5 times with little degradation of its properties in either state.

Phase I: Demonstrate air-stable switchable structures and measure microwave absorption at X-band in the conductive and non-conductive states.

Phase II: Optimize absorption and transmission characteristics, switching speed, air stability and reversibility.

N91-260 TITLE: Video Geometric Processor aces

CATEGORY: Engineering Development

OBJECTIVE: To develop a video processor which can take video scenes generated by a fast graphics computer and do real time rotation, translation, and zooming for input to the tracker hardware of an imaging missile system. This must be done at sufficient speed to support closed-loop tracker Hardware-in-the-Loop (HWIL) simulation.

DESCRIPTION: Testing of imaging missile system trackers in closed-loop HWIL simulations require the use of computer- generated imagery so that, for each video frame, the view of the target as seen by the seeker can be generated by the graphics computer in a position which accurately reflects the change in the missile's perspective due to guidance commands given during the previous frame. Since the simulation computer requires most of that frame time to compute the new missile position there is precious little time for the graphics computer to generate a new scene. However since only some elements, such as the rotation, translation, and zoom factor of the target as seen by the missile, are extremely time critical, it is possible to split up the operations. The graphics computer can take the time it needs to generate a view of the target scene from the proper perspective and then send that video image to a special geometric processor which can do the required time critical operations in a time period much less than the frame time. This is the approach taken now in the Imaging Systems Lab of the Simulation Laboratory using an in-house built Zoom Processor. However, this Zoom Processor does have some operational problems, was very expensive to build and is one-of-a-kind. This development effort would replace this Zoom Processor and give the same capability size for other tracker HWIL simulation workstations, which will be critically needed for present and future imaging missile system programs.

Phase I: Should consist of a study to identify all time critical operations, develop the analytical and in architectural approach and complete design specifications, and identification of potential problems which might introduce unacceptable video artifacts.

Phase II: Should use the approach outlined in Phase I to develop a working Geometric Processor and deliver, it to the government.

N91-261 TITLE: Multivariable Autopilot Design Using H-infinity and Mu Synthesis

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the feasibility of using recent control design techniques to design either missile autopilot that is protect operational over the entire flight regime, or an adaptive-type autopilot that varies as the flight environment changes.

DESCRIPTION: Tactical missiles today typically employ an autopilot that is designed at different points in the flight regime. The autopilot parameters are then switched as some measured or estimated variable(s) change during flight. With the advent of increased computational power, and new multivariable control design techniques, the possibility exists for a more advanced multivariable autopilot design. The study should focus on how the design techniques would handle the changing flight environment, and how they would handle the stability and performance-related design specifications.

N91-262 TITLE: Generic Guidance Integrated Fuzing Air-to-Air Missile Simulation

CATEGORY: Advanced Development

OBJECTIVE: To develop a generic 6 degree of freedom Guidance Integrated Fuzing air-to-air missile simulation. The simulation will give the Navy the capability to perform analysis in the area of Guidance Integrated Fuzing for air-to-air missile development.

DESCRIPTION: Modern Navy missile development is progressing toward an integrated guidance and fuzing system. The purpose of this project is to provide the Navy with the simulation capability to further the investigation of the benefits of Guidance Integrated Fuzing and promote advanced development into upgraded weapons systems.

Phase I: Modify an existing 6 degree-of-freedom generic air-to-air missile simulation to incorporate terminal fuzing features. Capabilities should include simplified changes for fuze waveforms and N -point aspect dependent target models.

Phase II: Expand on the developments of Phase I to increase the simulation capabilities with transition modes for long range guidance, fuze mode closing guidance, terminal fuzing, and detailed N-point aspect dependent fuzing target models. The final development will be delivered to the Navy as a fully capable simulation for future missile development utilizing Guidance Integrated Fuzing.

N91-263 TITLE: IR Physical Model Generation

CATEGORY: Exploratory Development

OBJECTIVE: To provide realistic physical models to be used in testing of infrared proximity fuzes.

DESCRIPTION: Naval Weapons Center (NWC) is developing a capability for the use of physical models in the testing of long-wave infrared proximity fuze hardware (target-detecting devices). The hardware under test will include developmental optical systems, signal-processing software, and complete assemblies. The models will be typically 1/10 to 1/4 scale simulations of targets of interest, including aircraft and anti-ship missiles. Testing will be carried out at scaled distances of less than 100 feet, and target detail is important. Models should be capable of showing aerodynamic heating and internal heat sources, and background reflections. NWC invites proposals to implement this physical modeling approach, either with an independent approach to scene generation or as further development of the scale models now being used at NWC.

Candidate approaches must have minimal flicker or graininess and be capable of arbitrary target aspect. The background will be generated independently and is the subject of a companion SBIR topic description.

Phase I: Should establish a workable scene generation technique and provide a simple proof-of-concept hardware demonstration.

Phase II: Will use the concept of Phase I and provide a single working scene generator suitable for use with NWC's models.

N91-264 TITLE: IR Background Scene Generation

CATEGORY: Exploratory Development

OBJECTIVE: Provide realistic background for physical models used in testing of infrared proximity fuzes

DESCRIPTION: Naval Weapons Center (NWC) is developing a capability for the use of scale models in the testing of long-wave infrared (LWIR) proximity fuzes. The fuzes (target detecting devices) are passive IR devices operating in the 8- to 12- micron infrared band. The device under test might include developmental optical systems, signal-processing software or hardware, and complete assemblies. The models will be typically 1/10 to 1/4 scale models of targets of interest, including aircraft and anti-ship missiles. A perceived need is for an infrared background generator which can produce realistic infrared background, especially of sea-surface reflections. The background generator will produce time-varying background scenes derived from L WIR video imagery provided by NWC. These scenes will be used as background during model encounters at scaled fuzing ranges.

Phase I: Should establish a workable scene generation technique and provide a simple proof-of-concept hardware demonstration.

Phase II: Will use the concept of Phase I and provide a single working scene generator suitable for use with NWC's models.

N91-265 TITLE: Radar System Upgrade

CATEGORY: Engineering Development

OBJECTIVE: To modularize an existing X-band Inverse Synthetic Aperture Radar CISAR) system to allow emulation of a wide variety of radar guidance systems.

DESCRIPTION: Missile guidance systems being proposed and systems presently under development have a wide array of operating parameters. These parameters include differing operational frequency bands, pulse characterizations, PRFs, and power output. Currently, to emulate the different guidance radars and their modes of operation requires different, unique, emulation system for each. NWC currently has an X-band ISAR under development. To allow the ISAR to keep current with future state- of the-art advances, it is proposed to modularize the ISAR system to the extent necessary to allow emulation of the different guidance parameters as required. The conversion from one set of parameters to the other should be accomplished with minimal impact on the current system.

Phase I: A conceptual study will be made to ascertain the necessary modifications to the ISAR hardware and software to accomplish the conversion.

Phase II: Will consist of the design, development, and delivery of the modified ISAR.

N91-266 TITLE: Image Processing of Radar Data

CATEGORY: Engineering Development

OBJECTIVE: To convert in near real time, wideband coherent data collected from an Inverse Synthetic Aperture Radar (ISAR) system into range profiles and two dimensional cross-range images.

DESCRIPTION: Radar glint and scintillation returns from a target have an impact on missile guidance, causing increased miss distances to occur. The sources of glint and scintillation appear to be random in nature and are not fully understood. By mapping radar glint and scintillation return sources from various targets, a better understanding of the phenomena can be developed, which would aid in the elimination of these affects on missile guidance systems. Radar imaging would also aid in the development of a method to differentiate between friendly and enemy aircraft. The Navy is presently under contract for the development of an instrumentation radar which will generate the raw radar data for the imaging task. However, the software necessary to convert the raw radar data into images on a near real time basis does not exist. Although software algorithms are presently available for converting radar data into images, they are not able to take advantage of the full capabilities of our state-of-the-art ISAR.

Phase I: Conceptual design of the necessary algorithm will be developed to prove feasibility.

Phase II: Development and testing of the software necessary to implement the algorithm developed in Phase I and delivery of the final product.

N91-267 TITLE: Free Gyro Angle, Rate and Phase Measurement

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of IR seekers

DESCRIPTION: Very small free gyro seekers are being designed for application to multispectrum guidance systems. These seekers need to obtain very precise measurements of the gyro gimbal angle and the rate and phase of the gyro motion. Existing ran systems are limited in the accuracy and linearity of these measurements. Angle measurements accuracies of 0.1 degrees with rate and accuracies of 0.1 degrees/second and phase measurements to 0.1 degrees are desired. These accuracies should be maintained over -ship a temperature of 40 to 70 degrees centigrade. They should remain constant over the life of the gyro and in various conditions of ally of motor drive. The objective of this initiative is the design and demonstration of a method of measurement in the small gimbals of a free gyro. The gyro hardware of the Multispectrum Guidance program can be used to demonstrate this capability. The space available for this measurement is extremely small. The total seeker diameter is about two inches.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design, develop and demonstrate a method of measurement in the small gimbals of a free gyro.

N91-268 TITLE: Image Processing for Conical Scan IR Seekers

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of conical scan IR seekers

DESCRIPTION: Significant developments have been made in image processing for optically scanned scenes. Optical processing methods have been developed for identifying and tracking objects in the presence of noise and structured background. Most of this processing is based on a raster scan of the scene which can reproduce an image. New IR seeker designs for multispectrum guidance use a conical scan of arrays of multiple detectors. The conical scan is the natural scan 2 method for these seekers.

The seeker output is in the conical scan coordinate system and often has varying, redundant sampling of the scene. The objective of this initiative is to define and demonstrate the ability to apply the mass of image processing algorithms to the conical scan seeker. Transformations of the processing algorithms and the use of the oversampled data need to be determined. The ability to use the transformed processing algorithms to detect moving targets in background scenes needs to be demonstrated. Consideration should be given to the ability to perform these algorithms on processors that can be used in missile seekers.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to define and demonstrate the ability to apply the mass of image processing algorithms to the conical scan seeker.

N91-269 TITLE: Spectral Analysis of Stray Light

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of IR seekers

DESCRIPTION: Free gyro IR seekers are being developed for multispectrum guidance that operate in the long wavelength IR spectrum. These systems are susceptible to degradation due to stray reflected and emitted light from internal and external sources. Currently, specialized computer programs exist for the analysis of stray light in static conditions. This analysis is done in the time domain. In order to evaluate the performance of the L WIR seeker, it is highly desired to perform the stray light analysis in the frequency domain. This would produce frequency spectrums for the rotating free gyro seeker. The objective of this initiative is to develop and test the capability for computer

analysis of stray light in the frequency domain. The optical design for the Multispectrum Guidance Project could be used to evaluate the capability.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to develop and test the capability for computer analysis of stray light in the frequency domain.

N91-270 TITLE: RF Seeker Near Field Measurement System

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of RF seekers.

DESCRIPTION: The utilization of multispectrum guidance systems has made the measurement and evaluation of the RF antenna patterns very complex. It is desired to use near field measurement techniques to assess the interactions between the radiation element, the radome, and the IR seekers in the near field. The RF antennas are gimballed microwave and millimeter wave systems typical of current RF air-to-air guided missiles. This will allow better design of the integrated antenna system and boresight error correction. The ability to measure local area insertion phase delay and transmission loss will improve design capability. The objective of the initiative is to design and demonstrate near field measurement equipment for use in multispectrum guidance.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design and demonstrate near field measurement equipment for use in multispectrum guidance.

N91-271 TITLE: Electronic Nutation Damping of Free Gyro Seekers

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of IR Seekers.

DESCRIPTION: Free gyro seekers like the Sidewinder have traditionally used complex mechanical dampers to reduce the oscillation of the seeker at the nutation frequency of the gyro. These mechanical designs are inherently j frequency dependent. Current designs can be improved if the gyro speed is higher and variable. This requires that the nutation damping be adjustable. Electronic damping may be possible over a range of gyro speeds. The objective of this initiative is to design and demonstrate electronic damping of a small free gyro for application to an IR seeker. The design parameters for the Multispectrum Guidance seeker will be provided for the initial design.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility-

Phase II: Use the approach outlined in Phase I to design and demonstrate electronic damping of a small free gyro for application to an IR seeker.

N91-272 TITLE: Optimized Antennas for Multispectrum Guidance

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of RF seekers with aperture blockage.

DESCRIPTION: Multispectrum seeker systems are being developed which will include a coaxial IR system mounted in the radome of a gimballed RF seeker. Presently the RF and IR seekers are developed independently and integrated into a single system. The RF antenna patterns are degraded by the presence of the IR blockage. Total system performance could be improved by designing the RF antenna for optimum average performance over all RF gimbal angles in the presence of IR seeker blockage. The objective of this initiative is the development and test of an optimized RF antenna in the presence of the IR seeker blockage. The degradation in antenna gain and sidelobes will be minimized as well as the magnitude of the boresight errors caused by the IR blockage.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design and demonstrate the ability to apply the optimization techniques to the antenna used on the Multispectrum Guidance Project.

The Naval Weapons Center SBIR office can provide information on the Multispectrum Guidance Project.

N91-273 TITLE: MPSK Synchronization Modes Study

CATEGORY: Research

OBJECTIVE: To demonstrate a differentially coded, band limited phase shift keyed signal, fed from encoder to decoder by cable, to determine lockup time, false lock, and no-lock conditions with random data and with known patterns--bit rate, carrier frequency, and number of phase states negotiable.

DESCRIPTION: Problem: In data links using phase shift keying (PSK), it is impossible to tell which of the two (or more) states of the carrier is present, only to determine the difference between them and (if there are more than two states) the direction in which the phase has "rolled". Since, on a system with three states equally spaced 120 degrees apart (optimum case), more than one "bit" of information can be transmitted by each transition. With four states (as in quadriphase shift keying [QPSK]), four possibilities exist, namely roll forward 90 degrees, roll backward 90 degrees, roll 180 degrees (direction indeterminate), and do not roll. In general, for a m-ary PSK system, the number of bits transmitted per symbol is the base-2 log of the number m.

Phase I: Conduct a study to demonstrate a system of this type, generating m phases on an RF carrier of arbitrary frequency (500 MHz to 3000 MHz region) to determine how quickly such a system can resynchronize after an interruption with data throughput rates of 2-5 Mb/s, using random sequences and data containing fixed patterns. Such a demonstration device would not emit RF energy, since the interconnection between the encoder and decoder would be a coaxial cable.

Phase II: Develop a prototype system. This will be followed by development of the fully functional system; meeting requirements defined in Phase I.

N91-274 TITLE: QPSK and MPSK Transmission and Receiving Equipment

CATEGORY: Research

OBJECTIVE: To demonstrate a quadriphase shift (and possibly more than quadriphase) receiving and transmitting system, determine the resulting bandwidth with modulation by a random digital source, and determine characteristics for recovery/resynchronization after noise bursts.

DESCRIPTION: Problem: All digital telemetry signals to date have been sent by binary frequency shift transmission means, which is the most easily implemented and most immune to noise of all digital transmission modes. High data rates (greater than 800 Kb/s) require that the transmission occupy three, five, or more channels.

(This is always an odd number because of an anomaly in the frequency management system.) Use of m-ary frequency-shift keying (where m is an integer greater than two, usually a power of two) has been investigated and found to not have the desired advantages, but phase-shift keying with m >2 seems worth investigation.

Phase I: Investigate the feasibility and approach to the problem.

Phase II: Develop and demonstrate the capability of such a system.

N91-275 TITLE: Circularly-Polarized Microstrip or Stripline Antenna

CATEGORY: Engineering Development

OBJECTIVE: Manufacture and test a single panel and/or multiple wraparound ("band aid") antenna that produces a circularly-polarized output normal to the mounting surface on a (negotiable) frequency between 1435 and 2400 MHz.

DESCRIPTION: Problem: Circularly polarized antennas are almost universally used for reception of telemetry signals, but linear (that is, not circular) polarization is used for the transmitting end. As a consequence, the receiver experiences a 3 dB loss due to the polarization mismatch thus dumping half the available signal power. Circularly-polarized antennas are also capable (when used at both ends of the link) of rejecting ground bounce and reflections.

Phase I: Explore the feasibility and approach to the problem.

Phase II: Develop and demonstrate the capability of such an antenna.

N91-276 TITLE: Burst Data Flywheel

CATEGORY: Engineering Development

OBJECTIVE: Build and demonstrate a circuit which produces a continuous, "smooth" data stream and associated clock from data received in bursts of variable length and fixed clock rates.

DESCRIPTION: Problem: Burst-mode telemetry systems accumulate data until a buffer is filled enough to make the data volume worthwhile, at which time the data is sent in the order received as a high speed burst result, the received data is in bursts, which is acceptable for computers, but not for display and analysis by human observers. A data flywheel would accept the burst-type data and provide an output at a constant rate. The flywheel box would be used instead of a bit synchronizer/signal conditioner (BSSC) in a typical ground station. A reasonable capacity is 1/30 second at a maximum output rate of 5 Mb/s and an input rate of 20 Mb/s.

Phase I: A study to determine feasibility and approach to the problem.

Phase II: Build and demonstrate a prototype.

N91-277 TITLE: HORACE Data Channel Equipment

CATEGORY: Advanced Development

OBJECTIVE: Build and demonstrate a pulse code modulation (PCM) encoder and decoder for the data channel portion of a composite data and video signal in accordance with NWC TP 7025.

DESCRIPTION: Problem: The technical description of the HORACE digital television protocol (NWC TP 7025) and NWC Specifications 2421 and 2422 describe a system in which data and digitized, compressed television

pictures may be combined with a high bit rate digital data stream (100 kb/s to 5 Mb/s). These documents are available from the Naval Weapons Center SBIR office.

While the protocol provides for such service, and the specification includes "hooks" for it, no such system has ever been built. A representative system would produce an encoder that operates to the standard, and an add-on card to the decoder or a free-standing box to accomplish the separation of the data in signal from the composite.

Phase I: An approach and implementation study would be required.

Phase II: Actual prototype hardware and appropriate documentation to validate Phase I and ensure compatibility with existing hardware.

N91-278 TITLE: Fast KUTA-class Encryptors

CATEGORY: Advanced Development

OBJECTIVE: Develop a hybrid or monolithic circuit which replaces the current KGV-68 data encryptor for data rates beyond 10 Mb/second and up to at least 20 Mb/second, with better standby battery voltage characteristics and more "standard" package as desirable features.

DESCRIPTION: The TSEC/KG-66, TSEC-KG-67, and hybrid TSEC/KGV-68 KUTA-class encryption devices are one-way encryption devices intended for use on telemetry links at data rates ranging from near DC to 5-10 Mb/s. The encryptor devices also form the basis for the decryptor. The KUT A-class equipment does not change the bit rate between input and output (i.e., no overhead bits are added), nor is data oriented in blocks as in some other systems. While cryptographic equipment of other types is made to operate at bit rates to 50 Mb/s and beyond, existing systems do not have the KUTA attributes and are generally far larger and run on voltages not conveniently available within an airborne environment.

Phase I: A study on a "fast" KUT A is needed to operate at bit rates up to at least 20 Mb/s, and preferably up to as high as 45 Mb/s. A proposed device would need to draw less power and retain the same size or be smaller than the jut linear existing KGV -68 device.

Phase II: Develop a prototype system and deliver to the Government the documentation package.

N91-279 TITLE: Development of Fully Automated Software Testing System

CATEGORY: Exploratory Development

OBJECTIVE: Develop software for a system that will develop and run test software and data for a given FORTRAN or Ada software module or hierarchial set of modules.

DESCRIPTION: The test software and data will be generated based on the interfaces defined in the module(s) to be tested. The system will also take test data inputs from a user. The test software and data will cover all logical paths in the software. The system will also be capable of running the test and develop test reports.

Phase I: (1) Establish detailed requirements for the Fully Automated Software Testing System: and (2) research hardware and software already available which performs this task, could be modified to perform this task, or could be data is in used to partially satisfy the requirements for the task.

Phase II: Develop a prototype system. This will be followed by development of the fully functional system. That system will meet requirements defined in Phase I and in prototype development and evaluation. Develop and test the system in accordance with government standards.

PACIFIC MISSILE TEST CENTER

N91-280 TITLE: Telemetry Real Time Intelligent Monitoring System (TRIMS)

CATEGORY: Exploratory Development

OBJECTIVE: Develop an expert system which will aid analysts monitoring missile systems during testing.

DESCRIPTION: The Pacific Missile Test Center is designated as the lead activity for conducting development testing of various missile systems. In support of this test effort the Cruise Weapons Division, Code 1070, provides analysts for monitoring flight tests. Typically, there are many separate strip charts and real time display stations which require monitoring. The real time displays which are currently used provide someone limited red-line (i. e., potentially hazardous conditions) checking for selected measurements such as engine and electrical parameters. Related measurements are checked and conclusions are drawn from the data solely dependent on the analysts experience. The difficulty and high ~t of maintaining a cadre of experienced "chart watchers" has made it apparent that an alternate solution for the effective monitoring of flight tests is required. Therefore, the requirement of this task is to explore that feasibility of incorporating expert system technology into the real time display software as an automated aid to the analysts. The challenge in this task is to develop a system that is robust enough to cross correlate related parameters and arrive at quality advisories under the conditions of noisy data, drop outs, and potentially missing parameters. Previously recorded flight test data will be provided to be used to develop and demonstrate the system. Management of this SBIR task would be accomplished in the following manner:

Phase I: Demonstrate concept on existing computer with real data.

Phase II: Determine hardware/software requirements to implement formulate POA&M to fully implement.

N91-281 TITLE: Radiation and Scattering Modeling of Microstrip Array Antennas

CATEGORY: Exploratory Development

OBJECTIVE: This study will provide a new methodology of analyzing and designing a new microstrip antenna, embedded in a dielectric substrate or layer, with minimal scattering effects which is necessarily required for T &E telemetry application.

DESCRIPTION: In the testing of new and future aircraft and weapon systems, the ability to detect and track low observable vehicles is necessary for test control, hazard assessment, and performance measurement. The tracking must not compromise the low-observable signature characteristics of the vehicle, either by added protrusions, changes in physical shape, or transmissions in the frequency of interest at the threat frequencies being evaluated. Present on-board transponders and command systems antennas may increase the radar cross section of the target system thereby degrade the performance and consequently constraining achievable test objectives. An alternate way of designing telemetry antennas with minimal backscattering effects is critically needed.

This study will provide a new methodology of analyzing and designing a new microstrip antenna, embedded in a dielectric substrate or layer, with minimal scattering effects which is necessarily required for T&E telemetry application. The analytical formulation should consider the effects of feed excitation and termination-structure. The analysis should also include the choice of antenna elements, feeds, termination shape, and material properties.

Phase I: Conduct an engineering study for investigating a new method of analyzing radiation and scattering properties of microstrip array antennas.

Phase II: Develop a computer analysis code as well as implement a prototype engineering design of a microstrip telemetry antenna with minimal scattering effect.

N91-282 TITLE: Fire Free Day/Night Signal Cartridge for Practice Bombs

CATEGORY: Advanced Development

OBJECTIVE: Develop a day/night practice bomb signal cartridge that will not start fires on bombing ranges.

DESCRIPTION: Over one million signal cartridges per year are used in practice Bombs for marking their point of impact on bombing ranges for scoring purposes. Cartridges now used are causing fires on the bombing ranges. The Military Services need a day/night signal cartridge which will satisfy the following criteria.

1) Not cause fires on bomb ranges. The static fire hazard test is as follows: the cartridge shall not produce a fire when the cartridge is fired at a distance of 3 feet +/- 1/2 foot from the end of the static test gun into the center of an excelsior target which is a minimum 2 1/2 feet square and 8 inches +/- 1 inch in thickness. The dry excelsior (PPP-E-911, Type I, Class 3B, Grade 5) shall be packed to a uniform density of 2 lbs +/- 1/2 lb per cubic foot, and be retained within a framed target to ensure that the excelsior is not dispersed by the firing of the cartridge.
2) Provide a system to instantaneously mark the impact point of the practice bombs detectible from a distance of not less than 1 mile: signal is not limited to flame and smoke.
3) Provide an emission long enough to be recorded and provide singular discrimination between succeeding impacts.
4) Provide a signal within 1.6 milliseconds of surface impact.
5) Be encased in a cylindrical cartridge 0.85 inches in diameter and approximately 6 inches long.
6) Not contain any material which is toxic, radioactive, or environmentally harmful.
7) Pass the 14 day temperature and humidity cycle of MIL-Sm-33I Test 105 without exploding, leaking smoking, or case cover separation.
8) Not explode or separate when subjected to the five-foot drop in which sample shall impact horizontally within +/- 15 degrees in accordance with MIL-Sm-33I, Test III, Procedure 2.
9) Pass the vibration test of MIL-Sm-810, Method 514.2 Procedure I, Figure 514.2-2 Curve J. rare 10) Not significantly increase unit cost.

Phase I: The first phase will determine if a fire free day/night signal cartridge is producible and, if feasible, demonstrate by producing prototypes.

Phase II: This phase will test and evaluate prototypes.

N91-283 TITLE: Target Drone Control Via Satellite

CATEGORY: Engineering Development

OBJECTIVE: Develop a target drone which can be controlled by satellite.

DESCRIPTION: Battleforce weapons being developed for the Navy's use in the 1990-2010 period require large ocean areas for in a test and training operations. The shift from fixed, line-of-sight ranges to the larger open ocean areas presents particular problems for command and control of target drones. The present methods using fixed, line-of-sight data links are impractical in an operation conducted hundreds of miles from a land based facility. Studies have shown that RPV's (remotely piloted vehicles) and target drones may be controlled via satellite data links from shore based operations centers. The purpose of this project would be the to design, fabricate, test and demonstrate a system that would remotely pilot a target drone or an RPV (Remotely Piloted s in Vehicle) over ocean areas via a satellite data link from a shore facility.

Phase I: Design and test data link and command and control system.

Phase II: Demonstrate by flight test, a remotely piloted vehicle via satellite.

N91-284 TITLE: Global Positionin2 Satellite (GPS) Transponder

CATEGORY: Research

OBJECTIVE: To develop transponder for GPS.

DESCRIPTION: GPS (Global Positioning Satellite) Transponder: In the near future GPS acquisition will be available on an around the clock basis, thereby, accurately conveying position, velocity, and time to the user. One application for this technology is in remotely acquired positioning via an RF link to a central location. The system would potentially operate analogous to a radar transponder, except identifying positional data when the system is interrogated. This positioning transponder system would then provide the location of all furnished units within a test range facility. The GPS system will collect all ephemeris data via the *CIA* code and then acquire accurate positioning with P code, both on the L band. Positional up dates through the satellites are on a time interval of tens-of-seconds, but could be increased by interpolation with velocity data. The system accuracy are built-in errors in the GPS processing and retransmission. The positioning transponder will be comprised of three subsystems, L bandreceiver, GPS processor, and a transmitter. There are three possible strategies to relaying the positional data via the transponder, interrogation, continuous, or time mutiplexed between the various systems.

Phase I: Study of potentially designing the positioning transponder (receiver, processor, and transmitter) to a need a minimum size, volume.

Phase II: Demonstrate actual positioning transponder hardware.

N91-285 TITLE: New Technologies for Determination of Angle of Arrival of Laser Sources

CATEGORY: Research

OBJECTIVE: To develop techniques to determine a laser threat.

DESCRIPTION: Phase I-investigate new and innovative concepts and technologies for determining Angle of Arrival (ADA) of laser sources. Emphasis should be placed on exploiting the physical properties of electro-optic (ED) materials that can be implemented in a lightweight, conformal surface configuration. The technology should be capable of performing to at least the following specifications:

Minimum Detectable Signal level: lxl0 W/cm)(Peak Power Density)
Pulse Width range: 10 to lOOns
False Alarm Rate: No more than one per hour Probability of Detection: 95%
Angle of Arrival Resolution: + 3 Degrees

Provide indication of threat laser wavelength and pulse repartition rate. Concepts should be based on current technologies and supported by validated physical models.

Phase II-demonstrate a brassboard proof of concept prototype of the technology for determining ADA of laser sources presented in the Phase I effort. This is not expected to be an operational technology, but must provide an unambiguous demonstration of the theory and principle of the Phase I concept.

A description and program plan of how this technology can be implemented on an operational platform must also be provided.

N91-286 TITLE: Submarine Training Minefield Real Time Tracking System

CATEGORY: Engineering Development

OBJECTIVE: Improve fleet submarine training in mine detection and avoidance by providing the Hawaiian Area Deep Water Submarine Training Minefield with a stand-alone tracking and positioning system. Real time self track

is a requisite for realistic submarine training exercises. The system would allow immediate feedback between the mine-hunting sonar operator and onboard observers, further enhancing the value of each exercise.

DESCRIPTION: The Hawaiian Area Deep Water Submarine Training Minefield is an exercise range consisting of 10 vertical arrays each containing one or two inert mineshapes. Simple acoustic transponders are located on central arrays and act as beacons for submarine safety and onboard positioning. The transponders output frequencies are detectable by the submarines's passive sonar but not by the active mine hunting sonar. The practice minefield allows for training of the mine hunting sonar operator in mine detection; the transponder permits real time review of his performance by onboard observers. Limited tracking: data, manual plot methods, and ambiguities in sonar returns means the exact position of the submarine during the exercise is not " precisely known, creating an inadequate training exercise. The purpose of this project is to develop a "smart" transponder and on board tracking system. When one transponder is interrogated by the submarine, it will in turn interrogated by all others in the field. Based on time delay from the transponders to each other and to the submarine, the submarine's exact position can be determined by the onboard tracking system. This would allow for training utilization of every shape in the minefield with an increase in realism and submarine safety. The onboard tracking system would include minicomputer with plotter and data storage. Feedback to the sonar operator would be greatly improved over present methods.

Phase I: Investigate available technology and application to this project.

Phase II: Assemble and test a prototype tracking system for one submarine and three exercise mineshapes.

Phase III would develop a complete system with all mineshapes instrumented, and at least three onboard tracking systems each and adaptable to particular submarine installations.

NAVAL AVIONICS CENTER

N91-287 TITLE: Multi-Frequency Personal Locator Beacon/Emergency Locator Transmitter/Emergency Position Indicating Radio Beacon (PLB/EL T/EPIRB)

CATEGORY: Advanced Development

OBJECTIVE: Develop a multi-frequency (121.5/243/406/282.8 MHz) radio beacon transmitter system as candidate replacement equipment for the AN/PRC-90(V)-2 PLB, AN/URT-33 (V) ELT and AN/PRT-S EPIRB. Integrate the 121.5/243/406/282.8 MHz frequencies into the AN/PRC-II2(V) covert survival radio as the primary replacement for the AN/PRC-90(V)-2 and the AN/URT-33 (V). A need and market exists for this advanced Search and Rescue (SAR) system within DoD, NASA, FAA, I USCG and foreign military/civilian agencies.

DESCRIPTION: The Multi-Frequency PLB/EL T/EPIRB should be capable of emergency radio beacon transmission on 406 MHZ (short message) COSPAS/SARSAT international emergency frequency and 121.5/243 MHZ moded (modulated swept tone/modulated morse code/unmodulated carrier wave) civilian/military frequencies. The radio beacon transmission cycle should be approximately 60 seconds with 440 ms of 406 MHz and simultaneous 121.5/243 MHz moded transmission (18 sec modulated Morse Code, 9.6 sec modulated swept tone and 22.4 sec unmodulated pure carrier wave. The 282.8 MHZ should be a transceiver frequency for emergency voice communications. The Multi-Frequency PLB/ELT/EPIRB should meet the requirements of NATO STANAG 3281 and RTCNDO-204, Minimum Operation Performance Standards 406 MHz Emergency Locator Transmitters (EL T), with exceptions as agreed upon by the Government Design Agencies. The system should be designed to provide maximum SAR performance, reliability, maintainability and survivability with minimum weight, volume and coot.

Phase I: Requires research and development of current and new radio beacon and communications technologies including operational requirements, standards and specifications, hardware, software and operation procedures.

Phase II: Requires full scale engineering development of prototype systems in PLB, EL T and EPIRB configurations. Test and evaluation will be conducted at the Naval Avionics Center and the Naval Air Test Center.

NAVAL ORDNANCE STATION/INDIAN HEAD

N91-288 TITLE: Degradation of Ordnance Ingredients by the White-Rot Fungus Phanerochaete Chrysosporium

CATEGORY: Exploratory Development

OBJECTIVE: To determine the applicability of White-rot fungus to decomposition of ordnance ingredients and materials.

DESCRIPTI0N: Phase I: Evaluation of the current status or research on Phanerochate chrysosporium for the degradation of TNT and other ordnance materials and investigation of its applicability to nitro-amines such as RDX, HMX, and nitro-guanidine.

Phase II: Investigation of possible applications to ordnance contaminated materials and sites, and to Navy waste inimization or waste disposal.

N91-289 TITLE: Processing of Energetic Materials with Supercritical Fluids 's

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel processing techniques for energetic materials.

DESCRIPTION: Research and development of process methods for energetic materials using supercritical and critical fluid technology. Ball-grain powder, pelletized nitrocellulose, high bulk nitro-guanidine (NO) and 1,3,5,7 Tetranitro -1,3,7-tetrazocine (HMX) are produced by processes developed twenty to forty years ago. Supercritical fluid technology with its excellent solvating character offers unique opportunities for the development of novel processing techniques for energetic materials.

Phase I: Investigate the extraction of components from obsolete propellants and explosives and produce new products from the recovered ingredients. The new products would be spherical particles of nitrocellulose, nitro-guanidine and HMX.

Phase II: Will emphasize the optimization of the processing technology and the development of a prototype demonstration to verify the validity of the techniques. The demonstration must also show the viability for scale-up for practical application should the project transition to Phase III.

N91-290 TITLE: Removal of Combustion Gases Produced from the Thermal Treatment of Propellants from Small Rocket Motors Utilizing Gas Scrubbers

CATEGORY: Exploratory Development

OBJECTIVE: To evaluate and develop gas scrubbers to remove gaseous combustion products generated from rocket motor lot acceptance testing, the demilitarization of small rocket motors, and the burning of scrap generated during propellant processing.

DESCRIPTION: The contractor is to develop state-of-the-art gas scrubbers to remove gases generated during rocket motor Lot Acceptance Testing, the demilitarization of small rocket motors by thermal treatment, and the burning of scrap generated during propellant processing. Specific gases to be removed include hydrochloric acid, oxides of aluminum, and oxides of nitrogen. The concentrations of these gases are to be reduced to an environmentally acceptable level before venting to the atmosphere.

Contractor should be aware that the combusting propellant produces large quantities of gases at very high temperatures. Formulations of the propellants to be thermally treated are classified, therefore personnel must meet be appropriate security requirements.

Phase I: Contractor shall provide a small scale working gas scrubber that reduces the concentration of mixtures of hydrochloric acid, oxides of aluminum, and oxides of nitrogen to an environmentally acceptable level. A final report should be provided with sufficient data to demonstrate feasibility.

Phase II: Continue development of the gas scrubber with modifications and appropriate scaling to handle actual burning propellants. Gas concentrations should be reduced to an environmentally acceptable level. Results of these tests are to be reliable and reproducible.