NAVY

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research. 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:

Office of Naval Research
ATTN: Mr. Vincent D. Schaper
ONR 4130 SBIR
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-4286

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 SBIR program has been redirected for FY 1994 from one that was integrated with the needs and requirements of the Navy through engineering development headquarters activities to one that is primarily integrated with the needs and requirements of the Navy through its science and technology program while providing "dual-use " topics. The program is a balance between twelve science (S) and eighteen technology (T) areas (shown in Table (1)) that the Navy has identified as necessary to meet its mission responsibilities. While a total of 30 S&T areas has been identified, all of these areas may not be funded equally during the two annual DOD SBIR solicitations in which the Navy participates. The Navy will fund topics according to priority it has established to meet its mission goals and responsibilities.

This solicitation contains 125 technical topics that meet the mission requirements of the Navy and PL 102-564 to which small R&D businesses may respond. As in the previous solicitation the Navy will provide potential awardees the opportunity to reduce the gap between phases I & II by providing a $70,000 Phase I proposal award and a $30,000 Phase I Option award or small businesses may elect to just submit a Phase I proposal. If small businesses choose the former, the Option effort should form the initial part of the Phase II work. Only companies whose Phase II proposal has been selected for award will be funded for the Phase I Option. Therefore, those who have finished or almost finished their "initial Phase I" portion should submit their Phase II proposal with an "initial Phase II" portion and an option. The Phase II proposal should contain a plan of how the proposer will commercialize the technology to the government (and the private sector) in addition to the technology demonstration portion of the proposal. At the end of the "initial Phase II" portion, a determination will be made by the Navy as to whether the proposer has satisfied the commercialization plan sufficiently for the government to fund the "Phase II option" portion of the proposal. The Phase II option should address the further R&D or test and evaluation aspects of the proposal. The total Phase II funding will not exceed $750,000 with 80% going to the "initial Phase II" portion and 20% for the "option Phase II" portion.

Selection of Phase I proposals is based upon technical merit and evaluation criteria contained in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only those proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY		SCIENCE
Computers	Training Devices	Computer Sciences
Software	Navigation, Guidance, and	Mathematics
Sensors	Vehicle Control	Cognitive and Neural Sciences
Communications Networking	Industrial Production	Biology and Medicine
Electronic Devices	Vehicle Structures	Terrestrial Sciences
Environmental Quality	Light and Optical Systems	Atmospheric and Space Science
Materials and Processes	Medical Devices	Ocean Science
Energy Storage		Chemistry
Propulsion and Energy Conversion		Physics
Design Automation		Electronics
Human-System Interfaces		Materials
Modeling and Simulation		Mechanics

NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY CATEGORY INDEX
NAVY FY94.1 SBIR TOPICS

SCIENCE/TECHNOLOGY — TOPIC NO

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Navy Topics

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

Topic Nos. N94-001 through N94-003

Administrative
SBIR Contact

Mail Address:

Commander
Marine Corps Systems Command
Attn: Code AW, SBIR Program, Topic No. N94-_____
2033 Barnett Avenue, Suite 315
Quantico, VA 22134-5010

Mr. Joseph Johnson
(703) 640-4801/2761

Handcarry Address:

Commander
Marine Corps Systems Command
Attn: Code AW, SBIR Program, Topic No. N94-_____
Building #3097, 2nd Deck
Quantico, VA 22134-5010

Topic Nos. N94-004 through N94-012

Mail/Handcarry Address:

Commander
Space and Naval Warfare Systems Command
Attn: Code SPAWAR OOK, SBIR Program, Topic No. N94-_____
Crystal Park #5, Room 110
2451 Crystal Drive
Arlington, VA 22245-5200

Ms. Betty Geesey
(703) 602-6092

Topic No. N94-013

Mail/Handcarry Address:

Commander
Naval Supply Systems Command
Attn: Code SUP 422B2, SBIR Program, Topic No. N94-_____
Crystal Mall #3, Room 710
1931 Jefferson Davis Highway
Arlington, VA 22241-5360

Ms. Linda Whittington
(703) 607-1648

Topic Nos. N94-014 through N94-024

Administrative
SBIR Contact

Mail/Handcarry Address:

Commander
Naval Air Systems Command
Attn: Code AIR-05TE2, SBIR Program, Topic No. N94-_____
1421 Jefferson Davis Highway
Jefferson Plaza #1, Room 444
Arlington, VA 22243-5003

Ms. Cathy Nodgaard
(703) 692-7393

Topic Nos. N94-025 through N94-028

Mail/Handcarry Address:

Commanding Officer
Naval Training Systems Center
Attn: Code PDR2, SBIR Program, Topic No. N94-_____
12350 Research Parkway
Orlando, FL 32826-3224

Ms. Janet Weisenford
(407) 380-8276

Topic Nos. N94-029 through N94-033

Mail Address:

Commanding Officer
Naval Medical Research and Development Command
Attn: Code NMRDC-42, SBIR Program, Topic No. N94-_____
Bethesda, MD 20889-5606

LT CDR Paul Knechtges
(301) 295-0885

Handcarry Address:

Commanding Officer
Naval Medical Research and Development Command
Attn: Code NMRDC-42, SBIR Program, Topic No. N94-_____
8901 Wisconsin Avenue
Building #1, 11th Floor
Bethesda, MD 20889-5606

Topic Nos. N94-034 through N94-047

Mail/Handcarry Address:

Commander
Naval Sea Systems Command
Attn: Code 06HE, SBIR Program, Topic No. N94-_____
Crystal Plaza #5, Room 924
2211 Jefferson Davis Highway
Arlington, VA 22242-5160

Mr. William Degentesh
(703) 602-3005

Topic Nos. N94-048 through N94-057

Administrative
SBIR Contact

Mail Address:

Commander
Naval Surface Warfare Center
Dahlgren Division
Attn: Code R05, SBIR Program, Topic No. N94-_____
Silver Spring, MD 20903-5000

Mr. Donald Wilson
(301) 394 -1279

Handcarry Address:

Commander
Naval Surface Warfare Center
White Oak Detachment
Attn: Code R05, SBIR Program, Topic No. N94-_____
Building #1, Reception Room
Silver Spring, MD 20903-5000

Topic Nos. N94-058 through N94-066

Mail Address:

Commander
Naval Surface Warfare Center
Carderock Division
Attn: Code 0112, SBIR Program, Topic No. N94-_____
Bethesda, MD 20084-5000

Mr. Frank Halsall
(301) 227-1094

Handcarry Address:

Commander
Naval Surface Warfare Center
Carderock Division
Attn: Code 0112, SBIR Program, Topic No. N94-_____
Building #1, Room 216M
Bethesda, MD 20084-5000

Topic No. N94-067

Mail/Handcarry Address:

Commander
Naval Surface Warfare Center
Attn: Code 183, SBIR Program, Topic No. N94-_____
300 Highway 361
Building #120
Crane, IN 47522-5001

Mr. James Linn
(812) 854-1352

Topic Nos. N94-068 through N94-070

Administrative
SBIR Contact

Mail Address:

Commander
Indian Head Division
Naval Surface Warfare Center
Attn: Code 830U, SBIR Program, Topic No. N94-_____
101 Strauss Avenue
Indian Head, MD 20640-5035

Ms. Beth Klapach
(301) 743-4250

Handcarry Address:

Commander
Indian Head Division
Naval Surface Warfare Center
Attn: Code 830U, SBIR Program, Topic No. N94-_____
101 Strauss Avenue
Building #D340
Indian Head, MD 20640-5035

Topic No. N94-071

Mail Address:

Commander
Naval Undersea Warfare Center
Detachment New London
Attn: Code 0911, SBIR Program, Topic No. N94-_____
New London, CT 06320-5594

Mr. Jack Griffin
(203) 440-4116

Handcarry Address:

Commander
Naval Undersea Warfare Center
Detachment New London
Attn: Code 0911, SBIR Program, Topic No. N94-_____
Building #39
New London, CT 06320-5594

Topic Nos. N94-072 through N94-075

Administrative
SBIR Contact

Mailing Address:

Commander
Naval Air Warfare Center Aircraft Division
Flight Test and Engineering Group
Attn: Code CT22, SBIR Program, Topic No. N94-_____
Patuxent River, MD 20670-5304

Mr. Daniel Watters
(301) 826-1144

Handcarry Address:

Commander
Naval Air Warfare Center Aircraft Division
Flight Test and Engineering Group
Attn: Code CT22, SBIR Program, Topic No. N94-_____
Building #304/3169
Patuxent River, MD 20670-5304

Topic No. N94-076

Mail Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Trenton
Attn: Code PE 34, SBIR Program, Topic No. N94-_____
Trenton, NJ 08628-0176

Mr. Robert Dobrowolski
(609) 538-6754

Handcarry Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Trenton
Attn: Code PE 34, SBIR Program, Topic No. N94-_____
250 Phillips Boulevard
Trenton, NJ 08628-0176

Topic Nos. N94-077 through N94-081

Administrative
SBIR Contact

Mail Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Warminster
Attn: Code 01B, SBIR Program, Topic No. N94-_____
P.O. Box 5152
Warminster, PA 18974-0591

Ms. Carol Van Wyk
(215) 441-2375

Handcarry Address:

Commanding Officer
Naval Air Warfare Center
Aircraft Division Warminster
Attn: Code 01B, SBIR Program, Topic No. N94-_____
Street Road/Jacksonville Road
Warminster, PA 18974-0591

Topic Nos. N94-082 through N94-085

Mail Address:

Commander
Naval Air Warfare Center
Weapons Division
Attn: Code C002, SBIR Program, Topic N94-_____
China Lake, CA 93555-6001

Ms. Lois Herrington
(619) 939-2712

Handcarry Address:

Commander
Naval Air Warfare Center
Weapons Division
Attn: Code C002, SBIR Program, Topic N94-_____
515 Blandy Avenue, Annex A1
China Lake, CA 93555-6001

Topic Nos. N94-086 through N94-092

Mailing/Handcarry Address:

Commander
Naval Air Warfare Center
Weapons Division
Attn: Code P3410, SBIR Program, Topic N94-_____
512 9th Street, Building 50, Room 1076
Point Mugu, CA 93042-5001

Mr. Eugene Patno
(805) 989-8801

Topic Nos. N94-093 through N94-101

Administrative
SBIR Contact

Mail/Handcarry Address:

Commanding Officer
Naval Command, Control and Ocean
Surveillance Center (RDT&E) Division
Attn: Code 0144, SBIR Program, Topic No. N94-_____
53560 Hull Street
San Diego, CA 92152-5001

Dr. Richard November
(619) 553-2104

Topic Nos. N94-102 through N94-105

Mail/Handcarry Address:

Commanding Officer
Naval Civil Engineering Laboratory
Attn: Code L03B, SBIR Program, Topic No. N94-_____
560 Laboratory Drive
Port Hueneme, CA 93043-5003

Mr. Daniel Zarate
(805) 982-1057

Topic Nos. N94-106 through N94-120

Mailing Address:

Commanding Officer
Naval Research Laboratory
Attn: Code 3204, SBIR Program, Topic No. N94-_____
Washington, DC 20375-5326

Ms. Patricia Schaefer
(202) 767-6263

Handcarry Address:

Commanding Officer
Naval Research Laboratory
Attn: Code 3204, SBIR Program, Topic No. N94-_____
4555 Overlook Avenue, SW
Building, 222, Room 115
Washington, DC 20375-5326

Topic Nos. N94-122 through N94-123

Mail Address:

Commanding Officer
Navy Personnel Research and Development Center
Attn: Code 13, SBIR Program, Topic No. N94-_____
San Diego, CA 92152-7250

Dr. Meryl S. Baker
(619) 553-7681

Handcarry Address:

Commanding Officer
Navy Personnel Research and Development Center
Attn: Code 13, SBIR Program, Topic No. N94-_____

53335 Ryne Road
San Diego, CA 92152-7250

SUBJECT/WORD INDEX TO THE NAVY SBIR SOLICITATION

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N94-023Virtual Simulation for Terminally-Guided Weapons

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NAVAL TRAINING SYSTEMS CENTER

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N94-054Electronically Tunable Solid State Laser

N94-055Oxidation-Resistant Composite Materials for High-Temperature Applications

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NAVAL SURFACE WARFARE CENTER/CARDEROCK

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N94-059Waterless Clothes Washer

N94-060High Current Switchgear

N94-061Flexible Coupling for a Liquid Cooled Coaxial Transmission Line

N94-062Non-invasive Sensors for Shipboard Sewage Systems

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NAVAL SURFACE WARFARE CENTER/CRANE

N94-067Photonic Systems Simulation

NAVAL SURFACE WARFARE CENTER/INDIAN HEAD

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N94-069Inline Gas/Air Monitoring System for Development and Small Scale Production in Processing Facilities

N94-070Infrared Sensor Integration for Wearable Damage Control Monitoring

NAVAL UNDERSEA WARFARE CENTER/DIVISION, NEWPORT

N94-071Electronic System Analytical Model Capabilities

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/PATUXENT RIVER

N94-072Options to Improve Basic Flight Testing

N94-073Advanced Avionics Architecture Stimulator System

N94-074Rotorcraft Handling Qualities and Flight Control System Specification Personal Computer Tutorial and Database

N94-075Aircraft Store Separation Analysis Methodology

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/TRENTON

N94-076Decision Aid to Assess Propulsion Technology Impact on Availability

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/WARMINSTER

N94-077Low Cost Six Degree of Freedom Accelerometer

N94-078Microindenter System for the Fabrication of Microcracks

N94-079Active Control of Aircraft Vibrations using Chaos Theory

N94-080Development of a Fine Water Mist Nozzle System

N94-081Narrowband Optical Filter for Laser Radar Applications

NAVAL AIR WARFARE CENTER/WEAPONS DIVISION/CHINA LAKE

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N94-083New Nonlinear Optical Material for High Speed Optical Signal Processing

N94-084Deployable Airfoils

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NAVAL AIR WARFARE CENTER/WEAPONS DIVISION/POINT MUGU

N94-086Binary Optics for Electro-Optical Sensors

N94-087Low Altitude Station Keeping Optical Instrumentation Platform

N94-088GPS Translator For Small Missiles

N94-089GPS Processing for Scoring

N94-090GPS Synchronized Time Code Generator for Airborne PCM Applications

N94-091Universal Two Stage GPS/INS Integration for Test Range Applications

N94-092Digital Relay, Reporter, and Responder

NAVAL COMMAND, CONTROL, AND OCEAN SURVEILLANCE CENTER/NRAD

N94-093Hopping Adaptive Interference Canceler

N94-094Digital Compression and Error Correction for Video Images

N94-095Develop A Strategic Industrial DUAL-USE Domestic Capability for High Performance 6-in and 8-in Silicon-on-Sapphire (SOS)

N94-096Human-Computer Interaction with Voice/Eye Tracking

N94-097Tactile and Proximity Sensing Sheet

N94-098Photonic Noise and Vibration Monitoring System

N94-099Diamond Electronic Packaging Technology

N94-100Antimultipath Capability for Global Positioning System Receivers

N94-101Ceramic Composite Electronic Packaging Technology

NAVAL CIVIL ENGINEERING LABORATORY

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N94-105Use of Microseisms to Predict Seismic Ground Motion Amplification

NAVAL RESEARCH LABORATORY

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N94-107High Voltage Field Effect Switching Transistor

N94-108Enhanced Eye Tracker

N94-109Non-Linear Optical and Solid State Laser Materials

N94-110Large Length, High Frequency Detector

N94-111Fiber Optic Biosensor

N94-112Altimeter Applications in Shallow-Water Areas

N94-113Tunable, Short-Pulse and Compact Source of X-Rays

N94-114Compact, Tunable Infrared Source of Radiation

N94-115Carbon Fiber Reinforced Phthalonitrile Resin Fabrication

N94-116Focal Plane Array Radar Experiment

N94-117Tunable (UV to IR) Narrow Band Filter

N94-118Integrating Diamond UV, X-ray and Particle Detectors.

N94-119Affordable Phased Array Radar for Ship Self Defense

N94-120Cavity-type Radiometer (UV to Far IR) System for High Precision Sensing

NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER

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N94-122Systems for Producing Readable Technical Text

N94-123Damage control training in a Virtual Environment

DEPARTMENT OF THE NAVY
SBIR TOPIC DESCRIPTIONS
DOD SOLICITATION 94.1

MARINE CORPS SYSTEMS COMMAND

N94-001TITLE: Innovative Approaches to Wide Area Networking for C4I

CATEGORY: Exploratory Development; Communications Networking

OBJECTIVE: Develop innovative solution approaches to providing secure, jam-resistant, high-bandwidth, networks between fixed and mobile C4I computer nodes under battlefield conditions.

DESCRIPTION: This topic seeks innovative approaches to providing networking between current and future C4I nodes within a Marine Expeditionary Force (MEF) engaged in a mobile combat environment. Current approaches to providing this inter-system connectivity are deficient in terms of bandwidth and security assurance. The desired capability set requires an approach that provides a high reliability, all-weather, multi-level secure, EMI and jam-resistant, wireless network with a node to node bandwidth exceeding 1 Mbps. The network should be capable of supporting more than 100 nodes and should not rely on line of sight propagation directly between nodes due to the likelihood of terrain being hilly or covered with heavy vegetation. The likelihood that some of the nodes may be aboard amphibious ships must be taken into account. Use of an airborne relay as a relay device is a potential strategy providing that the relay, including power source, is light enough to be an Unmanned Aerial Vehicle (UAV) payload. Security provisions should account for protection against network disruption through introduction of viruses, worms, etc. as well as for multi-level security protection of data on the network.

Phase I: Conduct a six month study effort to identify potential technological approaches using current and near-term future commercial networking technologies. Perform a comparative analysis of the ability of these approaches to satisfy the requirement using commercial LAN simulation tools in conjunction with a simulation or model accounting for the impact of the battlefield environment on communications connectivity and security.

Phase II: Design and construct a laboratory prototype of the most promising technological approach. Perform testing with the prototype to assess its strengths and weaknesses and report on the ability of the design to meet detailed requirements.

Phase III: Transition to an acquisition program if phase II results are sufficiently promising.

Commercial Potential: Technology developed under this initiative is directly applicable to civilian applications requiring networking between mobile facilities.

N94-002 TITLE: Smaller and Lighter Uninterruptable Power Supplies (UPS)

CATEGORY: Exploratory Development; Energy Storage

OBJECTIVE: Develop Uninterruptable Power Supplies (UPS) for critical C4I tactical systems that are smaller and lighter than current commercial UPS by an order of magnitude.

DESCRIPTION: Critical C4I systems need protection from power failure in the field environment. Commercially available UPS provide this protection but are prohibitively large and heavy. Development of UPS-like power assurance devices with an order of magnitude reduction in size and weight would allow incorporation of these devices into critical C4I nodes across the battlefield thus providing for reliable power to digital communications and computer systems even in the face of the uncertainties of tactical generator power. The objective is to provide uninterrupted power to systems for a period of about fifteen minutes during which time the normal power source would be restored or an orderly shut down conducted. The device must provide for smooth system power in the event of voltage and frequency variation (common with tactical generators) as well as when power has entirely failed.

Phase I: During a six month time period, survey the capabilities of current commercial UPS in order to establish a baseline and then research power technologies under development and on the drawing board which might provide order of magnitude size and weight improvements. Provide a report detailing any promising approaches which have been identified. Include in the report estimates of size and weight improvements feasible, estimates of cost for development and procurement, and information concerning environmental, equipment, and personnel safety issues which would have to be resolved.

Phase II: Design, build, and test prototype systems for the most promising technologies.

Phase III: Transition to an acquisition program if phase II results are sufficiently promising.

Commercial Potential: Widespread. The commercial demand for UPS to supply reliable power to computer and communication systems is well-established; the commercial market would welcome significant size and weight improvements.

N94-003 TITLE: Three-Stage Filter Separator

CATEGORY: Advanced Development; Propulsion and Energy Conversion

OBJECTIVE: Develop a filter medium, with vessel, for DOD use, that permits the coalescence of free water regardless of all known additives that may act as surfactants and still provide adequate solid contaminant filtration as outlined in American Petroleum Institute (API) Publication 1581 and Mil-F-8901. The medium surface area must handle 250% of the flow rate of Mil-F-8901.

DESCRIPTION: Current DOD filter separators were designed to handle petroleum propellants commensurate with the technology that existed 20 to 30 years ago. Advances in petroleum refinement techniques, new and improved additives have limited the effectiveness of that design.

Phase I: Provide a detailed description of the technology indicating the size, weight and cost of the system capable of coalescing and filtering 350 - 600 gallons per hour (GPM) of petroleum propellants with a specific gravity (SPGR) range of 0.75 to 0.85. A model should be developed detailing all contaminate and known surfactants for filter medium qualification.

Phase II: Construct a demonstration model.

Phase III: The new technologies developed could replace aging DOD filter separator designs and significantly improve fuel quality to the force.

Commercial Potential: There is considerable application for commercial use of this technology in the petroleum industry.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N94-004 TITLE: Increased Data Throughput on UHF SATCOM

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Develop new modulation and encoding methods to increase the user data throughput on 5 Khz bandwidth and 25 Khz bandwidth Ultra High Frequency (UHF) Satellite Communications (SATCOM) channels.

DESCRIPTION: The Navy currently uses two types of UHF SATCOM channels, 5 Khz bandwidth and 25 Khz bandwidth, with a maximum data throughput of 3,000 symbols per second (sps) and 32,000 sps, respectively. Given the ever increasing demand on satellite communications and the limited number of satellites and satellites channels, improving this data throughput by implementing more robust modulation and encoding methods offers a cost-effective approach for significantly improving UHF SATCOM DAMA and Non-DAMA capacity.

Phase I: Develop the basics of a modulation and encoding method to double the current data throughput rates on both 5 Khz bandwidth and 25 Khz bandwidth UHF SATCOM DAMA and Non-DAMA channels. The

modulation and encoding method must operate within the power and bandwidth constraints of the UHF Follow-On (UFO) satellites and existing Navy UHF SATCOM Terminal equipment.

Phase II: Develop, test and operationally demonstrate a UHF SATCOM modem which implements the encoding methods formulated under the Phase I SBIR effort. The modem shall be operable at both 5 Khz bandwidth and 25 Khz bandwidth UHF SATCOM channels. The modem shall be of a modular, open-architecture design to facilitate upgrades (e.g., integrating an enhanced DAMA protocol over the higher data rate channel) and integration into the Navy's Copernicus TADIXS communications architecture.

Phase III: Produce a UHF SATCOM modem that implements the encoding methods demonstrated in the Phase II SBIR effort.

Commercial Potential: New methodology can be used on narrow band width limited communications links.

N94-005 TITLE: Receiver Performance Improvements

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Explore the possibility of using front end signal processing techniques to improve the performance of existing Ultra High Frequency satellite communications.

DESCRIPTION: To increase the data rate and reduce the error rate of existing Ultra High Frequency satellite channels requires either more transmitted power or larger antennas. It is too expensive to increase the transmit power of satellites and in many application it is physically difficult to increase the size of antennas. The contractor should explore the possibility of using front end signal processing techniques to improve receiver performance in the presence of both random noise and interfering signal.

Phase I: Investigate existing satellite communication systems to determine how receiver performance in the actual environment is affecting communication quality. Explore the feasibility of using signal processing techniques to improve receiver performance.

Phase II: Develop a prototype receiver and perform testing over actual satellite systems.

Phase III: Develop a production model of receiver and support a joint service effort to produce a military standard for the incorporation of the improvements within existing satellite communication systems.

Commercial Potential: New techniques could be applied to communications links to increase data throughput deficiencies.

N94-006 Title: Near Field Transient Adaptive Beamforming

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: Design, Develop and Demonstrate an Adaptive Beamformer Optimized for Detection of Near Field Short Duration Signals.

DESCRIPTION: The traditional Navy threat was nuclear powered submarines operating in deep water. Existing beamformers are optimized to operate in this environment providing large array gains against plane wave arrivals of long duration signals. as a result these beamformers suffer severe performance degradation against near field non-plane wave signals having a relatively short duration which are more representative of signals from diesel/electric submarines operating in shallow water. A new generation of beamformers must be designed which provide array gain and directional noise rejection against intentionally and unintentionally emitted short duration, near field signals.

Phase I: Design and model a near-field Transient Adaptive Beamformer (TABF). Modeling must demonstrate an array gain improvement over existing beamformer approaches on short duration signals. The deliverable is a preliminary design document that includes the results of the modeling efforts.

Phase II: Modify the model to process government furnished ocean data and demonstrate array gain against near-field transient signals. Design a real time implementation of the transient adaptive beamformer. Deliverable products are a demonstration of TABF showing improvements of array gain and a design document for the real time TABF processor.

Phase III: Develop a real time transient adaptive beamformer and demonstrate the processor at a Navy installation for transition to ADS. Expected commercialization of the development for oil exploration may warrant a Cooperative Research and Development Agreement (CRDA) with a Navy laboratory.

Commercial Potential: The technology has application in the private sector in oil exploration and three dimensional phased radars for air traffic control.

N94-007TITLE: Realtime Recording

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: To provide a state-of-the-art, low-cost data recording capability for Sea Range realtime data.

DESCRIPTION: Develop a PC-based realtime recording capability that would allow realtime recording at a sustained data rate of 3-5 Mbytes/second while supporting simultaneous non-realtime reading of the realtime data at a sustained rate of 1-2 Mbytes/second. The purpose is to allow near-realtime processing of realtime telemetry and TSPI (radar) data for quick-look and quick-turnaround data packages. System should be low-cost and based on commercial technology (e.g. Pcs or low-cost UNIX workstations, etc.).

Phase I: The contractor shall research the issues and the available technology. The contractor shall then design and submit a proposed solution specifying the technology to be utilized. The contractor will provide cost estimates for the final product.

Phase II: The contractor will, after approval of phase I, develop, test, and document one PC-based realtime recording device. He shall then thoroughly test the device and measure the exact performance capabilities. He shall then demonstrate the device to the government and provide the device to the government for further government testing and evaluation.

Phase III: The contractor shall provide additional units to the government if the results of phase II determine the device to be useful and cost effective to the government.

Commercial Potential: The realtime recording capability is a technological capability that could be marketed to any customer requiring simultaneous writing and reading of large amounts of data. It might be used in highway traffic monitoring, air traffic control, water or power monitoring, and possibly dozens of other fields.

N94-008 TITLE: Wigner Transform Spectral Analysis

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: Develop and test algorithms for spectral analysis using the Wigner transform.

DESCRIPTION: Specific algorithms are sought for a discrete version of the Wigner Transform suitable for signal detection and analysis. The Wigner transform yields excellent time-frequency resolution if only one frequency component is present. For instance, the Wigner transform of a linear FM chirp is a straight line on a time-frequency plot. However cross-terms result when more complex signals are transformed. Recently, some researchers have shown that these cross-terms can be separated and deleted if a signal is first expanded in terms of Gabor coefficients prior to the Wigner transform. However, the Gabor analysis coefficients, used in the Gabor expansion, are not unique. A recent paper outlines a method to optimally compute the Gabor coefficients but does not offer a specific procedure. Algorithms are required to efficiently compute the Gabor coefficients and the Wigner transform. These algorithms must be tested against a variety of non-stationary signals such as PSK and FSK.

Phase I: Develop theoretical foundation for proposed algorithms. Define algorithms and test their performance against a range of signal types. Compare with conventional spectral analysis techniques. Fully document results.

Phase II: Implement algorithms on PC compatible DSP board, test and demonstrate.

Phase III: A prototype manufacturing product in the form of a signal frequency processor for test equipment use.

Commercial Potential: General purpose high-performance spectral analysis equipment.

N94-009TITLE: Application of Coherent Measurement Methodology to Shielding Effectiveness Measurements

CATEGORY: Research; Materials

OBJECTIVE: Extrapolate and apply current coherent measurement techniques to problems associated with Shielding Effectiveness (SE) measurements.

DESCRIPTION: The Navy is looking for a proposal where coherent measurements are used to develop a SE test method where phase as well as magnitude information is retained from the measurement.

Phase I: During the Phase I effort, a theoretical basis should be established such that using the scattering parameter information associated with the method, on can calculate the SE of large objects as both a function of frequency and wave impedance. The theoretical statistical analysis also would be accomplished during the Phase I effort in order to determine the repeatability of this method.

Phase II: Perform SE tests using the aforementioned test method in order to determine inter-compartmental SE as a function of both wave impedance and frequency. This data then will be compared head-to-head with data using the methods described in IEEE 299, MIL-STD-285 in NSA Standard 65-6. If successful, the method developed in Phase I and demonstrated in Phase II will form the basis for a next-generation SE standard.

Phase III: Transition the test method for new architectural shielding designs where composites are used for shielding effectiveness.

Commercial Potential: The techniques developed will have wide applicability in the design of composite materials such as Glass Reinforced Plastics (GRP) and conductive impregnated paper, in the construction and testing of shielded facilities and other structures, and in medical technology such as magnetic resonance imaging.

N94-010TITLE: Surveillance of Buried Command and Control Centers

CATEGORY: Exploratory Development; Simulation and Modeling

OBJECTIVE: To determine types of sensing that could be used to detect, survey, and monitor activities used to establish and operate buried command, control, communications, computers and intelligence (C^4I) facilities.

DESCRIPTION: A large numbers of countries are using deep underground command centers. The construction, activation, and operation of these centers are well concealed. The question to be answered is whether sophisticated sensing systems, such as acoustics, unmanned ground sensors, lasers, chemical detectors, etc. can be used to support targeting, mission planning, weapons research and development, and intelligence collection.

Phase I: At the end of six months, a concept study should be completed. The study should address the types of sensors that have capabilities to support this surveillance need; an approach to how the sensors would be deployed; how many sensors would be needed per specific sized area; and how the sensors would communicate their data/information to collection centers for analysis and reporting.

Phase II: At the end of two years, an in-depth concept study should be completed that validates the approach and applicable sensor types through use of models and simulations to determine accurate estimates of sensor performance, concept of operations, and cuing data and information transfer capabilities. The final step in Phase II is development of a test plan to validate or discredit the approach and sensors identified in the study. The

plan should also show the sensitivity to sensor selection, topography, soil and environmental conditions, and communications.

Phase III: Conduct a ground test that demonstrates successfully the sensor systems and approach validated in the Phase II study.

Commercial Potential: Many commercial applications exist for this type of technology from development of highly sensitive sensors able to determine the adverse heath risk if any from prolonged exposure to various levels of electromagnetic radiation, to sensors supporting recovery of people buried in ruble during mine disasters, terrorist bombings or earthquakes.

N94-011TITLE: Advanced Systems and Technologies for Future Naval Warfare

CATEGORY: Exploratory Development; Communications, Sensors

OBJECTIVE: Enhance Navy's future warfare capabilities in C4I, and wide area surveillance with emphasis in undersea and space-based surveillance sensors.

DESCRIPTION: Navy is seeking new, innovative, high risk/payoff ideas in technologies and/or advanced systems concepts that support the Navy's mission in the years 2000 and beyond. Ideas are required to enhance and solve technology problems detailed in the objective statement.

Phase I: At the end of the six month effort, work should have demonstrated the feasiblity of a system concept or technology, identified critical subsystems or technologies that must be matured for transition into the Navy's acquistion system. Work must also be performed in preparation for a Phase II effort to demonstrate technical feasibility and increase the potential of the technology or systems concept to transition.

Phase II: At the end of a two year effort, the technology or systems concept must have been developed enough to bring critical subsystems or technologies for transition to maturity. Sufficient work must be completed to enable the technology to transition to an advanced technology demonstration, or into a higher category RDT&E, or become the basis for a concept for Navy applications.

Phase III: A Navy Phase III effort is anticipated.

Commercial Potential: The products identified to enhance Navy's warfare capabilties will find commercial applications in communications (radio, television, telephones), environmental monitoring and fishing.

N94-012TITLE: Bioluminescence Test Bed

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Research is required to explore the feasibility of using naturally occurring, waterborne, bioluminescence phenomena for potential military and civilian applications in areas of harbor security and sensor systems.

DESCRIPTION: Vieques harbors contain plankton and other biological material which emits light when it is disturbed by objects moving through the water such as a boat or a swimmer. Establishing Vieques harbor as an experimental test bed may reveal potential military and civilian applications for this phenomena. A methodology could be developed to measure the emitted light intensity in relationship to the size, velocity, and location of the disturbance. As a result, the phenomena could be most useful in the areas of harbor security, such as detecting a terrorist diver in the process of planting a bomb. Since the phenomena is naturally occurring, it would be impossible to disable it as is the case of conventional security systems.

Local universities have been working on the phenomena for the past several years.

Phase I: In conjunction with knowledgeable institutions, prepare engineering analysis to determine concept feasibility and develop an engineering model for the test bed and potential applications to be tested.

Phase II: Using results of Phase I, test potential applications, analyze results and prepare report.

Phase III: Depending on the results of Phases I and II, implement applications by military and civilian users.

Commercial Potential: Security systems for installation in harbors or their bodies of water will detect, and therefore protect, ships and water-side facilities from illegal access, i.e., terrorists, criminals.

NAVAL SUPPLY SYSTEMS COMMAND

N94-013TITLE: Deterioration Sensors on Hazardous Material Containers

CATEGORY: Exploratory Development; Environmental Quality

OBJECTIVE: Reduce hazardous waste generation and requirements for new hazardous material acquisition.

DESCRIPTION: Approximately 80% of the hazardous material turned in for disposal by the Navy is unused and in its original packaging. Much of this material is being turned in simply because assigned shelf-life periods have expired. A study conducted by the Navy during 1992 showed that many assigned shelf-life periods bear little relationship to the true deterioration characteristics of hazardous material or its packaging and that the true life of the material considerably longer than assigned shelf-life codes indicate. This leads to the conclusion that shelf-life periods are artificial and much of the Navy's hazardous waste generation would be avoided if users of hazardous material had a simple way to tell whether or not their on-hand material was still good. One way to do this would be to develop sensors that detect hazardous material deterioration and put the readouts for the sensors on the exterior of all hazardous material containers. With such sensors, users would use their material until the sensor indicated that the material was no longer usable. Artificial shelf-life periods would no longer force material into premature disposal.

Phase I: Develop/justify concept.

Phase II: Coordinate with manufacturers of high volume materials and develop, test and demonstrate standard sensor systems for hazardous material containers.

Phase III: Develop training system to introduce government personnel to the new sensors. Be prepared to defend validity of the sensors within DOD logistical and engineering communities.

Commercial Potential: Extensive...all users of HM in government and industry will benefit. Sensors will reduce laboratory costs, requirements for new purchases, and hazardous waste volume.

NAVAL AIR SYSTEMS COMMAND

N94-014 TITLE: Optical Amplifiers for Airborne Applications

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Development and packaging of optical amplifiers for airborne applications.

DESCRIPTION: The ability to implement optical networks and sensors in aircraft has been impaired by the large optical attenuation incurred when a large number of in-line connectors must be used and the system must operate over environmental extremes. The telecommunications industry has shown the potential benefits of optical amplification and is planning implementation of transcontinental undersea links using this technology. Optical amplification can be achieved through the use of rare earth doped optical fibers (or rods) which are pumped with semiconductor light sources or through the use of stimulated emission in semiconductor materials. It is therefore the intent of this solicitation to develop optical amplifiers utilizing the above mentioned or alternative technical approaches. The amplifiers must be capable of operation in severe avionic applications. The proposed approach should emphasize low cost, weights and size and have the ability to survive the temperature, shock and vibration of a high performance aircraft. Since the length of fibers on aircraft is relatively short, the gain of these amplifiers may

not necessarily be as high as that of typical telecommunication amplifiers. The design should emphasize low noise performance and suitability for both analog and digital applications. Optical amplifiers operating in the 850, 1300, and 1500 nanometer wavelengths are desired with the specific technical approach keyed to a particular wavelength.

Phase I: Detailed design concept and definition of a preferred packaging approach.

Phase II: Amplifier fabrication, test and performance evaluation in a rugged package suitable for use on high performance aircraft.

Phase III: Transition of the delivered hardware into a demonstration network to show the performance benefits.

Commercial Potential: Applicable to all networks where high reliability and survivability is of prime importance such as commercial aviation, factory automation, medical imaging and telecommunications networks.

N94-015TITLE: A Real-Time Fiber Optic Network for "Fly-By-Light" and Vehicle Management Systems (VMS) Applications

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Design, fabricate, and test the digital interface for a real-time fly-by-light network

DESCRIPTION: There is a need for development of a real-time deterministic and fault tolerant network for fly-by-light control systems which has growth capability for future system enhancements. A commercial standard for such a bus has been developed and is designated as Society of Automotive Engineer (SAE) Standard AS4075, High Speed Ring Bus Standard. The commercial fiber distributed data interface (FDDI) standard American National Standard Institute (ANSI) X3T9.5 has also been suggested for real-time applications although this protocol was not specifically designed for such applications. Alternative high speed network protocols are also being developed commercially which might be utilized in real time flight critical applications. The purpose of this program is therefore to characterized and validate the real-time behavior determinism, reliability, and survivability of an optimum bus protocol and associated fiber optic network topology leading to development of flight-qualified hardware for "fly-by-light" applications.

Phase I: Detailed trade study comparing the AS4075, X3T9.5, and alternative high speed protocols for real-time control applications. The trade study should specifically address the features of each bus protocol standard including, but not limited to, data rates, critical timing delays and determinism. The network topology options should also be analyzed with respect to data integrity and fault isolation and circumvention. The built-in-test capability of the networks should also be analyzed and an optical power budget for multi-terminal networks shall be performed. Based on the above analysis, computer modeling tools shall be utilized to arrive at an optimum design of a real time network for aircraft flight-critical applications.

Phase II: Computer modeling tools shall be used to design and optimize breadboard model of a multi-terminal high speed ring bus for flight critical applications based on the above analysis. In the event that commercial chipsets are not utilized, Very High Speed Integrated Circuit Hardware Description Language (VHDL) tools will be used to perform circuit design and to generate test vectors to ensure compliance with the standard. The necessary circuit design for control of the physical layer should also be included complete with an investigation of available optical hardware including transmitter,s receivers, switches, couplers and fiber cables. A complete design package which can be reduced to a standard electronic module format E (SEM-E) modular implementation shall also be produced.

Phase III: Transition of the selected design to flight-worthy hardware and into a demonstration program to show the performance benefits.

Commercial Potential: Applicable to all networks where high reliability and survivability is of prime importance such as commercial aviation, factory automation, medical imaging and command-and-control networks.

N94-016TITLE: Monolithic Switched Photodiode Arrays and Receivers for High Speed Fiber Optic Networks and Optical Neural Networks

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Design and fabrication of monolithic photodiode array including receiving and switch circuitry for communication and neural networks.

DESCRIPTION: Advanced fiber optic communications and computer networks utilize PIN photodiodes and low noise receiver circuitry to convert optical signals to electrical form for use by the network nodes. In order to provide fault tolerance in a network, it is highly desirable to accommodate a multiplicity of fiber optic input lines into a terminal with the ability to switch the most desirable input signal or signals to the receiver circuit(s) with minimal time delay based on the amplitude of the input signals. The use of an array of PIN photodiodes with a switchable bias voltage applied to individual array elements can perform such a function. A monolithic chip implementation of such a switchable array complete with an amplitude detection and threshold circuits, low noise receivers, and decision logic can dramatically reduce the cost of such circuitry. These monolithic circuits can also be used for electro-optic crossbar switches. The addition of optical circuitry to sum the input signals from the photodiodes prior to thresholding can make such an array useful in optical neural networks. It is desirable for these circuits to operate in the 850 nanometer optical wavelength for silicon compatibility. Alternative materials implementation in the 1300 and 1500 nanometer optical wavelengths is also highly desirable to accommodate the loss minima in optical fibers.

Phase I: Circuit analysis and design with computer aided tools with detailed packaging analysis and design to accommodate an array of input fibers in a hermetic package.

Phase II: Circuit fabrication, test and performance evaluation in a hermetically sealed package.

Phase III: Transition of the delivered hardware into a highly survivable demonstration network to show the benefits.

Commercial Potential: Applicable to all networks where high reliability and survivability is of prime importance such as commercial aviation, factory automation, medical imaging and telecommunications networks.

N94-017TITLE: Low-cost Fault Tolerant Flight Controls for UAVs

CATEGORY: Exploratory Development; Software

OBJECTIVE: Develop low-cost solutions for providing fault-tolerant flight control systems for unmanned aircraft and other vehicles. Systems that rely on software, rather than redundant hardware systems, are particularly desired.

DESCRIPTION: Teleoperated and autonomous unmanned systems require provisions for fault detection and handling. Multiply-redundant schemes typically used in aerospace applications are prohibitively expensive for general application, especially where low cost or small size are critical.

New control strategies are sought which offer the potential for low-cost fault-tolerant control of parameter systems that will be applicable to a wide range of air, marine, or ground vehicles. For example, a "monitoring observer", or failure detection filter, could run a real-time simulation of the controlled system in parallel with the actual system, compare outputs of the two systems, and appropriately interpret discrepancies to detect system faults or failures. The system would then be reconfigured to operate on a reduced sensor or actuator set. Both the failure detection and control reconfiguring would take into account the parameter dependent nature of the system.

Phase I: Develop the concept and algorithms, primarily through computer-based simulation. Lab demonstrations, if not already available, should be provided in this phase.

Phase II: Provide a flight demonstration using an existing UAV and "simulated" faults in sensors or actuators. Contractor should state which UAV will be used and give a full explanation of how flight safety will be maintained.

Phase III: Develop and utilize the system in operational unmanned vehicles, and diffuse into other applications.

Commercial Potential: Fault-tolerant systems of the type envisioned here will have a wide variety of applications in (a) military, scientific and commercial unmanned aircraft, (b) commercial aircraft, and (c) advanced ground vehicles, such as the Intelligent Vehicle Highway System (IVHS).

N94-018TITLE: Vertical Cavity Surface Emitting Laser Packaging for Avionics Applications

CATEGORY: Advanced Development; Communications Networks

OBJECTIVE: Design, develop and fabricate optical packaging concept for vertical cavity surface emitting laser capable of operation in avionic environments.

DESCRIPTION: Vertical cavity surface emitting lasers have unique properties which make them potentially attractive for avionics applications. The devices require low threshold currents and emit in a circular output beam pattern, and can operate over military temperature ranges without the need for thermoelectric coolers. There is a need to develop a packaging concept for these lasers which would make the devices suitable for avionics applications. The package should provide a hermetic seal for the enclosed devices as well as an optimum thermal transfer path for the devices to assure reliable operation. The package should provide the necessary optical elements to couple the optical output very efficiently to an array of optical fibers. All required electronics should be contained in the array package with an efficient bonding method for the enclosed devices. An optimized method for attaching the package to both ceramic and or silicon substrates as well as printed circuit cards shall be explored.

Phase I: Detailed analysis of all optical, electrical, mechanical and thermal properties of the selected surface emitting laser arrays to optimize a packaging concept. The package should be modular in design to accommodate arrays with a diverse number of elements. Thus the package should be expandable from a single laser to a linear array and finally to a two dimensional array if possible. All optical elements shall be analyzed including discreet lenses or lenslet arrays. Sealing and bonding methods shall be investigated to assure automation to achieve low cost. Analysis shall be made with respect to typical avionic environments. A final design package including a CAD/CAM design package will be delivered.

Phase II: Fabrication and demonstration of a prototype package in accordance with the above selected design. Detailed manufacturing and assembly techniques will be explored and documented to achieve high volume low cost production. All materials options will be investigated and implemented to achieve an optimum package. Delivery of prototype packaged devices to validate the optical, mechanical, electrical and thermal properties. Demonstration of the coupling to optical fiber arrays as well as the attachment methods to substrates and circuit boards will be required. A complete design package which can be applicable to a standard electronic module format E (SEM-E) modular implementation shall also be produced.

Phase III: Transition of the selected design to flight-worthy hardware and into a demonstration program to show the performance benefits.

Commercial Potential: Applicable to fiber optic networks or optical computing where high reliability and survivability is of prime importance such as commercial aviation, factory automation, medical imaging and automotive applications.

N94-019TITLE: Finding Cracks Underneath Coatings On Ferromagnetic Metals

CATEGORY: Advanced Development: Materials and Processes

OBJECTIVE: Develop nondestructive inspection (NDI) techniques enabling detection of circumferential cracks beneath electroplated nickel or chrome on ferromagnetic substrate materials.

DESCRIPTION: Currently magnetic particle inspecting cannot be performed with coatings in place that could prevent the detection of surface defects in a ferromagnetic substrate. Normally such coatings include paint or metal plating greater than 0.08 mm (0.003 inch) in thickness or ferromagnetic coatings such as electroplated nickel greater than 0.03 mm (0.001 inch) in thickness. A number of engine and landing gear components have failed due to the

inability of magnetic particle inspection to detect circumferential cracks and machine grindings that led to stress cracks beneath these coatings. The barkhausen noise measurement method shows promise towards the evaluation of stress related phenomenon in metals. Additionally, this method has proven to be useful in the evaluation of various processing steps.

Phase I: Identify and demonstrate the feasibility of barkhausen noise process control. Preliminary testing shall focus on provisions for measuring or monitoring process parameters.

Phase II: Process control shall be developed and thoroughly evaluated by the contractor. The primary goal shall be the evaluation of stress related defects location under the various coatings proposed. The design, development, and testing of a prototype unit shall be accomplished.

Phase III: Once prototyped and certified, the test unit shall be made available for Navy and commercial or other use.

Commercial Potential: This NDI process has application in the commercial maintenance industry, aerospace and automotive.

N94-020TITLE: Near IR Absorbing Pigments

CATEGORY: Advanced Development; Materials and Processes

OBJECTIVE: To develop pigments for use in white paint or in fluorescent lamps that absorb near infrared (rear IR) emissions.

DESCRIPTION: In order to achieve good red color in night vision imaging systems (NVIS), compatible displays filter elements must be added to reduce light emissions in the near IR wavelengths. Because of the sensitivity of night vision goggles in red light, NVIS compatibility of full color displays is very difficult to achieve. This would be significantly reduced if near IR absorptive mechanisms were present in the backlighting module. Since most of the surface area in a backlighting module is coated with a highly reflective white paint, an ideal mechanism would be near IR absorbing pigment that could be added to a white paint with little or no loss of reflectance. A similar pigment mixed with the lamp phosphor of the fluorescent lamps used to backlight LCDs could also have a large impact.

A more efficient mechanism would be through the development of a so-called "anti-stokes" phosphor. This phosphor would absorb two or more photons, include at least one undesirable near IR photon, then release energy in a more energetic visible wavelength. Near IR spectral scans of typical fluorescent lamps would identify the near IR line emission(s) to be absorbed by this phosphor.

Phase I: A study will be performed to identify existing materials and explore the feasibility of developing new materials. A report will describe these materials, describe the difficulties in developing them, calculate the reduction of near IR emissions that could be achieved as well as their impact on system efficiency, and propose a development program.

Phase II: A development program will be completed. Sample pigments, paints, and fluorescent lamps will be fabricated and tested.

Phase III: Integrate into future aircraft production as recommended.

Commercial Potential: This is a "dual use" topic. Requirement exists in the private sector in photography and in the law enforcement area.

N94-021TITLE: Development of a Durable Anti-Reflective Coating Suitable for Application to a Complex Surface

CATEGORY: Advanced Development; Materials and Processes

OBJECTIVE: Develop an anti-reflective coating that can be applied economically to complex curved surfaces of silica glass, stretched acrylic and polycarbonate windows. The anti-reflective properties should be tuned for

maximum effect in the visible and near IR wavelengths. The anti-reflective coating should not cause significant optical distortion, or radiant attenuation over the operating range. The coating should be durable enough to withstand repeated cleaning over the service life of the application. If re-application is required, the methods should not be cost- prohibitive. The anti-reflective coating should also be low maintenance so as not to require special materials or techniques to clean.

DESCRIPTION: As aircraft cockpits modernize with electronic displays and automobile interiors look more like aircraft, the need for a durable anti-reflective coating will increase industry-wide. Also, digital electronic color displays provide a tremendous capability in all types of displays. The displays, however, cause a very disagreeable reflection on the interior surfaces of windscreens, canopies and windshields. In some cases the reflections make viewing impossible. At present, there are anti-reflective coatings on the market. However, there are no coatings durable enough for commercial or military applications on complex curved surfaces like windscreens, canopies and the "new" styled auto windshields.

Phase I: A study will be performed to identify existing anti-reflective coatings and explore the feasibility of developing new coatings. A report will describe these materials, describe the application methods, and difficulties involved with their use. The results achieved by the anti-reflective coating will also be provided in the final report.

Phase II: A development program will be completed. Sample coatings will be tested and the results documented.

Phase III: Integrate into future aircraft as recommended.

Commercial Potential: This is a "dual use" topic. The commercial potential for this technology would be automobile windows, as well as commercial and military applications. In addition, the use of this technology in commercial observation points like lounges and restaurants, with a curved window where the ambient light levels are higher at the inner surface, would be beneficial.

N94-022TITLE: Small/lightweight Electric Vertical Take-off and Landing (VTOL) Unmanned Aerial Vehicle (UAV)

CATEGORY: Exploratory Development; Software

OBJECTIVE: To perform a feasibility study necessary to characterize a small/lightweight electric VTOL UAV.

DESCRIPTION: A small, lightweight (less than 30 lbs) electric VTOL UAV with an imagery payload would be very cost effective for performing reconnaissance and surveillance missions of about one hour. Such a system could be launched from anywhere and thus be independent of the need for takeoff and landing space. Electric power would simplify logistics by eliminating the need for liquid fuels and would also provide a system that was extremely quiet. Low cost would allow the system to be considered expendable in certain missions.

Military applications include: (1) Army land forces -Detect targets at short ranges, i.e. , over the next hill. (2) Naval amphibious forces - Conduct beach and surrounding area surveillance prior to assault. (3) Air Force - Survey air fields for damage, indications of intrusion, or terrorist activities.

Phase I: Phase I would generate conceptual designs which would be validated through analysis and simulation.

Phase II: Phase II would consist of fabrication and integration of the ELECTRIC VTOL UAV proof of concept.

Phase III: Phase III would plan to design and build demonstration air vehicle as well as pursue Navy and commercial application of the electric VTOL UAV via demonstration.

Commercial Potential: There are numerous para-military and commercial applications for small, lightweight VTOL UAVs, examples of uses include: monitor traffic, assist in search and rescue operations, assist in urban riot control, survey hazardous waste sites, monitor fish and game movement, detect forest fires, detect oil spills, assist in mapping and mineral/oil exploration, and monitor suspected drug or other criminal activity at specific locations.

N94-023TITLE: Virtual Simulation for Terminally-Guided Weapons

CATEGORY: Advanced Development; Training Devices

OBJECTIVES: Improve the procedural weapon skills of the tactical strike aircrew through the injection of virtual reality (VR) technology and techniques into either existing and/or new training devices.

DESCRIPTION: Establishing proficiency with terminal guidance skills for the man-in-the-loop air-to-ground weapons used by the Strike community has been difficult with current training devices. In employing these weapons, the AGM-84E Standoff Land Attack Missile (SLAM) and the AGM-62 TV Walleye, the operator steers the weapon to the target using infrared and television guidance, respectively, and a hands-on slew stick. Simulating this process in a two-dimensional space, as observed in present part-task training devices, provides little operator realism. Using a three-dimensional display and employing concepts of virtual reality, the operator's point of view can be placed either in the cockpit or in the seeker head of the weapon, at his option. This will enable the operator to improve his timing and performance by acquiring a better understanding and "feel" for the weapon's response to the slew stick.

Phase I: Examine a number of design approaches for injecting the virtual representation of the SLAM and Walleye missiles into the a Navy trainer. Determine the feasibility of the best approach.

Phase II: Develop a "virtual world" representation for SLAM and Walleye terminal guidance and specify any dedicated hardware and/or peripherals, such as a helmet-mounted display, and their interface required for installation into the trainer selected in Phase I. Develop a prototype, using this trainer as a testbed. The Navy will be responsible for testing and validation.

Phase III: Install the software and any required hardware into the Navy trainer used in Phases I and II. Potential exists for converting these products for use with Air Force and Army trainers as well.

Commercial Potential: Direct application for use in video games, recreational simulations, computer-based training, and entertainment devices.

N94-024TITLE: Secondary Sensor for High Speed Anti-Radiation Missile(HARM)

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Devise a sensor for targeting critical ground-based radar components that does not rely on electro-magnetic (EM) emission from targets.

DESCRIPTION: HARM missiles home on a radiating electro-magnetic source and are especially effective as a defense suppression weapon. However, when the threat EM source is shut off for countermeasure purposes or fails to radiate during pre-emptive launch, the HARM must maintain course without additional guidance information from the radiating source. Several incidents during Operation Desert Storm highlight the lack of ARM's ability to identify and guide toward a selected/specified target in a "shutdown" environment. In order to significantly increase the probability of kill (Pk) and reduce the probability of fratricide, a secondary sensor is needed to supply guidance information during the terminal flight phase. Novel proposals are sought for a secondary sensor that will also provide an aimpoint select capability and address the need for Battle Damage Assessment. Contractors should consider sensor and guidance candidates that are compatible with the current HARM airframe.

Phase I: Perform an investigative study of the proposed secondary sensor system that provides proof-of-concept using computer simulations and models and/or a partial breadboard system.

Phase II: Construct a brassboard system that demonstrates critical elements of the sensor concept and prepare a documentation package that is suitable for taking the concept to Advanced Development. Conduct studies validating the performance of the proposed system.

Phase III: Advanced Development -- Develop prototype missile systems to undergo laboratory, field, environmental, captive flight and free flight test and evaluation that validates the concept. Prepare a documentation package that is suitable for taking the concept to Engineering Manufacturing Development.

Commercial Potential: Secondary sensor technology can potentially apply to vehicular or site identification and image processing in law enforcement and drug interdiction initiatives.

NAVAL TRAINING SYSTEMS CENTER

N94-025TITLE: Portable 3D Data Acquisition Technology for Computer Image Generation (CIG) Visual Databases

CATEGORY: Advanced Development; Modeling and Simulation

OBJECTIVE: Develop a portable system for capturing surface/low altitude 3D data for use in visual systems.

DESCRIPTION: Realistic visual systems use geometric shapes and texture to portray oceans, navigational cues in ports, and terrain. New technology is available for potential use in capturing and manipulating the data to convey the detail needed for effective training. This technology includes digital cameras, GPS receivers and CIG work stations which capture geometric shapes and textures.

Phase I: Develop a work plan for Phase II development of an integrated Data Acquisition System incorporating portable video and photographic devices for surface/low altitude 3D data acquisition of geometry and texture.

Phase II: Develop, demonstrate and evaluate a prototype portable 3D Data Acquisition System by developing ship handling and aircraft visual databases using data acquired from shipboard, surface vehicles, helicopters and low altitude aircraft.

Phase III: Produce commercial product based on the prototype.

Commercial Potential: Commercial simulators with visual systems (navigation training, entertainment, medicine).

N94-026TITLE: Special Effects for Ocean Computer Image Generation (CIG) Visual Simulation

CATEGORY: Advanced Development; Ocean Science

OBJECTIVE: Develop low cost simulation of certain dynamic ocean effects.

DESCRIPTION: Simulations of certain ocean effects (whitecaps, foam, spray from the bow of a ship as it goes through water) are not currently available on existing commercial or military simulators. These effects present cues for landing helicopters. This task will develop the simulation of special effects for dynamic ocean simulation using the latest low cost CIG workstation capabilities.

Phase I: Survey existing commercial/military ocean effects databases; identify the special effects to be simulated and define the characteristics of the databases to be developed in Phase II.

Phase II: Develop and evaluate prototype databases to demonstrate the special effects using the latest texture and low cost CIG workstation capabilities.

Phase III: Produce commercial database applications as products based on the low cost prototype (less than $15k).

Commercial Potential: Commercial simulators for both military and civilian training and possibly entertainment applications.

N94-027TITLE: Low Cost, PC-Based Navigational Skills, ATC and Crew Coordination Training Tool

CATEGORY: Advanced Development; Training Devices

OBJECTIVE: Develop a PC-Based Crew Coordination and Navigational Skills training tool that could be used for aviator training.

DESCRIPTION: Aviators do not have enough opportunity to practice navigation and crew coordination skills in actual aircraft or simulators. A PC-Based training aid would provide an opportunity for practice when deployed away from conventional training sites. In addition to piloting an aircraft, maintaining proficiency in the combined task of following ATC instructions, navigation, and crew coordination can be difficult. The PC-Based simulation would have a simulated ATC and other voice traffic that the pilot would have to listen and follow. In addition, several systems could be networked together to provide a total system for the additional feature of crew coordination training. The system will consist of a low fidelity flight simulation system with a database with user definable attributes that could be used with actual air charts. Also, to be included, development tools to allow the user to create simulated radio traffic. The system should include representative flight models, user definable weather conditions, and software tools to provide an analysis of the training session. The use of existing software and hardware is encouraged. Low cost flight controls that may add to the fidelity training environment are not required but are encouraged and, if provided, should be representative of actual flight controls (yoke, stick, collective, etc.).

Phase I: Examine the current technology base for applicable products. Develop a system that would be an effective Navigational/ATC/Crew Coordination training tool.

Phase II: Design and construct a prototype Navigational/ATC/Crew Coordination training tool.

Phase III: Demonstrate, evaluate, and commercialize the training tool in both military and commercial aviation communities.

Commercial Potential: Interest in this tool has been expressed by both the civilian and military aviation training communities.

N94-028TITLE: Low-Cost Real-Time Stereoscopic Multiplanar Display Development for Future Navy Battle Management Training Systems

CATEGORY: Advanced Development; Training Devices

OBJECTIVE: Develop a prototype for a low-cost Battle Management System which utilizes a stereoscopic Multiplanar display to create true three-dimensional training scenes in real-time (update of 30 frames per second). The display subsystem must create a true real-time three-dimensional image which occupies a volume and can be viewed from all sides by several people.

DESCRIPTION: Most current Navy Battle Management Training Systems utilize terrain boards of two-dimensional graphics to simulate three-dimensional scenes for modeling geographic areas. Terrain boards lack simulation of time of day, atmospheric effects, and special cues. Two-dimensional graphics lack true parallax motion cues that real-world images give. These limitations can be overcome by generating a true three-dimensional simulated scene. The Battle Management System must meet the following requirements:

- Full color
- Air/ground operation station
- Minimum update rate of 30 Hz
- Rapid database loading
- Interface with IOS
- Image made within 3-D space
- Terrain and Feature modification capability
- Terrain and Features database derived from DTED and DFAD
- Atmospheric effects simulation
- Special effects simulation
- Multiperson off-angle viewing
- Time of day (day, dusk, night)
- No eyeglasses for viewing optics
- Moving model simulation

Two-dimensional PC or workstation displays which give the illusion of three dimensions (perspective drawing) are not permitted. Stereo-pair displays which require special eyeglasses or optics to produce virtual images are not permitted because ten percent of the population cannot fuse images and off-angle viewing is very limited. Holographic displays are not permitted because their characteristics change with viewing angle and the images

cannot be updated in real-time. Successful completion of this effort will result in low-cost three-dimensional display technology.

Phase I: Perform and finalize preliminary concept design.

Phase II: Construct a prototype which will be available for testing in Marine Corps training facilities.

Phase III: Transition to battle management, air traffic control, and medical training applications; explore video game potential.

Commercial Potential: These simulations have commercial potential for video games and medical simulations (where real-time 3-D simulation is desirable)

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND

N94-029TITLE: Blocking Agents for Human Blood Transfusion

CATEGORY: Exploratory Development; Biology and Medicine

OBJECTIVE: Develop antibody blocking reagents which will block a blood transfusion reaction in humans caused by giving mismatched blood to an incompatible recipient.

DESCRIPTION: ABO mismatched transfusion reactions are caused by the binding of naturally occurring anti-A or anti-B agglutinins present in the plasma of the recipient with the corresponding antigens on the surface of the donor erythrocytes. This binding leads to intravascular agglutination and hemolysis of the transfused erythrocytes, and these events lead to severe hypotension, shock, acute renal failure, hemorrhagic diathesis, and subsequent death of the recipient. Reagents are to be developed which will block the binding of the anti-A and anti-B antibodies to the erythrocyte antigens and thus prevent the destruction of the transfused red cells. If such reagents were available, then blood from any donor could be safely transfused into any recipient without fear of a subsequent transfusion reaction.

Phase I: Develop high affinity mouse monoclonal antibodies to A and B blood group antigens to be used as blocking reagents for A and B antigens on red blood cells.

Phase II: By genetic engineering, prepare cDNA clones of the heavy and light V regions for the anti-A and anti-B monoclonals to prepare short polypeptide variable region chains to be ligated to human constant region genes.

Phase III: By genetic engineering, ligate the variable region polypeptide H and L chains to H and L truncated human antibody constant region to prepare humanized blocking reagents to be transitioned to the Navy laboratories for testing in a SCID mouse model.

Commercial Potential: The blocking of transfusion reactions would have application in the private sector as well as in military medicine.

N94-030TITLE: Color Coding for CRT Displays

CATEGORY: Exploratory Development; Human-Systems Interfaces

OBJECTIVE: Develop a method for color coding self-luminous displays which is based on color science (i.e., the CIE system, color vision theories, fundamental data of color perception and physiological optics). The method should account for discrimination of color symbology in terms of symbol color (including luminance), symbol size, and surround color. Existing Navy and NATO symbology are of particular interest.

DESCRIPTION: Color science has provided methods with which to infer the conspicuousness and confusability of segments of color images, based on measurements of the light from the segments. Highly-discriminable color symbols may be engineered using these methods. Applicability of these methods is severely limited because practical symbols are smaller in subtense than the segment sizes upon which the methods are based. Symbols of realistic sizes are less discriminable than would be predicted based on these methods. In addition, the methods are

based on neutral gray surrounds for the segments. Colored surrounds alter the apparent color of the symbols in ways not contemplated by existing methods. A theoretical empirical approaches to these problems are ineffective because the combinations of surround color, symbol colors and symbol sizes are virtually limitless. A general approach, based on color science, is required to predict the effects of symbol and surround colors and symbol size on symbol discriminability. The effectiveness of the approach should be demonstrated using existing Navy and NATO symbologies.

Phase I: Develop a theoretical approach to design of color codes for self-luminous displays, accounting for symbol size, symbol color, surround color, and ambient light. Provide convincing data from a "laboratory demonstration" that the approach works.

Phase II: Demonstrate the method works with existing Navy and NATO symbology in the context of Navy ship and aircraft workstations.

Phase III: Participate in Cooperative Research and Development of a new workstation and symbology in the U.S. Department of Defense (preferably in the Navy). Apply the method to optimize the workstation symbology.

Commercial Potential: Commercial aircraft cockpit displays, automotive display symbologies, map design, situation displays, computer assisted design symbologies, arrival-departure type displays, process control displays, display of data, highlighting items in text, data-base browsing aids.

N94-031TITLE: Injury Preventing Helmet Servo-Support System for High Performance Aircraft

CATEGORY: Exploratory Development; Biology and Medicine

OBJECTIVE: To develop an aviator helmet-support that allows full pilot head movement and provides protective support during ejection.

DESCRIPTION: Aviator helmets not only protect the pilot's head but are used as platforms for additional systems such as night vision goggles, FLIR displays, HUD displays, laser protection devices, laser protection devices, earphones, visors, and so on. The end result of this proliferation is increased weight and a concomitant decrease in the pilot's ability to maneuver his head effectively, support the load without strain or eject without the inertial loading resulting in a neck injury. A great deal of effort has gone into reducing the weight on an aviator's helmet by reducing the weight of components but this approach is limited. Furthermore, as new technologies progress, there will be increased pressure to place more equipment on the helmet, not less. The solution is to support the helmet by means of mechanical servo mechanisms, thereby taking the weight of the helmet off the pilot and placing it onto the airframe. Proposers should include a preliminary design of a helmet-support system with their proposals.

Phase I: At the end of the six month effort the expected product is a set of detailed technical drawings of a prototype system to be fabricated in the following two years.

Phase II: Develop fully functioning prototype helmet-support system that works within the specifications described in the preceding objective and descriptive sections of this document.

Phase III: Refine the prototype system; prepare and deliver pre-production units

Commercial Potential: This technology has application in the robotics industry.

N94-032 TITLE: Genetic Constructs To Produce Rickettsial Antigens.

CATEGORY: Exploratory Development; Biology and Medicine

OBJECTIVE: Develop genetic constructs which are optimal for high level expression, proper folding state and rapid purification of recombinant antigens.

DESCRIPTION: Current methods for serodiagnosis of rickettsial diseases require antigens purified from infected yolk sacs or tissue culture cells. It is very expensive and hazardous to prepare large amounts of rickettsial antigens by present methods. Substitution of native antigens with recombinant antigens will revolutionize the serologic

diagnosis of rickettsial diseases. The genetic constructs of immunodominant genes should be designed with three criteria to permit 1) high level expression, 2) proper folding, and 3) rapid purification.

Phase I: Subclone genes for selected scrub typhus antigens from pBR322 to pUC, and evaluate expression of subcloned genes under strong promotor control.

Phase II: Express the subcloned genes to meet following criteria: the level of expression should be $\geq$ 5% of total protein; antigen should be properly folded to conserve antigenic sites; specific tag or fused protein should be added for affinity purification.

Phase III: This effort is needed for the refinement of the system to increase the level of expression, minimize proteolytic degradation, or change signal sequences to direct the cellular location of recombinant protein to further simplify purification.

Commercial Potential: The technology has application in the private sector since in recent years a remarkable increase in the incidence of infection due to rickettsiae has occurred in several countries including the United States. Misdiagnosis is common and may result in delay or inappropriate treatment and even mortality.

N94-033 TITLE: Production of Infectious Dengue-1 RNA.

CATEGORY: Exploratory Development; Biology and Medicine

OBJECTIVE: To construct a full-length dengue-1 CDNA clone that can be used to develop a genetically engineered vaccine.

DESCRIPTION: DNA sequencing studies are being conducted at NMRI to determine the genetic mutations responsible for dengue-1 virus attenuation. The attenuating mutations will be engineered into full-length dengue 1 CDNA clones by site-directed oligonucleotide mutagenesis. Infectious mutated RNA clones will be transcribed *in vitro* from the CDNA and packaged into infectious attenuated virions to use as a vaccine candidate.

Phase I: Construct a CDNA plasmid library of dengue 1 overlapping subclones that contain fragments representative of the entire dengue 1 genome.

Phase II: Connect the dengue 1 fragments and clone into a transcription vector to form a full-length infectious dengue CDNA clone.

Phase III: The infectious CDNA clones will be transitioned to the Naval Medical Research Institute and used to engineer a live attenuated dengue 1 vaccine candidate.

Commercial Potential: Dengue is wide spread throughout the tropics and subtropics. Travelers from the U.S. are at high risk and periodic outbreaks have occurred in the Southern U.S.A. A vaccine would have commercial application in preventing such infections.

NAVAL SEA SYSTEMS COMMAND

N94-034TITLE: Active Noise Control

CATEGORY: Advanced Development; Electronic Devices

OBJECTIVE: By application of active noise control, reduce shipboard airborne noise from selected in-service system or component while demonstrating additional benefits of the control application (such as substantial weight or fuel savings).

DESCRIPTION:

Phase I: Focus concepts on a specific type of application of active noise control to a known ship problem where airborne noise reduction together with ancillary benefit represents an attractive ship and commercial application. For example, diesel exhaust mufflers are very large and heavy. Substitution of an active noise control package will save considerable weight and space as well as save fuel through the reduction in back pressure. Identify performance goals.

Phase II: Develop and demonstrate through laboratory testing an application package that will reduce airborne noise and offer an added feature that will reduce ship system cost, and meet performance goals.

Phase III: Build and install the application package on a naval combatant. Support the evaluation and document system operation and performance.

Commercial Potential: Offending airborne noise is common to many combatant shipboard and commercial vehicle and other industrial applications. This effort will be conducted as an unclassified task and be applicable to commercial use.

N94-035TITLE: Unmanned Undersea Vehicle (UUV) Long Endurance Energy Sources

CATEGORY: Advanced Development; Energy Storage

OBJECTIVE: The Navy requires energy sources for tactical sized UUVs which are submarine compatible and provide long endurance.

DESCRIPTION: The long endurance energy system should have an energy density of greater than 150 W-hr/lb (including all necessary auxiliaries) when discharged in 12 hours (i.e. Li-SOCl2 equivalent or improvement). The energy source should also have very low rate discharge during periods when the UUV is dormant. The energy source should be capable of power levels between 3-10 KW, storage between -40 and 160 deg F, and have a shelf life of 5 years or more (at room temperature). The long endurance energy system will be required to be carried aboard submarines and should not employ materials or components which will preclude its certification for use aboard a submarine.

Phase I: Phase I should include detailed conceptual designs, and critical component sub-scale testing. Phase I designs and tests, in addition to meeting the above requirements, should address concerns associated with submarine certification of the energy source (fault tolerance, failure modes and mitigations, compatibility with submarine atmospheric controls, sub-safe issues, and potentially MIL-STD-2105A type testing).

Phase II: Phase II should include the development and demonstration of full scale prototype(s), including special safety demonstrations in certification critical areas.

Phase III: The Navy will utilize the results of phase II efforts in the design of specific UUV systems for performing operations.

Commercial Potential: Results could be used in underwater search and rescue vehicle or in a underwater robot.

N94-036TITLE: Application of Advanced 3-D Visualization Techniques to Tactical Decision Aids for Naval Warfare

CATEGORY: Advanced Development; Human-System Interfaces

OBJECTIVE: This project will examine areas of potential contribution of 3-D visualization technology to the Sensor Performance Prediction Program and will also address the implementation of a 3-D display development environment which has considerable military and commercial potential in developing advanced displays.

DESCRIPTION: Graphic presentation of the tactical decision process has the potential to make trade-offs associated with alternative system parameters easier to grasp and evaluate than current processes.

Phase I: The Phase I effort will examine the 3-D rendering features of X Window system version X11R5 and other emerging 3-D graphics languages to define potential applications of 3-D real-time rendered displays in representing tactical performance data (such as shallow water active sonar performance assessment). This effort will further establish a 3-D toolkit for use in creating Tactical Decision Support Displays, and demonstrate the utility of the 3-D toolkit by implementing a prototype active sonar performance assessment display.

Phase II: The Phase II effort will design and develop a full scale documented environment for development and testing of tactical 3-D displays.

Phase III: Implementation of the 3-D development environment in advanced tactical decision aids, simulations, and training systems.

Commercial Potential: This project is applicable to a broad spectrum of commercial display applications including automated control systems and others which require display of complex information.

N94-037TITLE: Two Body Hydrodynamic Models

CATEGORY: Advanced Development; Modeling and Simulation

OBJECTIVE: Development of models and algorithms for predicting UUV vehicle dynamics when operating within the influence of the submarine flow field.

DESCRIPTION: The Navy is focusing considerable effort in the development of Unmanned Undersea Vehicles (UUV). Many of the missions of these UUV's may require that the UUV be launched and recovered from a submarine. A requirement of the design effort will be to model the hydrodynamic flow when the vehicle is within the influence of the submarine flow field. This model is necessary to define many aspects of the vehicle design such as type and size of the vehicles propulsors and to evaluate recovery system design approaches. The recovery operation requires complex maneuvering and vehicle control when the vehicle approaches and is in the proximity of the submarine. The goal of this task is to develop a two body hydrodynamic model to support the design of UUV control systems.

Phase I: Phase I efforts should include development and/or modification of algorithms into a partial model capable of predicting the dynamics of the UUV under limited conditions.

Phase II: Phase II should include development and demonstration of a full model for representative environments. The model should be capable of handling a full range of parametric analysis for various UUV control designs.

Phase III: The Navy will utilize the results of phase II efforts in the design of specific UUV systems for performing operations from submarines.

Commercial Potential: Simulate undersea maneuverability of ROV/UUVs in a high current environment near submerged structures such as oil platforms and shipwrecks.

N94-038 TITLE: Ship Construction Process Modeling

CATEGORY: Advanced Development; Modeling and Simulation

OBJECTIVE: To create a higher quality and better integrated design package by utilizing commercially available software to develop innovated modeling components that facilitate the communication of shipbuilding production concepts without building prototypes.

DESCRIPTION: Modeling components are independent of ship type, therefore this generic design package has equal applicability to commercial shipbuilding as to U.S. Naval shipbuilding.

Phase I: Model the hull block construction of a recent U.S. Naval ship showing the sequencing. Satisfactory completion and demonstration of the modeling allows transition to Phase II. Deliverables are reports documenting the model development and a videotape showing, in real time, the process.

Phase II: Model representative detailed subassemblies and completely outfitted modules containing habitability spaces. Incorporate the above detailed models into the model from Phase I. Utilize commercially available human factors programs to analyze habitability spaces and determine benefits gained from such an approach both in terms of shipyard assemble and in terms of day to day living. Satisfactory completion and demonstration of the modeling allows transition to Phase III. Deliverables are reports documenting the model development and approach analysis and a videotape showing, in real time, the process.

Phase III: Develop a generic ship hull block construction sequencing procedure and modelling method that incorporates prefabricated and outfitted modules. Demonstrate technique by modeling a recent or proposed

commercial ship. Deliverables are reports documenting the model development, a videotape showing, in real time, the process, the software used, a training course on how the software modeling is accomplished, and a menu driven system for walking through the process. All software utilized and developed must be compatible with on going ARPA/DON efforts in this area.

Commercial Potential: The software tools developed would be ship generic and could just as easily be used to develop designs for commercial ships (both new and overhaul). Commercial shipyards could also use this software to help them better fabricate new acquisition U.S. naval ships.

N94-039TITLE: Integrated Communications Network

CATEGORY: Advanced Development; Modeling and Simulation

OBJECTIVE: To develop an integrated Communications Network

DESCRIPTION: Present communications modeling techniques address each area of communications separately. With the increased emphasis on wireless communications there exists a real need for a model that will allow the designer to see how these systems will interact/interfere in an integrated communications architecture that addresses voice, video, and data requirements. This type of modeling would have direct applicability to the emergency services arena, ie police, fire and emt services.

Phase I: Identify technical issues, using the Navy's current and projected systems, that must be addressed in an integrated modeling system. Propose an approach that will meet the objective. Deliverables would include, but not be limited to engineering/Technical analysis', progress reports, and a final report.

Phase II: Building on the tasks performed under Phase I, a model shall be developed and tested using a using a target configuration agreed upon by the navy and contractor. Deliverables shall include, but not be limited to, engineering/Technical analysis', software documentation, progress reports, and a final report.

Phase III: A final simulation model shall be developed and delivered to the Navy. The model shall meet all requirements identified and agreed upon during Phase I and II efforts.

Commercial Potential: This modeling approach would allow communities to better integrate their communications systems and provide better service to the taxpayer. Exact $ value is hard to calculate, but every county and large metro area has a need to integrate these services.

N94-040TITLE: Thermal Insulation for Piping Systems

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: Develop an alternative thermal insulation material to polyphosphazene (MIL-I-24703) that can be used onboard submarines for piping systems and has a strong commercial market.

DESCRIPTION: Submarine thermal insulation material is used in piping applications above 125_F and below 40_F, as well as being used for anti-sweat purposes between 28_F and 99_F. The material must produce be low levels toxicity when in use or exposed to fire or hot surfaces. The ideal material shall support combustion and will not obscure vision when exposed to direct flame or extremely hot surfaces. The material needs to be flexible in order to be applied to numerous sizes of pipe as well as in sheet form for larger components. The ideal material will flex to follow pipe bends. The material needs to limit absorption of heat from an external source which would be detrimental to the system. Low volume and light weight materials are preferred. The material would be used on piping systems such as the chilled water system, refrigeration systems, and seawater systems. The material and thickness requirements of MIL-STD-769 are to be used as guidance. The material developed would be acceptable for use on surface ships as well as commercial ships and industrial process systems.

Phase I: Identify alternative material options which are comparable to polyphosphazene and identify planned testing to determine acceptability of materials. Materials must exceed the capabilities of MIL-P-15280 insulation. Insulation to MIL-P-15280, while low cost, has been identified as a potential fire source/problem on

submarines. Preliminary testing should be conducted to aid in material selection. The end product of Phase I should be the recommended alternative material.

Phase II: Produce the alternate material and qualify the material for use onboard submarines.

Phase III: Upon successful completion of Phase II and given funding, Phase III will pursue further development or field installation.

Commercial Potential: This material would be useful in commercial buildings and industrial plant application where thermal insulation and fire resistance is required.

N94-041 TITLE: Polymer Current Limiters

CATEGORY: Advanced Development; Materials and Processes

OBJECTIVE: To develop a 100, 250 and 400 amp continuous current limiting device made of polymer materials which operates multiple times to replace single use current limiting fuses in electrical distributions systems in Navy ships, commercial ships and manufacturing facilities.

DESCRIPTION:

Phase I: Develop, build and test a prototype 100 amp continuous polymer current limiter. The performance characteristics are to limit a 100,000 amps short circuit to a maximum 6000 amps, operate in a 65_ or 75_ C ambient temperature, transition from the low impedance to high impedance in less than 0.5 millisecond, and operate in the high impedance mode for 20 milliseconds. The technical data includes a prototype 100 amp test device and a technology cost savings evaluation report and a test report. Next phase transition depends on successful test and evaluation of the device and cost evaluation.

Phase II: Develop, build and test a prototype 250 and 400 amp continuous polymer current limiters. The performance characteristics are to limit a 100,000 amps short circuit to a maximum 6000 amps, operate in a 65_ or 75_ C ambient temperature, transition from the low impedance to high impedance in less than 0.5 millisecond, and operate in the high impedance mode for 20 milliseconds. The technical data includes a prototype 250 and 400 amp test devices and a detailed technology cost savings evaluation report and a test report. Next phase transition depends on successful test and evaluation of the devices and detailed cost evaluation.

Phase III: Develop manufacturing processes, build and test a 100, 250, and 400 amp continuous polymer current limiters. The performance characteristics are to limit a 100,000 amps short circuit to a maximum 6000 amps, operate in a 65_ or 75_ C ambient temperature, transition from the low impedance to high impedance in less than 0.5 millisecond, and operate in the high impedance mode for 20 milliseconds. The technical data includes a manufactured 100, 250, and 400 amp commercial devices and a test report.

Commercial Potential: Replace fuses in Commercial shipboard applications and manufacturing facilities.

N94-042TITLE: Neural Networks for Fast Predictions of Transients and Diagnostics in Shipboard Electrical Distribution Systems and Machinery

CATEGORY: Advanced Development; Propulsion and Energy Conversion

OBJECTIVE: Develop capability for real-time predictions of transients produced by shipboard electrical casualty faults and by electrical system reconfiguration and the detection and classification of electrical machinery status. End products will lead to improve circuit protection controls and devices.

DESCRIPTION: Shipboard electrical casualty faults can produce destructive voltage transients and outages that impair ship capacity to fight hurt and for casualty fight through. Circuit protective devices are being developed that will be capable of switching power busses and feeders in several microseconds; these devices will greatly enhance the survivability of generators, solid-state components, distribution systems, and loads if intelligent switching decisions are made in real time (i.e., several microseconds). Conventional prediction methods, even those methods

that used reduced-order models require excessive computational throughput to achieve accurate, affordable real-time predictions.

Phase I: In Phase I, the contractor is to apply recent developments in dynamic artificial neural networks suitable for real-time predictions of transient responses of complex systems and define an appropriate neural network approach that will fuse the features from both vibration and electrical signatures to classify the condition of electrical machinery and allow detection of component deterioration in very early stages. Training algorithms should be able to have low complexity and be readily implementable in low-cost, off-the-shelf Digital Signal Processing (DSP) hardware. The contractor should postulate a representative, simplified power distribution system acceptable to the sponsor, use conventional methods to create a database of simulated transients for a variety of faults appearing in the postulated system, synthesize real-time prediction neural networks from the simulation data, and validate these neural networks on data from independent simulation runs.

Phase II: In Phase II, the contractor shall extend the real-time prediction work to include more comprehensive distribution systems and fault cases. Distribution system switching strategies shall be developed. These shall use classification neural networks to translate the transient and diagnostic predictions into appropriate switching decisions that affordably protect shipboard electrical circuits to enhance casualty fight through and survivability. The contractor shall prepare a plan for transfer of this technology to affordable shipboard and terrestrial power systems, and implement the paradigm on low-cost DSP hardware and demonstrate its utility.

Phase III: The Phase III effort should involve joint development for naval and terrestrial system markets, of advanced, affordable, modular, circuit protection product by teams of small-business contractor and industry suppliers.

Commercial Potential: Commercial potential exists in the commercial shipbuilding and retrofit markets, in small-scale terrestrial electrical power systems, and ultimately in large scale terrestrial systems. Affordable automated intelligent machinery diagnostic tools can improve reliability, reduce down time and provide significant savings in the areas of maintenance and repair by providing early detection of incipient failures for critical electrical machinery components.

N94-043TITLE: Seawater Distilling Plant 3-way Bypass Solenoid Valve

CATEGORY: Advanced Development; Propulsion and Energy Conversion

OBJECTIVE: Develop a design for a noise-quiet, cost-effective seawater distilling plant three way bypass solenoid valve for use on submarines. This valve is also targeted for use in processing and power plants where existing commercial valves do not meet OSHA acoustic requirements.

DESCRIPTION: The Navy needs a low noise and low cost three way bypass solenoid valve for use in the condensate/distillate piping of seawater distilling units aboard submarines. Innovative low cost concepts are sought which meet distilling plant requirements and the SSN21 acoustic requirements.

Phase I: Develop multiple design concepts for Navy consideration. Provide a report with concept drawings which discusses the limitations, pros and cons of each design. Compare the production and life cycle costs of each design. Identify possible changes to Spec 1000-386 which would lower procurement costs while satisfying the valve functional requirements. Provide supporting rationale and analyses for recommended changes to Spec 1000-386 for each concept. Emphasis of design attributes will be quietness, manufacturing cost, simplicity of concept, reliability and life cycle cost.

Phase II: Design and build a prototype of the valve concept selected by the Navy and evaluate performance and acoustic capabilities by testing. Design the valve to satisfy 1000-386 with cost reduction changes, as approved by the Navy. Develop a manufacturing process plan prior to manufacture. Manufacture the valve and document the manufacturing process as it actually occurs. Simulate full scale production during the manufacturing process vice single prototype fabrication methods. Test the acoustic and functional performance of the valve. Make design changes and manufacturing process changes, based on manufacturing feedback and test results. Manufacture the new valve design and document the manufacturing process as it actually occurs. Test the acoustic and functional performance of the new valve.

Document both valve designs and changes, manufacturing processes and changes, test results, and lessons learned in a final report. Identify recommendations which could further improve valve performance and reduce manufacturing cost.

Phase III: Upon successful completion of Phase II, Phase III efforts will pursue complete first article qualification (e.g. endurance, shock and vibration) for use on SSN21 and other Navy ships.

Commercial Potential: This valve has potential applications in processing and power plants where existing commercial steam valves do not meet OSHA acoustic requirements.

N94-044TITLE: Application of Fuzzy Logic to Emitter Classification Algorithms in Submarine Electronic Support Measures (ESM) Systems.

CATEGORY: Exploratory Development; Software

OBJECTIVE: Development of Fuzzy Logic Algorithms and Software for ESM Systems to Resolve Emitter Classification Ambiguities.

DESCRIPTION: Present submarine tactical ESM systems use library lookup tables to compare measured frequency, PRI, PW, chirp, agility, scan and other parameters of target emitter signals to classify the signals. In cases where the measured parameters are near the boundaries of library classifications, ambiguities and failures result. Fuzzy logic technology has matured to the point where it offers the potential of resolving these cases. A fuzzy logic algorithm augmenting present emitter classification routines will provide more reliable, robust ESM system performance.

Phase I: Analyze present ESM system emitter classification failures and identify fuzzy logic algorithms and software capable of correct classification in marginal cases. Define breadboard classification software system and prepare Phase II Program Plan.

Phase II: Develop breadboard fuzzy logic algorithms and software and integrate with ESM system emitter classification system. Prepare analysis of expected performance. Test combined classification system in Submarine Tactical ESM system against emitter signals now causing classification ambiguity and failure

Phase III: The fuzzy logic emitter classification upgrade will be transitioned to deployed ESM systems to provide improved target emitter classification performance

Commercial Potential: Improved emitter classification systems will have application to law enforcement activities requiring intercept of emitter signals, such as drug interdiction.

N94-045 TITLE: 94 Ghz Space Fed Phased Array

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Develop and characterize passive phase-shifters (reflectors or two-port devices) for use at millimeter-wave frequencies.

DESCRIPTION: Elements are needed for use in beamforming applications for antennas. Such elements are required to produce compact phased-array antennas without the cost of an individual transmitter for each element. Of particular interest are phase shifters suitable for conformal or non-planar arrays for air vehicles, particularly guided projectiles, which have constrained volumes that make a conical or pyramidal arrays preferable over flat plates.

Phase I: Conduct design studies, using analytic and computer methods, for phase shift elements and arrays. The phase shift elements should be suitable for MMIC construction techniques. The primary application is a 5 inch guided projectile seeker with a 25 watt peak power transmitter, with the ability to steer the beam 20_ off the nose. Specific matters to be studied are:

? Element and array patterns, including array beamwidth and side and backlobe levels

? Suitability for mass and MMIC production. Low cost is critical for use in gun ordnance and for commercial uses.

? Impedance and loss of elements
? Alternatives for the transition from free space to guided wave within the elements.
? Noise added by phase-shifters (for radar receiver and passive radiometer applications)
? Polarization of elements, array, and feed.

This work shall include analytic studies and computer models, and limited physical studies if needed to determine basic parameters for the models. The final result of Phase I shall be a technical report, a set of designs for a small number of prototypes of elements and arrays, and a statement of work for Phase II.

Phase II: Produce prototypes of elements and arrays to validate the analyses of Phase I. These prototypes do not necessarily have to be form and fit. The parameters calculated in Phase I for these designs (pattern, noise, polarization, etc), shall be measured in Phase II. The final product shall be an optimized design for correct-scale production, corrected models of its performance, and a test plan to characterize the performance of the optimized design.

Phase III: Produce a prototype of the most promising Phase II design. This item will be dimensionally suitable for use in the ogival nose of a 5" gun projectile seeker with a diameter of 100 mm and length of 355 mm. It is required to survive gun launch gee-forces (30,000 Gs for 5 Ms) and the temperatures of supersonic flight. Characterize the radiation pattern, noise figure, polarization, beam width, and gain of this model.

Commercial Potential: Applications to compact radars for vehicle and highway use, aircraft wing icing detection, and passive sensors for remote sensing and land resource management. Passive millimeter-wave radiometry has unique abilities to differentiate metal from non-conductors, combining radar and infrared characteristics.

N94-046TITLE: Probability of Detection of Spread Spectrum Signals with Specified System Parameters

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Determine the probability of detection (Pd) of emitters in the communications frequency band using parameters of present and future submarine Electronic Support Measures (ESM) systems. The goal is to develop frequency search or prediction algorithms that will enable the ESM system to find and track spread spectrum signals.

DESCRIPTION: The present electromagnetic energy environment has been observing an increasing number of spread spectrum signals. Since the communications signals can be greatly increased in bandwidth (factors of 10 to 10,000 are common), the energy is spread over such a wide bandwidth that many times the signal is below the noise floor of a conventional acquisition system, which cannot detect the presence of the signal. Types of spread spectrum signals that interest the Navy include frequency hopping, direct sequence, stacked carrier, chirp, and time hopping signals.

Phase I: Conduct a six-month study to demonstrate the feasibility, based on a realistically modeled signal environment, of developing a prediction algorithm for use in a submarine ESM system.

Phase II: Construct and demonstrate performance of a prediction algorithm for spread spectrum signals. The effort shall produce a fully programmed computer model of the algorithm that will confirm and demonstrate the practicality of the spread spectrum signal prediction system.

Phase III: The technology will be transferred to the Government for use in surface and subsurface platforms that are concern with spread spectrum signal detection and identification.

Commercial Potential: The technology has application in the private sector in the cellular phone, telecommunications, radio industry, and drug interdiction.

N94-047TITLE: Automated Ship Active Sonar Mutual Interference Planning

CATEGORY: Advanced Development; Software

OBJECTIVE: Perform advanced development of automated ship active sonar mutual interference planning considering optimum sonar employment, ship positioning, search requirements, environmental concerns, and threat definition, while maximizing search performance.

DESCRIPTION: The system should support evaluation of the effects of mutual interference, both forecast and in-situ, and generate a mutual interference plan to minimize the negative effects on search while maximizing search performance. In addition, any system developed must allow operator interaction at various levels of the automated process or provide the operator the ability to investigate and override the automated recommendation.

Phase I: The Phase I effort will result in a design for an active sonar mutual interference planning software module that would be compatible with existing decision aids, and a proof of concept software demonstration.

Phase II: The Phase II effort will result in completed development of a prototype active sonar mutual interference planning software module in accordance with the phase I design. The module will be supported by a GOTS/UB-compatible user interface and will be ready for integration within existing fleet tactical decision aids.

Phase III: The Phase III effort will consist of at-sea test and evaluation of the prototype active sonar mutual interference software module

Commercial Potential: Mutual interference planning applies to all commercial underwater active sonar applications where concert operations involving multiple platforms are employed. Examples are: fish harvesting, surveys, and salvage operations.

NAVAL SURFACE WARFARE CENTER/DAHLGREN DIVISION

N94-048TITLE: Mine Location Processing System

CATEGORY: Advanced Development; Computers

OBJECTIVE: Development of data processing system used in transient electromagnetic location and classification of mines in a marine environment

DESCRIPTION: Very recent experimental work has conclusively shown that it is possible to localize and identify small mines in a marine environment using transient electromagnetic waves. The experimental apparatus consisted of a small tank with separate receiving and transmitting antennas. An electromagnetic wave, whose wavelength had decreased because of the salt water and was comparable to the size of the mine, was emitted from one antenna. A second antenna collected the scattered wave and the fourier transform was taken from this signal. From this, it was observed that different objects in the tank yielded different transform components. However, due to the high attenuation of the wave due to the conductivity of the water, the high dispersion changing the wave shape and the fact that salt water is electrically conductive, data processing played an important part in this system of mine detection.

Would it be possible to optimize the data processing system? Would processing two or three components simultaneously (Ex,Ey, Hz for example) yield a higher detection probability? Would a transmitted square wave signal be superior to a tone burst? Is the fourier transform the optimal transform? Would a statistical approach be better? What about the use of FIR filters vs the fourier transform?

Phase I: Design an optimal signal processing technique and demonstrate its use with Navy supplied data.

Phase II: Construction of dedicated hardware to include transmitting, receiving and data processing equipment.

Phase III: Actual demonstration in the littoral zone

Commercial Potential: Supports research, in automobile guidance by roadway magnets (California). Also, could be used in a sea salvage and for the location of underwater objects such as oil pipelines and telephone cables

N94-049TITLE: Superconducting Advanced Multichip Module

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: Demonstrate a superconducting multichip module that offers 1000 to 10000 millions of instructions per second (MIPS).

DESCRIPTION: Superconducting circuits and multichip module technology are becoming available to meet embedded systems performance needs. This demonstration will pursue a module that offers large amounts of digital signal processing power and has a power consumption of less than 2 kilowatts, including cooling. Module size should be less than one cubic foot including cooler. The ability to handle numerous analog and digital inputs is needed. One or more RS-232 serial ports are desirable to support system and code development. The architecture will be oriented to very high performance digital signal processing for such tasks as radar processing, beamforming and spectral analysis.

Phase I: Deliverables shall include a study of processors, supercooling hardware, architectures, and interconnection technologies to choose the best design choices. A detailed design package and supporting documentation are also required in this phase.

Phase II: Implementation of the Phase I SAMM design is required. Three modules and coolers shall be constructed, debugged, tested and delivered along with complete fabrication documentation.

Phase III: Possible Navy applications are airborne radar processors and autonomous underwater vehicles.

Commercial Potential: A superconducting advanced multichip module would have tremendous application in desktop workstations and other high performance uses. It could be the most cost effective technology to improve the computing capability of desktop systems by an order of magnitude.

N94-050TITLE: High Power Switch

CATEGORY: Advanced Development; Electronic Devices

OBJECTIVE: Develop for manufacturing a high power switch capable of 100 kilowatts average power, 100,000 volts, 100 joules/pulse and operating at 1000 hertz.

DESCRIPTION: The Navy has spent considerable time and money in developing high power switches to support research in particle beam weapons, high power microwave sources and impulse radar. NSWCDD has shown that hydrogen spark gap technology is 100 times faster than other existing technologies.

The twitch is expected to be a pressurized spark gap capable of holding off at least 100 kilovolts before being triggered. The switch will be capable of at least 100 J/pulse and operation of at least 1 kilohertz for long periods of time (minutes). Materials and cooling system will be chosen so that the switch can handle 100 Kw of average power passing through the switch into a low impedance load. Most of the basic technology has already been demonstrated and patented by the Navy. Continuous operation and a commercializable design are the main areas of development.

Phase I: Design of a high power switch along with a plan for its manufacture in small numbers.

Phase II: Manufacture and test of a high power prototype switch and the delivery of several for Navy testing.

Phase III: Source for commercial sales of switches to Navy Research and Development programs.

Commercial Potential: Applicable to particle beam accelerators, nuclear fusion, electron beam formation, materials processing and recycling, ion production, communications and any system that uses high peak powers at high repetition rates.

N94-051TITLE: Improvement of High Power Silver-Zinc Rechargeable Batteries for Underwater Vehicles

CATEGORY: Advanced Development; Energy Storage

OBJECTIVE: Demonstrate performance capability of bipolar, rechargeable silver-zinc (Ag/Zn) batteries for underwater vehicles.

DESCRIPTION: The Ag/Zn battery has the highest rate capability of any commercially available rechargeable battery. It is also relatively safe and non-toxic. Its high power density stems from a very conductive electrolyte and rapid electrode reactions. To capitalize on these qualities the system needs to be developed in a bipolar configuration which utilizes space efficiently and eliminates intercell connector resistance. A major concern to be addressed is shelf life limitation consequent on common electrolyte leakage currents in the bipolar construction.

Phase I: Maximize bipolar battery energy and cycle life in prismatic cell cases having exterior dimensions of
1.4" x 3.8" x 4.9".

Phase II: Maximize bipolar battery energy and cycle life in prismatic cell cases having exterior dimensions of 2.8" x 5.9" x 6.7".

Phase III: Further development may be supported by the high energy battery project.

Commercial Potential: Applications in TV cameras, lap-top computers, surgical instruments, and electric vehicles.

N94-052TITLE: Improved Rechargeable Batteries for Underwater Applications

CATEGORY: Exploratory Development; Energy Storage

OBJECTIVE: Improve the stability of rechargeable lithium/lithium cobalt oxide batteries used in underwater targets or vehicles.

DESCRIPTION: Interstitially-lithiated metal oxides are attracting worldwide R&D interest as cathodic materials for undersea target as well as electric vehicle propulsion batteries. The Navy has been developing the most energetic of these, lithium cobalt dioxide (LixCoO2), for underwater vehicles in which Li/LixC02 batteries will replace the present silver oxide/zinc. Prior work, using cells with methyl formate based electrolytes, have demonstrated a small capacity loss when stored at 35 degrees C for three months or at 22 degrees C for nine months. The Navy wants to extend its understanding of the effects of storage at elevated temperature. The following approach is suggested

Quantify degeneration, if any, of LixCoO2 at temperature up to 70 degrees C. Compounds of LixCoO2, lithiated from approximately x = 0.5 to x = 1, will be characterized structurally, e.g., by x-ray analysis, and stored in an inert environment for different periods and temperature. They will be recharacterized after storage to identify degeneration. If degeneration might be reduced for LixCoO2, with minor compositional adjustments, samples of such should be included. Stability of the active material should also be characterized after storage as a cathode component in the presence of electrolyte. One or two different grid materials and one or two different electrolytes should be considered. The upper temperature of storage may be limited by compatibility with, or stability of the electrolyte. Electrodes should be characterized by electrochemical as well as physical methods before and after storage.

Phase I: Identify candidate methods and materials to improve stability in Lithium/Lithium cobalt dioxide cells.

Phase II: Optimize the design and provide cells for storage evaluation (35_C for 3 months or 22_C for 9 months.)

Phase III: Successful designs may transition into the development of a new rechargeable under water vehicle battery.

Commercial Potential: This technology will have private sector application in electric vehicles, under water vehicle battery.

N94-053TITLE: High Performance Battery for Missile Guidance

CATEGORY: Exploratory Development; Energy Storage

OBJECTIVE: Develop an electrochemical power supply capable of supplying in excess of 2000 Watts for 10 minutes from a four (4) to five (5) pound package demonstrating an 80 watt-hour/pound energy density.

DESCRIPTION: Missile guidance control electronics require increasing power to effect sensor fusion and real-time analysis of multiple data inputs in addition to increasing control actuation power at high voltages for high dynamic maneuvering. Traditionally, molten salt thermal batteries have provided high power density (>700 W/lb) at low energy densities (<20 WH/lb) with limited operational lifetimes (1 to 5 minutes). Lithium organic/inorganic electrolyte batteries have provided high energy densities (>150 WH/lb) but at low to moderate power densities (<100 W/lb) and exhibit thermal management and safety problems. Silver-zinc aqueous electrolyte batteries have provided good (>30WH/lb but <120WH/lb) energy densities at moderate power densities (>100 W/lb but <300 W/lb) and have required special storage and use handling. The goal is to develop a battery which maximizes power and energy density with extended shelf life, wide operating temperature range and low maintenance e.g. deliver 80 watt-hour/pound at discharge rates between 2 and 20 minutes.

Phase I: Design a safe cell capable of high power discharges at high voltage (>100 volts) and having power densities greater than 400 watts/power.

Phase II: Optimize cell design into a prototype cell stack and test. Provide additional cells for independent evaluation.

Phase III: Flight testing of successful prototype in missile flight.

Commercial Potential: Applications in electric vehicle propulsion (rechargeable version) and in aircraft emergency power.

N94-054TITLE: Electronically Tunable Solid State Laser

CATEGORY: Exploratory Development; Light and Optical Systems; Sensors

OBJECTIVE: Develop an agile electronically tunable laser to provide a real time frequency selectable illuminator for multispectral remote sensing.

DESCRIPTION: Multispectral and hyperspectral imaging techniques have been identified as a powerful tool for the remote detection of targets of military interest. Currently multispectral imaging systems are limited by using the sum as the source of illumination. It would significantly enhance a multispectral remote sensing systems capability by utilizing an efficient real time electronically tunable solid state laser as a source of illumination. Innovative concepts are sought to design such a laser illuminator. Ideally, the laser would be pulsed with a pulse repetition rate (PRF) of at least 30Hz (video rate) and frequency selectable at the PRF with sufficient plank power to illuminate the ground for the multispectral imager. The primary frequency range of the laser would ideally be 350 to 1100 nm, however other tunable frequency grounds, such as 3-5 um are also of interest.

Phase I: Provide an engineering tradeoff study to show feasibility of designing and later producing or extrapolating from existing technologies a specific device which can meet this proposal. Phase I must determine possible laser technologies, tuning technologies, and system integration capabilities.

Phase II: Develop, build, and deliver a breadboard prototype system which meets all necessary specifications.

Phase III: If Phase II is successful, full-scale development will be considered for future Navy & Marine Corps electro-optical systems.

Commercial Potential: For the tunable laser, the possibilities are numerous: entertainment, medical, remote sensing of the environment, including oil prospecting, geological mapping and exploration, agricultural and forest monitoring, and so on.

N94-055TITLE: Oxidation-Resistant Composite Materials for High-Temperature Applications

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: Identify and demonstrate improved oxidation-resistant, refractory diboride-based composite materials.

DESCRIPTION: Refractory diboride composite materials (based on ZrB2 and HfB2) were investigated in the 1960's for potential use as high-temperature, oxidation-resistant leading-edge materials for hypersonic vehicles. Silicon additions, as SiC or MoSi2, were found to provide the highest oxidation resistance, although additions of al, Y, Cr, and other elements were also attempted. It is believed that other diboride alloy compositions may provide substantially greater high-temperature oxidation resistance than the Si-alloyed ZrB2 and HfB2 materials. Improved materials could have application in commercial and DoD hypersonic vehicle nosecaps and leading edges, solid and liquid rocket nozzles, air-breathing propulsion hot sections, high-temperature furnace heating elements, and possibly electrodes for A1 production.

Oxidation resistance improvement may be possible by several approaches. A direction that has not been explored is the alloying of diborides other than the group IV metals, such as the group V or group VI metals. Metal-oxide free energies of formation (FEOF) increase in the progression of group IV to V to VI transition metals. This suggests that the latter metal borides show the highest promise of exhibiting enhanced oxidation resistance with alloying additions of A1, Si, or possibly Cr. Another possible direction is the addition of Be, even into groups IV diborides, taking advantage of the very low FEOF and slow diffusion properties of BeO.

Phase I: Provide analytical calculations and experiments which show potential of a candidate material.

Phase II: Produce an optimized oxidation-resistant composition.

Phase III: Identify and optimize low-cost processing techniques to fabricate sub and full-scale composite components.

Commercial Potential: Commercial aircraft engine improvement.

N94-056TITLE: Computer Tools for Complex System Design

CATEGORY: Exploratory Development; Software

OBJECTIVE: The development of method and toolset for the representation and the evaluation of the behavior (both static and dynamic) of large-size, complex, and real-time system.

DESCRIPTION: Navy system architectures today are very large-size, complex, and dynamically response to external conditions. The ability to evaluate various system behaviors at many different stages of the design process becomes necessary for the system engineers. Although, methods and techniques for design evaluation exist, they are typically fragmented and are performed independently. Usually, each method only allows system engineers to evaluate certain aspects of the system at a time, and/or it only focuses on certain design stages. The integration of existing methods which allows system engineers to evaluate many system aspects at various design stages is necessary but unachievable at this moment due to the diversity of how information is being represented in these methods.

The method(s) developed within this research should show the understanding of different evaluation techniques for system behaviors at various stages in the system development process. The method(s) should allow the evaluation of both the control behavior of the total system as well as the detail behaviors that are associated with particular system's functions or resources. Hence, the control representations for system behavior has to be addressed in a hierarchical manner to accommodate different levels of fidelity. The hierarchical concept would provide options for system engineers to address the system's behavior at both abstract and detail level of complexity. The method(s) should also supports system engineers as well as domain experts to easily understand the control states of the system. For example undesirable control states has to be recognized by all persons who involve in the system development process. The method also has to allow system engineers to specify the system robustly so that a direct transformation between the representation information and the evaluation techniques can take place.

Phase I: Methodology should be developed in the design of a computer tool. Feasibility should be shown by application of methods to a Navy problem.

Phase II: Work should include the full scale development of the automated tool. Usefulness of the methods and tool should be demonstrated on a sample test case by the end of Phase II to facilitate the transition of the work

into Navy systems. The initial methodology report should be updated to incorporate the lessons learned during the development of the tool.

Phase III: Full scale development of the automated tool that was developed in Phase II and its application in a Navy program.

Commercial Potential: Exists in the design of large distributed commuter systems. Examples: air traffic control, stock trading, and banking.

N94-057TITLE: Tracing Requirements Through the Later Phases of System Development

CATEGORY: Exploratory Development; Software

OBJECTIVE: Develop a method and tool for tracing requirements throughout the entire life cycle. The research should augment the current traceability case tool environment which current concentrates on tracing Requirements throughout the initial stages of system/software development.

DESCRIPTION: It is essential that computer intensive systems being built fully contain the desired and specified functionality and are maintainable over long periods of time. Traceability is essential in achieving these goals. Lack of full traceability causes inefficient systems to be built that do not fully capture all the required functionality. Also systems which lack traceability are extremely difficult to maintain because the effects of changes to parts of the system are unknown and could create disastrous results.

There are several commercially available system/software requirement traceability tools which can be used to solve some of the above concerns. But these tools concentrate on the linking of the requirements to the initial phases of the design cycle (structured analysis, structured design, etc.) Their methodologies fall short in terms of linking throughout the later parts of the design cycle (i.e., simulation, testing, implementation, etc. Generic objects can be created to represent these items but direct tracing to capture representation of these later design phases fail to exist. A more complete traceability methodology which concentrates on the design representation throughout the entire life cycle needs to be developed. A traceability tool will require interfaces that allow the interaction between the different tools which captures each part of the design is also essential along with the ability to link the method to current design and implementation tools.

Phase I: Design of a method and its feasibility shown by application to a Navy system.

Phase II: Full scale development of an automated tool and its demonstration on a Navy system.

Phase III: Transitions into a large-scale navy programs for which the requirements are under development.

Commercial Potential: Exists in all large computer systems, which use developmental or CASE tools. Examples are communications, satellites, automated manufacturing, and air traffic control.

NAVAL SURFACE WARFARE CENTER/CARDEROCK

N94-058TITLE: Waterless Dish Washer

CATEGORY: Research; Environmental Quality

OBJECTIVE: To acquire the scientific knowledge and understanding necessary for development of shipboard dishwashing technologies that clean dishes to an acceptable level without generating water.

DESCRIPTION: A waterless dishwasher would reduce ship generated graywater generation by over 25 percent. This would reduce the size and cost of subsequent shipboard treatment systems as well as reduce the overall freshwater requirement for Navy ships. At the same time ships would be able to hold graywater for greater periods of time without treatment system.

Phase I: Investigate concepts and techniques for cleaning dishes without the generation of waste water.

Phase II: Develop breadboard model of waterless concept identified in Phase I.

Phase III: Transition to the Navy's Shipboard Environmental Program.

Commercial Potential: This technology has application in the private sector in the appliance industry.

N94-059TITLE: Waterless Clothes Washer

CATEGORY: Research; Environmental Quality

OBJECTIVE: To acquire the scientific knowledge and understanding necessary to develop shipboard clothes-cleaning technologies that can clean clothes to an acceptable level without generating appreciable quantities of wastewater.

DESCRIPTION: A waterless clothes washer would reduce shipboard graywater generation by up to 21 percent. Reductions in wastewater generation will reduce the size, cost, and complexity of subsequent shipboard treatment systems and improve the Navy's ability to comply with expected graywater holding requirements. A waterless clothes washer would also result in reduced freshwater requirements for ships.

Phase I: Investigate techniques that are applicable to the cleaning of clothes to reduce/eliminate wastewater.

Phase II: Build laboratory apparatus, a working breadboard model to evaluate the process.

Phase III: Transition to the Navy's Shipboard Environmental Protection Program.

Commercial Potential: This technology has application in the private sector in the appliance sector.

N94-060TITLE: High Current Switchgear

CATEGORY: Advanced Development; Propulsion and Energy Conversion

OBJECTIVE: The objective of this topic is to develop switches, flexible joints, and interconnection schemes for high current (50,000 to 200,000 Amp), low voltage (less than 1000 volts) a.c. or d.c. power distribution systems. In addition, for signature and safety reasons, stray electromagnetic fields must also be controlled.

DESCRIPTION:

Phase I: Develop designs for high current switch(es), flexible joint(s) and connectors which minimize stray magnetic fields.

Phase II: Construct and test prototype hardware for selected design(s).

Phase III: Develop manufacturing processes for high current components.

Commercial Potential: Electric utilities are becoming increasingly concerned about the biological effects of electromagnetic fields. Techniques developed could be transitioned to electric utility applications, albeit at higher voltage and power levels.

N94-061TITLE: Flexible Coupling for a Liquid Cooled Coaxial Transmission Line

CATEGORY: Exploratory Development; Propulsion and Energy Conversion

OBJECTIVE: Develop and Demonstrate a flexible coupling for a 30,000 ampere coaxial transmission line which is liquid cooled.

DESCRIPTION: Superconducting systems require large currents at full power to develop the necessary horsepower to propel a ship. To minimize the external magnetic fields created by the transmission of large currents coaxial transmission lines are used. The lines are liquid cooled to remove heat from the transmission line. Integration of coaxial transmission lines into a ship requires the line be able to with stand a Navy environment which includes shock, vibration and hull contractions. Development of a flexible coupling to meet such needs is important to future application of coaxial transmission lines on ships.

Phase I: Tradeoff study selecting and developing drawings for the best design to meet Navy needs.

Phase II: Develop and construct 30,000 ampere flex coupling for test at Navy scaled test facility. Deliver to the Navy the flex coupling and associated fabrication documentation.

Phase III: Possible applications are for Navy electric propulsion candidate system.

Commercial Potential: The potential impact of magnetic fields generated by transmission lines is point of environmental concern in both military and commercial transmission lines. Coaxial transmission lines reduce the magnetic field external to transmission lines, and Flexible couplings are required to account for environmental factors such as movement of the Coaxial transmission lines during thermal expansion, wind, and deformation of supporting structures. Naval and Maritime benefits include reduced own-ship magnetic signature, and a large market potential exists in the utility industry overhead power lines, and other instances where large currents must be transmitted by the utilities.

N94-062TITLE: Non-invasive Sensors for Shipboard Sewage Systems

CATEGORY: Research; Environmental Quality

OBJECTIVE: To develop a non-invasive sensor for shipboard sewage.

DESCRIPTION: Two major maintenance problems for Navy shipboard blackwater and graywater systems are excessive scaling of pipe and fouled level sensors for tanks. It is very costly and time-consuming to identify the point at which piping has become clogged, and then to replace that piping. A non-invasive process for identifying the amount of scale in shipboard waste piping would allow ships force to diagnose clogging problems and to predict future clogging sites. Sewage tank levels sensors become caked with grease and often fail. The cost and safety problems associated with opening these tanks could be read without depending on internal tank components would eliminate these problems.

Phase I: Investigate concepts and techniques for a non-invasive means for measuring wastewater pipe scale and measuring liquid levels in tanks.

Phase II: Develop and test model of best technology identified in Phase I.

Phase III: Transition to shipboard use.

Commercial Potential: This technology has application in the private sector in the wastewater treatment and chemical industries.

N94-063TITLE: Affordable Maxwell Solver for Large Objects

CATEGORY: Exploratory Development; Vehicle Structures

OBJECTIVE: Develop an affordable technique for computing Maxwell Equation solutions for electromagnetically large objects.

DESCRIPTION: Develop an accurate and affordable technique for solving Maxwell Equations in the scattering of the electromagnetic waves from large objects such as naval ships or ship sections. The rigorous determination of electromagnetic interactions is required to evaluate and predict the radar cross section of ships and the performance of a wide variety of antennas mounted on ships. The frequencies of interest range from 6MHz to 100GHz. Current computational techniques used by the Navy are less than rigorous and use approximation techniques such as Physical Optics and Physical Theory of Diffraction. Attempts at rigorous Maxwell solutions have so far been too computationally intensive to be of practical use.

Phase I: Determine the range of computational approaches to developing a rigorous Maxwell solver. Evaluate these approaches to determine the effectiveness and practicality of each. Determine the applicability of various computer hardware platforms to the best approaches and estimate the costs of performing RCS and antenna performance analysis of naval ships using the best approaches with the most appropriate computer platform.

Phase II: Based on the information obtained during Phase I, select the most appropriate computational approach and develop algorithms that demonstrate the accuracy and cost effectiveness of the approach. The demonstration shall include objects large enough to establish the practicality of extending the approach to full scale naval ships and shall also include canonical shapes that verify the accuracy of the computation.

Phase III: If Phase II is successful, a full ship computational Maxwell solver will be developed.

Commercial Potential: An affordable Maxwell solver for large objects will have application for installation of communication systems on ships, airliners, trains, buildings and other large structures as well as the design of large antennas. In addition, the techniques developed for a Maxwell solver may be applicable to other computationally intensive problems.

N94-064TITLE: Multi-Spectral Signature Control Air Induction Systems, Effluent Ducts, and Exhaust Systems

CATEGORY: Exploratory Development; Vehicle Structures

OBJECTIVE: Investigate air induction systems, effluent ducts and exhaust systems that provide integrated structure and signature control for infrared, visual, radar, and acoustic spectra.

DESCRIPTION: Openings in ships to either introduce air or permit the dumping of effluents or exhaust gases must have signature control in multiple spectra. Many of these subsystems are above the KG of the ship and any parasitic signature control makes the KG of the ship worse. Additionally, many of the treatments for one signature spectra are incompatible with other signature treatments. An integrated signature control system is needed that has the following characteristics:

a. Lighter weight than existing systems;
b. Incorporates infrared, radar, visual, and acoustic treatments;
c. Compatible with normal Navy maintenance and painting practices;
d. Does not involve VOC's or toxic materials;

Phase I: Develop concepts for inlet systems, effluent ducts, and exhaust systems; perform trade-off analysis based on selection criteria; select best systems approach; demonstrate feasibility of approach with laboratory model; prepare a final report that documents Phase I activities and design for a prototype field system application.

Phase II: Develop, test, and evaluate subsystem which has the capabilities described above and principles demonstrated in Phase I. Prepare a final report that documents all Phase II activity.

Phase III: A Phase III effort is anticipated for field application of successful subsystems to US Navy ships. Commercial application of subsystems is possible for some subsystems to counter terrorist threats to commercial shipping.

Commercial Potential: The technology has application in the private sector in the ship building industry.

N94-065TITLE: Composite Inner Liner for New Tanker and Tanker Retrofit to Double Hull Configuration

CATEGORY: Exploratory Development; Vehicle Structures

OBJECTIVE: Develop a low cost method of providing double hull protection to existing oil tankers

DESCRIPTION: Develop a method of providing double hull oil spill protection to existing oil tankers with a minimum impact on payload. The design must be low cost and have a minimum impact on schedule. The design should be capable of being installed at pier side or with minimal shipyard support (no dry dock). No extensive (expensive and time consuming) tank cleaning or purging shall be required. The inner hull must be tough and durable and resist puncture even with major impact.

Phase I: Perform a full feasibility analysis on the candidate design(s); perform material evaluation and test, installation methodology and evaluation; prepare a final report that documents all Phase I activity.

Phase II: Conduct detailed design and fabricate test samples to develop design allowable; perform full system design for an application; fabricate sub scale hull for model basis evaluation; install double hull in a full scale hull section; prepare a final report that documents all Phase II activity.

Phase III: If Phase II is successful, full scale development will be considered for oil tanker retrofits.

Commercial Potential: The technology has application in the private sector in the oil tanker industry.

N94-066TITLE: RGS Based Modeling and Panelization for CFD Simulation

CATEGORY: Computational Fluid Dynamics; Simulation and Modeling

OBJECTIVE: Develop techniques for creating parametrically varied geometric surface models and discretizations for input to computational fluid dynamics (CFD) codes to predict flows around ships and submarines, and waves and currents in coastal regions, for both military and commercial design applications.

DESCRIPTION: Geometric models and their discretizations into panels and grid cells for incompressible and subsonic flow analysis are typically generated by ad hoc programs committed to specific topologies. There are few general-purpose low-cost surface panelizing tools, and those that exist have very limited parametric or associative capability. As a result, the use of CFD for analysis of parametric series of geometries, or for systematic optimization within a parametric design space, is tedious, labor-intensive and error-prone.

Relational Geometric Synthesis (RGS) is an emergent CAD technology providing a formalism and environment for extremely flexible and rapid creation of 3-D models having very strong parametric and associative properties.

Phase I: Conduct a 6-month study to assess the potential for application of RGS to panelization problems. Use existing RGS tools to develop examples of typical geometries. Identify required extensions of RGS to fulfill panelization needs.

Phase II: Develop and implement required RGS extensions as preprocessors, postprocessors, and new RGS entities. Apply the techniques to several real hydrodynamic,aerodynamics and coastal flow simulations. Connect RGS at a pilot level to several standard flow codes.

Phase III: The technique will be developed into an integrated workstation or PC program for creation and panelization of models; generation and verification of flow-code input decks; and display of flow code results such as surface pressures, singularity densities, and streamlines.

Commercial Potential: Panelization is required for application of CFD to design of vehicles of all types, including ships, aircraft, and automobiles, as well as pumps and other types of devices involving fluid flows.

N94-067TITLE: Photonic Systems Simulation

CATEGORY: Exploratory Development; Modeling and Simulation

OBJECTIVE: To develop a photonics simulations software package for use in advanced radar systems design and photonic component development.

DESCRIPTION: A physics based numerical simulation of lasers, photodetectors, modulators, multiplexers, couplers, optical waveguides, and lightwave amplifiers is needed. The simulation should run on a Unix workstation and have two and three dimensional simulation capability. Algorithms compatible with the monolithic integration of optical components are required.

Phase I: Should address the critical technical issues. Analysis and design sufficient to indicate a good probability of success package for an on-going NAVSEA program.

Phase II: Should provide a high quality a high-quality versatile photonics simulation package for an on-going NAVSEA program.

Phase III: Full development for commercial, military, and university research applications is envisioned. Target commercial industries include communications, aerospace, and optical monitoring and remote sensing industries.

Commercial Potential: Strong commercial potential exists. Photonics simulation software has been identified as an outstanding need for both military uses and commercial communications applications. Medical, biological, environmental, and materials sciences would also benefit from the availability of such software.

NAVAL SURFACE WARFARE CENTER/INDIAN HEAD

N94-068TITLE: Biologic Methods for Degradation of Waste

CATEGORY: Exploratory Development; Environmental Quality

OBJECTIVE: Determine the biologic methods such as white-rot fungus for decomposition applicability of: 1) nitrate-ester-based substances, such as Otto Fuel II, metriol trinitrate (MTN), butanetriol trinitrate (BTTN); 2) binders, such as carboxyle-terminated polybutadiene (CTBN), hydroxyl-terminated polybutadiene (HTBN), and polyurethane; and 3) explosives, such as Explosive D (ammonium picrate).

DESCRIPTION: Biologic methods have been shown capable of degrading munition ingredients such as TNT and RDX, but no work has been found on application to nitrate-ester-based substances or to the binder/complete formulation. Extension of this type technique to nitrate-ester-base substances and to polymeric-backboned/multi-based propellant might yield a feasible disposal method.

Phase I: Evaluate the applicability of biologic methods for decomposition of: 1) nitrate-ester-based substances, such as Otto Fuel II, metriol trinitrate (MTN), butanetriol trinitrate (BTTN); 2) binders, such as carboxyle-terminated polybutadiene (CTBN), hydroxyl-terminated polybutadiene (HTBN), and polyurethane; and 3) explosives, such as Explosive D (ammonium picrate). Include in the evaluation potential decomposition of polymeric-backboned & multi-based propellants and ingredients. Phase II: Development of a prototype scale-up demonstration to assess the optimizing the technical and economic feasibility of the process.

Phase III: Potential military follow-on efforts to advance state of the art technology with particular application to reclamation of "Explosive D". Explosive D is a toxic substance with no known reclaiming process to date. Anticipated support for this follow-on effort by Navy Ordnance Environmental R&D Program (IHD/NSWC) and Navy Ordnance Reclamation Program (Crane).

Commercial Potential: Industries that utilize oil, fertilizers, pesticides, nitrate ester, stabilizers, and plastics.

N94-069TITLE: Inline Gas/Air Monitoring System for Development and Small Scale Production in Processing Facilities

CATEGORY: Exploratory Development; Environmental Quality

OBJECTIVE: Identify gas/air monitoring techniques and incorporate them into a system that will allow pilot plant facilities for R&D and small scale production of Defence Critical Technologies to comply with the environmental and National Institute for Occupational Safety and Health (NIOSH) regulations due to take effect by the year 2000.

DESCRIPTION: Inline gas/air monitoring techniques have to be identified, procured, and incorporated into a system that will allow pilot plant facilities for R&D and small scale production of Defence Critical Technologies to comply with the environmental and NIOSH regulations due to take effect by Year 2000. The monitoring system should allow small plants to monitor stack emissions for air permits required by the EPA. Currently, pilot plant facilities have to calculate emission by theoretical methods intended for large scale plants that produce a single chemical. The theoretical methods seriously hinder the function of pilot facilities by not providing a realistic estimate of low level emissions. The use of empirical methods for emission will provide the needed realistic data to

maintain capabilities. The engineering problem involves developing an on-line system for pilot plant environments which is able to continually monitor an air steam for 15 or more different types of chemicals in trace amounts. The system will be used to develop a data base for modeling and baseline testing. The system must adaptable to a generic manufacturing environment by being user friendly, easily maintained, and cost effective.

Phase I: Identify and develop gas monitoring sensors and techniques for use in R&D and small scale processing facilities. Using the 150 Gallon Advanced Vertical Mixing Facility at Indian Head Division, Naval Surface Warfare Center (IHD/NSWC) as a test bed. The system designed must be generic and transferable to any small scale processing application. To verify the Phase I design, prepare a test program which detail methods that accurately characterize the facility's processes. Phase II: Fabricate and install the prototype gas monitoring system in the 150 Gallon Advanced Vertical Mixing Facility at IHD/NSWC. Conduct test plan from Phase I to verify design and process. Make necessary modifications for efficiency. Document capabilities of system for public release. Develop data base for modeling and baseline testing.

Phase III: Solicit identified candidates for their particular requirements and tailor Phase II system to produce the baseline data for technology transfer to industry. Potential follow-on effort with particular application to the AEPS programs. Commercial Potential: Industries where emissions need to be monitored to meet NIOSH regulations as well as military pilot plant facilities.

N94-070TITLE: Infrared Sensor Integration for Wearable Damage Control Monitoring

CATEGORY: Exploratory Development; Human-System Interfaces

OBJECTIVE: Develop a wearable computer system with infrared optical sensors for shipboard emergency damage control operations.

DESCRIPTION: During emergency conditions aboard ship, supervisors must make split-second decisions with thought to a large and diverse amount of information specific to the emergency arena critical to safe operations under stress. There is a need to provide damage control supervisors with a wearable computing system that is capable of "seeing" through smoke and obscurants while simultaneously providing access to large amounts of computer-based data. Such a system would increase situational awareness and safety.

Phase I: Develop a wearable computer system with infrared sensors to be worn under extreme adverse conditions found during damage control operations.

Phase II: Design, test, and demonstrate prototype wearable computer that will comfortably integrate to current damage control personnel protective equipment (PPE) on board ship without impacting personnel movement and safety. Demonstration must also show the viability of a scale-up application for transitioning into Phase III.

Phase III: Potential follow-on efforts are anticipated for the Safety, Survivability, and Damage Control Program. Scale-up system to meet the needs of industries that produce fire protection, emergency medical care, rescue operation, or hazardous materials removal equipment.

Commercial Potential: Commercial potential exists in:
1) fire fighting and advanced life support; 2) hazardous/explosive materials control and removal operations; and 3) all highly technical, yet physically interactive fields requiring hands-free applications.

NAVAL UNDERWATER WARFARE CENTER/NEWPORT

N94-071TITLE: Electronic System Analytical Model Capabilities

CATEGORY: Advanced Development; Modeling/Simulation

OBJECTIVE: To provide automated data input tools and additional capabilities to existing computer models to assess the reliability, maintainability, and availability of complex electronic systems. Such tools would have use in design of both commercial and military equipment.

DESCRIPTION:

Phase I: Computer models are being used that estimate the reliability, maintainability, and availability (RM&A) of shipboard electronic systems using stochastic methods to predict the functional influence of failures. Substantial effort is expended in modeling the connectivity of functional elements of the system and the interrelationships of potential failures. These modeling steps are performed with manual labor that translates system design data into appropriate computer model inputs. Changes to the system during the evolution of its design require substantial rework of input data for the computer model. Automation in developing model inputs from design data would speed the modeling effort, and allow model reliability, maintainability, and availability predictions to be effective in the overall system design process.

Elements of system performance that are treated with modest fidelity in current computer models include the influence of software errors and the system maintenance concept. The computer models do not have the capability to include performance modeling and fault localization (PM/FL) capability, maintenance action effects, logistic delays, the availability of replacement parts, and the capability of maintenance technicians in the assessment of system reliability, maintainability, and availability. Including the effects of these system performance capabilities and logistic support limitations would allow the computer models to be more effective in the overall system design and logistics support process.

Phase II: Identify automation techniques to improve the computer model data input process; demonstrate an approach to implementing an automation technique in the computer model. Identify additional capabilities to be added to the computer model to address the impacts of system PM/FL capabilities and the planned system logistics support. Demonstrate an approach to implementing the additional capabilities in the computer model.

Phase III: Implement and demonstrate improvements identified in Phase I.

Commercial Potential: Make computer modeling techniques available, with potential Navy endorsement, to prime contractors developing and supplying electronic systems to the Navy. These analytical modeling techniques will be of use to electronics contractors in designing competitive systems for evaluation by the Navy. Use of these same techniques in development of commercial equipment is also practical.

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/PATUXENT RIVER

N94-072TITLE: Options to Improve Basic Flight Testing

CATEGORY: Advanced Development; Computers

OBJECTIVE: Use areas of research, like expert systems and speech recognition systems, combined with flight test data management systems, to reduce the time required to plan and report flight test results.

DESCRIPTION: The time required for test plans, flight testing, data reduction, and reports needs to be minimized. Expert systems, speech recognition systems, and flight test data management systems could be used to significantly reduce the time required to plan and report test results. A commercially available Test Plan Automation System (TPAS) could be used to help reduce the time required to develop test plans, especially for junior engineers. At the same time, OSD is using expert systems to develop a prototype system to facilitate Test and Evaluation Master Plan (TEMP) development. The TPAS concept could be extended to include flight test reports, and a voice recognition front-end could be added to make the system more user friendly. A flight test data base management system, with appropriate software, could be added to reduce the flight test data processing time. The goal is to have all this capability at the engineer workstation, to help optimize the individual engineer's output productivity. The program should also be compatible with on-going OSD efforts to automate TEMP development.

Phase I: Review existing commercial and military flight test plan automation programs and related expert system flight test applications. Also review applicable voice recognition systems, rotorcraft flight data reduction software, and flight test data management systems. Develop a plan for integrating these technologies for all types of rotorcraft test programs, and for presenting the information to the individual engineer workstations. Start developing the knowledge base required for the program.

Phase II: Implement the plan at a selected military or commercial activity. Develop the required knowledge base for each type test program. Also develop a plan for extending the system to joint services rotorcraft testing, and also to the fixed wing testing.

Phase III: A Navy funded Phase III program to extend this effort to fixed-wing aircraft testing is anticipated.

Commercial Potential: The program is also an excellent candidate for Phase III acquisition by the major commercial aircraft flight test activities.

N94-073TITLE: Advanced Avionics Architecture Stimulator System

CATEGORY: Advanced Development; Modeling and Simulation

OBJECTIVE: Develop a modular avionics/advanced avionics architecture stimulator system which can be used as a development and risk reduction tool to support RDT&E of new avionics, modular avionics, and advanced avionics architectures.

DESCRIPTION: Complexity of emerging modular avionics systems and increased data rates projected in advanced avionics architectures requires the development of engineering tools capable of simulating and analyzing systems level performance. This system could best be defined as a "smart rack" which serves as the backbone for modular avionics integration. The system must be capable of stimulating modular avionics processors and associated embedded software with laboratory-generated or high fidelity recorded data to provide a realistic and dynamic development environment. The type of information required includes aircraft state data together with communication, navigation, identification and sensor data. The system must allow interface between integrated avionics racks populated with modular avionics via backplane and standard signal interfaces with current MIL-STD-1553 based avionics architectures; i.e. to demonstrate advanced avionics in an actual aircraft avionics architecture.

Phase I: Complete a detailed development plan, conduct required trade studies, perform of engineering design and analysis, and complete detailed system design.

Phase II: Construct a prototype system which can be used and refined on avionics test programs planned at Naval Air Warfare Center.

Phase III: Manufacture systems as defined in Phase II for DOD requirements. These requirements will be identified in phase II.

Commercial Potential: This topic has tremendous potential for "dual use" application. Of the eleven broad areas which have been identified by the Defense Technology Conversion Council as key dual-use technologies, this topic could be placed in either the "information infrastructure" or "aeronautical technology" area. Its application throughout the DOD RDT&E community is clear. It also has application to commercial aviation as well as manufacturers with high speed data requirements. Customers for this are NASA and the FAA; and Avionics, Aviation, Electronic, and Computer Equipment Manufacturers.

N94-074TITLE: Rotorcraft Handling Qualities and Flight Control System Specification Personal Computer Tutorial and Database

CATEGORY: Advanced Development; Computers

OBJECTIVE: Develop a rotorcraft handling qualities and flight control system specification PC tutorial and database to enhance rotorcraft flight testing.

DESCRIPTION: The Army made considerable progress in advancing rotorcraft handling qualities criteria during the 1980's. Their work included developing a proposed revision to MIL-H-8501A and the associated background information users guide (BUIG). Aeronautical Design Standard 33C (ADS-33C) was developed for future Army LH testing. Recent Army flight tests were conducted to validate ADS-33C requirements for the AH-64A and

OH-58C helicopters. The Army is currently working to get the proposed rotorcraft handling qualities specification approved as a joint MIL-SPEC. Commercial activities producing aircraft for the Army, and other services like the Navy are currently involved or will be involved in the near future. It is important to get commercial and military flight test engineers and pilots up-to-speed on the proposed rotorcraft handling qualities, and frequency domain specification requirements as soon as possible.

Phase I: Review all previous, current, and proposed rotorcraft handling qualities and flight control system criteria and specifications. Development a proposal to show how this information could be incorporated into a PC tutorial to be used by flight test engineers. Also develop a proposal to show which flight test data are required for the tutorial and how the data can be obtained from typical flight tests to build a flight test database.

Phase II: Develop the rotorcraft handling qualities specification and flight control system PC tutorial and install it at a specified military or commercial activity and tie the PC tutorial into an existing network system. Assist and support two flight test programs to check-out and validate the PC tutorial, showing how flight test data can be added to the database.

Phase III: An Army/Navy funded Phase III effort is anticipated.

Commercial Potential: The PC tutorial will be used by commercial rotorcraft manufacturers, as well as, academic institutions teaching rotorcraft handling qualities theory, and commercial flight test activities.

N94-075TITLE: Aircraft Store Separation Analysis Methodology

CATEGORY: Advanced Development; Software

OBJECTIVE: Develop efficient methodologies and software for store separation analyses using unstructured grids.

DESCRIPTION: Due to its inherent capability to handle complex geometries with ease, unstructured grid methodology has developed rapidly over the past several years. Unstructured grids are able to efficiently incorporate adaptive refinement and moving boundaries. Technology is currently available to model and analyze complex 3-D configurations using unstructured inviscid codes. This technology has been applied recently to aircraft store separation problems using single block tetrahedral fixed meshes. Aircraft store separation is a viscosity dominated, multi-body interaction problem. The Navy is soliciting innovative approaches utilizing extensions (like moving grids and adaptive refinements) to the unstructured grid technology to the aircraft store carriage and separation problem.

Phase I: The objective is to explore application of advanced unstructured grid methodology to the store separation problem and to arrive at a set of guidelines for further development.

Phase II: The objective is the development of a comprehensive, interactive method and software to analyze and predict multi-body store separation behavior.

Phase III: During this phase, utilization of the software would be funded by Navy test projects requiring advanced aerodynamic-structural integration analyses.

Commercial Potential: The objective is to use the software in complex aerodynamic interaction problems between aircraft and stores. The Navy, Air Force, Army and commercial airframe manufacturers would be able to use the software to reduce requirements for expensive and hazardous flight testing.

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/TRENTON

N94-076TITLE: Decision Aid to Assess Propulsion Technology Impact on Availability

CATEGORY: Exploratory Development; Modeling and Simulation

OBJECTIVE: Develop a model that can perform trade analyses to determine the impact of advanced propulsion technologies on engine availability. This decision aid will evaluate whether a particular advanced technology will improve availability when compared to a baseline technology.

DESCRIPTION: The propulsion technology development community's main focus has been on performance. Some promising technologies were never transitioned because it was determined during acquisition they were too difficult to support. Some were transitioned, but support capability wasn't fully secured for several years because supportability issues were addressed too late. This effort will help decision makers identify and pursue the technologies that are more supportable. Also, it will help bring to light any critical supportability issues early in the development and design of future systems. Availability is achieved by design characteristics such as: reliability, maintainability etc. along with support system characteristics like: repair and inspection capability and spares posture. Technologies should be developed and transitioned into fleet engines that optimize the relations between these parameters.

Phase I: Develop a model identifying the relations between all critical parameters for a propulsion system that affects availability. Develop a representative set of metrics to quantify the parameters of this model. Develop a set of decision rules that establish weights (relative importance) between the parameters. Provide a detailed report documenting all Phase I efforts.

Phase II: Develop a database that provides baseline technology metrics for each parameter for all major parts of an engine. This should incorporate the support requirements (equipment and procedures) for each major part. Develop a detailed model and the software for the decision aid. Construct a computer-based, prototype system. Conduct a simulation of the decision aid by imputing a list of advanced propulsion technologies and their metric values to determine their impact on availability when compared to a baseline. Assess the viability of the results.

Phase III: Based on favorable results of Phase II, further develop this model for actual application.

Commercial Potential: This decision aid will be easily modified for applications to commercial aircraft systems. Also many other technical areas are confronted with decisions of technology insertion and their impact on availability.

NAVAL AIR WARFARE CENTER/AIRCRAFT DIVISION/WARMINSTER

N94-077TITLE: Low Cost Six Degree of Freedom Accelerometer

CATEGORY: Advanced Development: Human - System Interfaces

OBJECTIVE: Develop an accurate, low cost, light-weight, miniaturized six D.O.F. accelerometer for use in evaluating injury potential of aircraft crew escape systems.

DESCRIPTION: Injuries sustained during escape from aircraft are dependent on numerous factors, including the type of maneuver under way, crewmember positioning at escape initiation, helmet impact with canopy, crewmember physiology and anthropometry, etc. As surrogates, manikins are widely used for evaluating escape system performance and potential for injury. The techniques which can be used to relate manikin dynamic responses to prediction of injury, generally require measurement of several parameters, including the linear and angular accelerations of various anatomical segments.

Current six D.O.F. measurement techniques based on cluster accelerometry alone, or in combination with other angular measurement devices, are judged to be too expensive for this application.

A need, therefore, exists for a low cost, accurate, light-weight, miniaturized accelerometer capable of measuring linear and angular accelerations about three perpendicular axes. Errors from cross talk, bias offset, thermal effects, etc., should be small.

Phase I: Phase I should result in a detailed conceptual design, analysis and proof of concept.

Phase II: Phase II consists of prototype development, demonstration, validation and hardware delivery.

Phase III: See Commercial Potential

Commercial Potential: Commercial Aircraft Inertial Navigation Systems, Automotive Navigation Systems, Automotive Crash Dummy Investigations (Auto, Insurance Labs, DOT).

N94-078TITLE: Microindenter System for the Fabrication of Microcracks

CATEGORY: Basic Research: Materials

OBJECTIVE: To develop a new computer controlled microindenter system that will allow the operator to introduce simultaneously two indentations in close proximity and in perfect alignment on a crystalline substrate. The device will be capable of controlling, via a computer, the applied load, the indenter orientation and the positions of the indentations on the substrate. The substrate support and the diamond indenter head will be independently temperature controlled via the computer and the process will take place in an inert gas atmosphere.

DESCRIPTION: A completely new approach for microelectronics device fabrication consists in the incorporation of cleavage microcracks on an otherwise crack free material. Once the microcracks are introduced, they can be filled with different electronic materials to achieve the desired electronic properties. In order to succeed in this new approach, a controlled way of introducing microcracks in crystalline substrates is required.
Commercial microindenters have been used to introduce microcracks in crystalline substrates. Unfortunately, they have only one diamond pyramid in the indenter head and the positioning of the substrate relative to the indenter is performed manually. As a result, alignment of the indentation marks is difficult and poor microcracks develop. This problem can be solved by incorporating two aligned diamond pyramids in a single indenter head. The diamond pyramid tip to tip separation being approximately 2000 mm. A computer controlled substrate positioning table would allow for the incorporation of multiple microcracks in one substrate for multielectronic device fabrication. The applied loads will range between 100g and 2000g. The substrate and indenter head temperature control would allow the cracks to grow without introducing further plastic deformation. Finally the controlled gas atmosphere would prevent contaminants from entering the crack region.

Phase I: Development of two perfectly aligned double Vickers indenter heads for use with a standard Tuckon 300 commercial microindenter from Wilson Industries. One of the double Vickers indenter will be fabricated so that the pyramids have a common side while the other will be fabricated so that the pyramids have a common vertex. The tip to tip separation in both cases will be approximately 200 mm. Also, a final report will be produced that will outline the approach which will be undertaken to pursue the requirements for Phase II.

Phase II: Development of the complete computer controlled diamond indenter system. The indenter will include the optics, computer controlled positioning and loading, substrate and indenter head temperature control, software and double diamond pyramid indenter heads.

Commercial Potential: This device will have the capability of measuring many mechanical properties of materials, such as: Elastic Modulus, Hardness, Fracture Toughness, wear resistance, interfacial properties and all at several temperatures. Potentially new electronic devices could be fabricated with this device.

N94-079TITLE: Active Control of Aircraft Vibrations using Chaos Theory

CATEGORY: Exploratory Development: Modeling/Simulation

OBJECTIVE: To devise a methodology that is based on Chaos Theory that suppresses vibrations and improves the ride quality of helicopters. The usefulness of the methodology needs to be demonstrated with an application to either a military or a civilian helicopter.

DESCRIPTION: At the Naval Postgraduate School, Chaos Theory has recently been applied to vibration reduction in helicopters. The flight test sensor data that was used was divided into two components: (1) Harmonic Component and (2) Chaotic Component. The harmonic component was deemed controllable, with the associated benefits being possible vibration reduction and improvement in structural life. Chaos Theory has been applied in various scientific disciplines, chiefly sponsored by the Office of Naval Research. However, the theory has not reached a stage where it can be put to practical use in an aircraft. Further research is needed to establish the usefulness of Chaos Theory to the active control of nonlinear vibrations in helicopters. Also, other potential applications to aircraft need to be investigated.

Phase I: Phase I of the SBIR should involve a clear methodology to suppress vibrations in helicopters based on Chaos Theory. Other possible applications of Chaos Theory should be stated. Also, the implementation aspects of the methodology need to be discussed.

Phase II: Phase II would involve analysis of flight test data and feasibility demonstration of the active control strategies via simulation and testing.

Phase III: Phase III funding depends on the significance of benefits demonstrated in Phase II.

Commercial Potential: Helicopters are used for civilian applications such as transportation of medical patients, police patrol, etc. Thus, the associated benefits of vibration reduction and increase in structural life carry over to the private sector also.

N94-080TITLE: Development of a Fine Water Mist Nozzle System

CATEGORY: Advanced Development; Materials and Processes

OBJECTIVE: To develop a Fine Water Mist Nozzle System to disperse 10 micron diameter droplets. The successful system will rapidly produce high velocity droplets for turbulent mixing in aircraft compartments for fire protection and explosion suppression.

DESCRIPTION: Fine Water Mist technology is being researched and developed for Naval aircraft fire protection and explosion suppression. Currently, air atomizing and hydraulic type atomizing nozzles are being studied. A need exists to develop a converging-diverging nozzle to produce high velocity small diameter droplets. The successful nozzle system must be small and light weight, activate in a temperature range of 65^{o}F to $+300^{o}$F, conform to MIL STD 704E Aircraft Electrical Power Characteristics and conform to an aircraft environment. It is important that droplet size be small (10 microns) so that a large surface area con be covered by a relatively small volume of water. It is of equal importance that droplet velocity be high, especially in the case of explosion suppression. The droplet velocity and system response must be faster than the velocity of the pressure wave of the deflagration of a JP-4 or JP-5 fuel-air mixture to successfully prevent an explosion. Both droplet size and droplet velocity must be verified.

Phase I: A Fine Water Mist Nozzle System design is expected as a deliverable of Phase I. The system will include the successful nozzle design for dispersion of high velocity small diameter droplets. A final report must be provided, outlining the Computational Fluid Dynamics process used to determine the prototype design.

Phase II: Testing by the contractor is required to determine droplet diameter, droplet velocity and system response. It is expected that the contractor will conform to aircraft parameters for weight and electrical requirements. Verification tests will be accomplished by the government to determine system parameters and performance including: droplet diameter; droplet velocity; time response of the system; temperature performance; fire extinguishment/explosion suppression capability; weight requirements and aircraft electrical requirements.

Phase III: The Phase III effort anticipated is to replace all Halon fire extinguishment systems with the Fine Water Mist Systems. Further, additional aircraft fire protection would be provided by the successful Fine Water Mist System where there is currently no fire protection/explosion suppression capability.

Commercial Potential: The commercial potential is enormous for this effort. Commercial use of the nozzle could include: Commercial Fire Protection, Chemical Processes, Evaporative Cooling, Moistening and Wetting, Dust Suppression, Humidifying and many additional applications.

N94-081TITLE: Narrowband Optical Filter for Laser Radar Applications

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: To develop a narrow linewidth optical filter for use in a laser radar receiver. The linewidth must be less than 5 angstroms and have a transmission of greater than 80%. The filter must be scaleable to at least 6.5 cm clear aperture and have a field of view of at least 15 degrees full angle. The filter need not be tunable, but it must be

able to be designed to operate anywhere in the green wavelength region (510-550 nm). The filter must be able to be used in an imaging receiver system.

DESCRIPTION: Presently the Navy is exploring the use of Laser Radar for underwater detection near the water surface where the acoustic techniques are limited. There are a number of programs that are developing systems to perform these tasks. One of the issues with these systems is the solar background, which limits the daytime performance. To achieve equal daytime/nighttime operation a narrow linewidth optical filter is needed to reject all light except within a narrow width centered at the transmitter wavelength. Presently a 2 nm interference filter with 70% transmission is being used as a base line. If a filter is used with a transmission linewidth ratio greater than the base line it will reduce the requirements for the laser transmitter or enhance the performance depth. The transmission can be smaller, however the ratio of the transmission per bandwidth must be greater than 16%/angstrom. The field of view can be reduced or enlarged if the aperture is changed while holding the aperture-field of view product constant (100 degrees cm).

Phase I: Should address the design and critical technical issues associated with the production of these new filters.

Phase II: Should provide a high quality prototype filter with the maximum bands of 0.5 angstrom, field of view of 15 degrees full angle, clear aperture of 6.5 cm and at least a 20% transmission.

Phase III: At least two classified 6.2 programs exist which would use this technology.

Commercial Potential: Any filtering device developed can be used in any system hampered by the solar background, for example, remote sensing of chemical pollutants and astrological observing.

NAVAL AIR WARFARE CENTER\WEAPONS DIVISION\CHINA LAKE

N94-082TITLE: Fiber Optic Interface for High Power Density Laser

CATEGORY: Advanced Development; Light and Optical Systems

OBJECTIVE: The objective of this project is to design, fabricate, and test a fiber optic interface device which will improve coupling of high energy, pulsed lasers into commercial fiber optics at a low cost per device.

DESCRIPTION: Development of low cost laser initiation systems for ordnance applications has been frustrated by the difficulty of interfacing high power, short rise energy pulses into an optical fiber. Energy losses are unacceptable due to high reflectance at the fiber surface and damage to the fiber due to absorptive imperfections.

Phase I: Develop preliminary design approaches and evaluate feasibility.

Phase II: Design and demonstrate prototype devices. Design goals are:

Reflective loss: <10% at device input, <10% at device output
Internal losses: <15%
Input diameter: 2000 um
Output diameter: not to exceed 200 um
Peak power density: 5 MW/mm2
Pulse duration: 50 nsec
Cost in quantities >100: not to exceed $ 80 each

Phase III: Transition to military ordnance community. Determine interest in medical/surgical community and industrial welding, heat treating, and material removal applications.

Commercial Potential: An improved coupling technique for high power lasers would have immediate application in industrial processing and laser surgery systems. Specifically, elimination of mirrors would result in savings in system size, weight, and complexity.

N94-083TITLE: New Nonlinear Optical Material for High Speed Optical Signa Processing

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: Prepare 2nd-order nonlinear optical polymer (NLOP) film material for integrated optical microcircuits (optical chips).

DESCRIPTION: Optical chips, employing electro-optical waveguides, to be fabricated from the NLOP, require a material with macroscopic polar order. An electric field, applied across the NLOP waveguide, switches the light at rates > 60 Ghz.

Phase I: Deliver two grams of an amorphous, organo-soluble, film-forming, polymeric material in which the chromophore is chemically part of the polymeric material. Specific targets for this material are as follows:

1) the wavelength of the electronic charge-transfer absorption maximum in the bulk material should be greater than 400 nm,

2) the absorption coefficient at a wavelength of 1.3 microns in the bulk material should be less than 0.5cm $^{-1}$,

3) the chromophore concentration in the bulk material should be greater than 10 x 10^{20} chromophores per cubic centimeter,

4) the ground-state dipole moment of each chromophore should be greater than 5 D,

5) the glass transition temperature of the NLOP, in the finished optical waveguiding form, should be greater than 210_C,

6) the NLOP must be chemically stable, should not contain azo nor other groups that undergo thermal or photolytic isomerization.

A final report will be delivered which summarizes results of phase I work, and outlines the approach for phase II work.

Phase II: Deliver ten channel waveguides of high optical quality, prepared from the successful NLOP, that have an aged, electro-optic coefficient (r_{33}) greater than 30 pm/V, retain 95% of this value after heating to 125_C for 24 hours, and have less than 1.0 Db/cm optical waveguiding loss. Deliver ten grams of optimized second-order nonlinear optical polymer (pre-film material) and 50 grams of optimized buffer-layer polymer. Deliver a final report that recommends preferred processing conditions (e.g., solvents, baking and poling conditions). Deliver an environmental impact statement for producing larger batches of the polymer. The final report will summarize results of phase II work, and outline the approach for phase III work.

Phase III: A pilot plant will be built for production runs of NLOP. The technology will be transitioned to commercial and/or government R&D polymer chemical facilities. Optical chip fabrication will be done at China Lake and/or at the U.S. Army's MICOM laboratory (Huntsville, AL), IBM (Almaden, CA), Lockheed (Palo Alto, CA), COMSAT (Clarksburg, MD), Electrical Eng. & Computer Sci. Dept. U.C. (Davis, CA).

Commercial Potential: Optical signal switches, phase shifters and modulators will find wide commercial use in fiber-optic communications systems, avionic systems and hybrid computers.

N94-084TITLE: Deployable Airfoils

CATEGORY: Exploratory Development; Vehicle Structures

OBJECTIVE: Explore concepts and develop solutions for close-coupled, deployable airfoil deceleration and stabilization subsystems and recovery subsystems for use in tactical aircraft emergency egress systems.

DESCRIPTION: As documented in the Reference (1), the conditions associated with the use of Naval emergency escape systems are extremely severe, primarily because of operational environments aboard aircraft carriers. As a result, the majority of current Naval aircrew fatalities and injuries occur during low-airspeed, low-altitude escapes, with half of the fatalities due to ground or water impact before seat/man separation or before the recovery subsystem can be fully inflated. Deployable airfoils, powered by the ejection propulsion system, are capable of much faster inflation and offer greatly enhanced flight control and maneuverability characteristics than parachutes. A joint Navy/Air Force program exists to develop advanced technology for an ejection seat with controlled flight and vertical-seeking capability through thrust vector control of the propulsion system. The successful conclusion of this technology development will provide an opportunity to use rapid opening deployable airfoils for deceleration/stabilization and final recovery.

Phase I: Conduct a six-month study to explore various alternative concepts deployable airfoils, and define the most promising concept(s). The preferred concept(s) must be appropriate for use in ejection seats.

Phase II: Demonstrate the concept(s) chosen during Phase I by constructing, testing, and evaluating deployable airfoils to verify performance.

Phase III: Transition the technology to a contractor where the deployable airfoil will be produced for use in advanced aircraft emergency egress systems, In turn, the contractor will gain the technical and production knowledge associated with the deployable airfoil which later can be marketed for commercial use.

Commercial Potential: The technology has application in the private sector in the ultra-lightweight aircraft industry.

N94-085TITLE: Low Cost Integrated Circuit Design and Fabrication using Shared Mask Methodology

CATEGORY: Exploratory Development; Design Automation

OBJECTIVE: Design and develop a system of manufacturing integrated circuits (IC) in small volumes using shared masks for gate arrays (similar to the ARPA funded "MOSIS" process for standard cell IC's).

DESCRIPTION: DoD typically has requirements for small volumes of integrated circuits (<1000 IC's). Full Custom and Standard Cell methodologies are high cost/long lead time/high volume items compared to gate-array technology. However, there are still significant costs associated with processing and mask fabrication. By sharing

the processing/masking costs across several customers, the costs can be reduced by a factor of at least ten. While this process is similar to the MOSIS process in philosophy, it is different in that it is applicable to gate-arrays (semi-custom IC's).

Phase I: This phase will include the design, fabrication and testing of sample gate arrays.

Phase II: This phase will include a full scale multi-project gate array fabrication run.

Phase III: This phase will include COMMERCIALIZATION of the service for both DoD and Industry.

Commercial Potential: This process could be used by commercial vendors as well as the military industrial complex, for any IC development program where small quantities are required. For example - signal processors, computers, high resolution TV, communications, college lab courses, state machine implementations, digital neural nets, etc. The applications for this program are endless.

NAVAL AIR WARFARE CENTER/WEAPONS DIVISION/PT MUGU

N94-086TITLE: Binary Optics for Electro-Optical Sensors

CATEGORY: Exploratory Development; Design Automation

OBJECTIVE: Assess the utility of binary optics to airborne electro-optical sensors

DESCRIPTION: Binary optics is a term to categorize optical elements made by a relatively new manufacturing process that eliminates most of the steps previously required for lens making. Desired shapes are etched directly to the surface of the optical material using integrated circuit manufacturing techniques. These techniques permit creation of intricate monolithic microlens structures. Lens packing densities can exceed 20,000 per square centimeter. Diffraction effects are used to control light instead of the conventional refraction. As a result, binary optical techniques are well suited to directing laser light. Because very small lenses can be produced with high quality, binary optics arrays are well suited as sensor systems focusing and relay optics, scanning optics and transducers.

Phase I: Devise methods to improve onboard, aircraft sensors and missile seekers through the utilization of binary optics. Predict sensor and seeker performance improvements. Predict vulnerability impact to onboard, countermeasures devices due to missile seekers employing binary optics.

Phase II: Validate predictions by making laboratory measurements of the effectiveness of one or more of the devised techniques.

Phase III: This binary optics effort will be transitioned into a brass board sensor development.

Commercial Potential: Binary optics will find many commercial applications including medical instruments.

N94-087TITLE: Low Altitude Station Keeping Optical Instrumentation Platform

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: The object of this Topic is development of a small unmanned airborne optical data collection system.

DESCRIPTION: The Navy currently uses high accuracy mounts which carry cameras outfitted with telescopes to record weapons tests. Most of these systems are mounted in precisely surveyed towers located at strategic locations on a test range. A few of these systems, equipped with special stable platforms, are mounted in aircraft. The systems on the ground are often unusable because of low altitude haze or fog. The aircraft mounted systems are often unusable because of the cost of deploying the aircraft and because the aircraft cannot be brought close enough to the test, for safety reasons, to collect adequate optical information. The desired characteristics of this topic's optical instrumentation platform are as follows: Ability to remain on station for periods of up to 8 hours at wind speeds of up to at least 35 knots; ability to collect optical information annotated with the direction the telescope was

pointed and the time of day for which the data applies, ability to detect and record high speed encounters such as a MACH 4 missile approaching head on to a MACH 3 aircraft. The Navy can furnish certain items such as radio down uplinks and downlinks for controlling the system as it is directed to and from its station keeping location. While a total system is desired the Navy will consider proposals to develop parts of the system. The Navy will support contractor testing at a Navy test range.

Phase I: Development concepts, test high risk devices, prepare specifications for a prototype.

Phase II: Develop and flight test a prototype.

Phase III: Produce 10 to 15 units for verification of produceability and field testing.

Commercial Potential: This technology has application in situations where a close-up airborne view is needed but the situation is too hazardous for manned aircraft or airships. Typical applications would be riots, burning ships or oil platforms, forest fires, assessing damage during bad weather, and detecting personnel or aircraft crossing international borders.

N94-088TITLE: GPS Translator For Small Missiles

CATEGORY: Exploratory Development; Navigation, Guidance, and Vehicle Control

OBJECTIVE: Develop a Global Positioning System (GPS) translator system, for use in small, highly dynamic, air launched missiles. The system receives position and time information from four or more satellites and translates the information to signals that can be digitally multiplexed on IRIG standard telemeters.

DESCRIPTION: The typical small air launched test missile has a volume of up to fifteen cubic inches allocated to radar beacons to aid determining time, space, position information during test firings on instrumented ranges. The tracking of missiles with radar requires line of sight coverage during missile flight. The flight envelopes of current and future missiles make it impractical to provide line of sight radar coverage at land ranges and virtually impossible at ocean ranges. Also, the position accuracy obtained by the best range instrumentation radars is not sufficient to evaluate end game results without additional complex instrumentation. The requirement is for a four or more channel GPS receiver and data link capable of providing the accuracy for unaided end game evaluation, over the horizon coverage, inertial interpolation of position sufficient for ten to fifteen updates per second, and one second launch initiation. The massive commercial market for GPS equipment is stimulating rapid advances in GPS engine components. The telemeters used in test missiles provide an available transmission link for GPS signals. Inertial data available through test instrumentation in missiles undergoing development could provide the needed source of interpolation information between GPS updates. The merging of these data sources would provide the opportunity for meeting the requirements of missile test instrumentation.

Phase I: Conduct a 6 months study to identify components and interfaces of the elements of a small missile GPS translator system that meets the above needs.

Phase II: Design, fabricate and test a breadboard design of the small missile GPS translator including antennas, GPS engine, inertial interface, and telemeter interface.

Phase III: Design, fabricate, and test three prototype models of the small missile GPS translator and document the design for transition into a production program.

Commercial Potential: The technology has application in the private sector where small sized, rugged GPS sensors are needed. When interfaced with new or existing communications links, this technology would provide long distance, precise position information to central control centers on aircraft and commercial land vehicles for many functions including: emergency search and rescue location, crash location, and traffic control.

N94-089TITLE: GPS Processing for Scoring

CATEGORY: Advanced Development; Navigation, Guidance, and Vehicle Control

OBJECTIVE: Develop techniques for using signals from the Global Positioning System (GPS) for scoring the engagement between a guided missile and a target (aerial or surface).

DESCRIPTION: GPS provided both Time-Space Position Information (TSPI) and, if processed for this purpose, velocities and accelerations.

Multiple GPS receiving antennas on the same vehicle, observing the same GPS satellites, can provide attitude. Combination of these outputs allows definition of vectors in space to describe vehicle dynamics. Comparison of the dynamic vectors for two vehicles passing each other in space is a definition of scoring wherein both the vector miss distance and attitude at the time that the weapon would detonate is determined. Processing of the GPS signals from the missile and the target could be accomplished on the target vehicle and the results transmitted to the remote control station; or the GPS signals received at each vehicle could be transmitted independently to the remote control station for resolution.

Phase I: Examine the parameters of this technique and the physical and dynamic characteristics of current and planned weapon/target engagements to determine the extent to which this technique will apply to the wide dynamic range of potential engagements (scenarios).

Phase II: Presuming that this technique applies, assemble an engineering development model that can be demonstrated in conjunction with support by the NAWCWPNS, Point Mugu.

Phase III: Presuming a successful demonstration, assemble six pre-production prototypes (six missile and six target systems) and specification for competitive procurement. Conduct test and evaluation (T&E) on the six prototypes systems to determine performance capabilities and produce a final report.

Commercial Potential: Although scoring is considered peculiar to weapons and DOD applications, there are other possible adaptations that include use for formation operation of unmanned vehicles (including targets), close approach of two independently controlled vehicles (space vehicle docking or aircraft approach warning) and automated control of two approaching vehicles so that they do not collide.

N94-090TITLE: GPS Synchronized Time Code Generator for Airborne PCM Applications

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Develop a time code generator that can continuously read and synchronize to time information available on the GPS (Global Positioning System).

DESCRIPTION: The ability to insert accurate time information into PCM data is a prime requirement in modern test programs that require the time correlation of multiple events. Until now, time code generators could be synchronized only before the test and allowed to free run for the duration of the test. This has meant that time errors would increase dramatically as test times increased. With the advent of GPS and the availability of GPS receivers for virtually any application, the means now exist to have the correct time information inserted into PCM data at all times.

The time code generator would include an accurate clock source and output the time whenever requested by the data acquisition system. It would use the serial data from the GPS receiver to resynchronize at specified intervals. This design approach would assure that time information is still available even if there was a failure in the GPS receiver.

Phase I: Perform a detailed design including all electrical and mechanical specifications. Submit detailed documentation to the sponsor for review and approval.

Phase II: Manufacture and test five prototypes. Deliver prototypes to sponsor for evaluation.

Phase III: Full Qualification and Limited Production Run serving both Military and Commercial environments.

Commercial Potential: This type of technology has both Military and Commercial applications for accurate location and communications for air, ground, and ocean vehicles.

N94-091TITLE: Universal Two Stage GPS/INS Integration for Test Range Applications

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: The objective of this program is to develop and test an innovative estimator for combining GPS with inertial measurement systems which will be universal in the sense that it will not require custom filter design. Such universal integration with virtually any inertial system would save both non recurring engineering and software development cost.

DESCRIPTION: Recent work on closed form nonlinear estimators for solving the GPS pseudorange equations has provided a method for integrating GPS with inertial systems which promises both increased accuracy and simplified, cheaper GPS/INS integration. By using different norm constraints to estimate the solutions to the pseudorange equations, different robustness and accuracy requirements can be met, reducing transient effects and the need for data editing schemes which may cause filter divergence. By prelinearizing the integrating filter with these point estimates, it is possible to develop a universal integration method for virtually any inertial system. Such a scheme would allow integration with the need for custom filter design, thereby reducing non recurring engineering and software development cost.

Phase I: Develop and test software prototypes of universal integration schemes using point estimators based on various norm constraints designed for robustness to outliers, near sufficiency, minimum variance, noise suppression and mitigation of the effects of large deviations.

Phase II: Develop and flight test a hardware prototype.

Phase III: This technology has application to military test and training ranges and commercial, private and military aircraft.

Commercial Potential: This type of integration scheme could result in substantial savings and simplification for navigation equipment for commercial aircraft. It could also provide a ready source of inexpensive off the shelf navigation equipment for private aircraft.

N94-092TITLE: Digital Relay, Reporter, and Responder

CATEGORY: Exploratory Development; Communications Networking

OBJECTIVE: To use modern digital techniques to perform chirp waveform generation and pulse compression in a reprogrammable device. This device could then be used as a Relay, Reporter, and Responder (R-cubed) unit, and be reconfigured on-the-fly to emulate other data link transceivers.

DESCRIPTION: The existing R-cubed units have characteristics that are favorable for sea range applications, including a single hop transmission distance that meets requirements. One disadvantage is the restrictions imposed by the frequency allocation, i.e. no land range use is allowed. With the trend towards interoperability between sea and land ranges, being pushed by the littoral zone combat scenario, a modernization of data links is required.

Phase I: Conduct a 6 month study to determine if existing digital technology has advanced enough to make digital R-cubed feasible. Design a capable R-cubed unit.

Phase II: Fabricate and test a digital R-cubed prototype.

Phase III: The results of this effort would be combined with related efforts, such as the Standard Interoperable Data-link System (SIDS), to produce the next-generation data link transceiver.

Commercial Potential: The existing R-cubed units are being sold to other countries, so any improved version would have customers. One of the features of digital technology is an ability to change frequencies of operation, and this would benefit customers in other countries with different frequency allocation considerations.

NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER/RDT&E DIVISION (NRAD)

N94-093TITLE: Hopping Adaptive Interference Canceler

CATEGORY: Exploratory Development; Communications Networking

OBJECTIVE: Develop, demonstrate and test a Hopping Adaptive Interference Canceler (HAIC) to suppress radio frequency interference among collocated hopping UHF radios.

DESCRIPTION: Command and Control Systems require multiple radios operating in close proximity. All services are incorporating frequency hopping radios in their Command and Control Systems. Multiple radios of this type operating in close proximity suffer from degradation due to collocation interference problems. A HAIC will substantially reduce the degradation by suppressing interfering signals at the receivers. The HAIC must be capable of adapting quickly to each frequency hop to suppress noise sidebands.

Phase I: Design and development of a two channel UHF HAIC breadboard model for laboratory evaluation.

Phase II: Design and development of a four channel VHF/UHF HAIC suitable for limited field test with hopping radios. Demonstrate improvement in Bit Error Rate performance of the collocated radios with the HAIC operating.

Phase III: Transition to SPAWAR and UAV PEO to support development of multiple channel collocated frequency hopping VHF/UHF Communication Systems.

Commercial Potential: This technology has commercial application to mobile telephone systems and wireless networks including aircraft, vehicle, and fixed site systems.

N94-094 TITLE: Digital Compression and Error Correction for Video Images

CATEGORY: Exploratory Development; Communications Networking

OBJECTIVE: To measure the performance of various video compression techniques when a channel introduces noise or distortion.

DESCRIPTION: The goal of this project is to identify a video compression technique appropriate for use with JTIDS. Because of high bandwidths necessary to transmit video information, compression schemes are generally required; however, the subjective effects of compressing an image, corrupting the compressed image via voice or channel effects, and then uncompressing, are not clear. This project will determine the level of corruption that various image compression techniques can tolerate. Variables include the amount of noise, other types of corruption, and the compression technique. In order to evaluate compression techniques, a software tool will be developed and used. This tool will compress a video image according to a candidate compression scheme, introduce noise or distortion, then uncompress and display the image.

Phase I: During a six month period, the necessary software tool will be designed. Because of the need for an interactive, flexible simulation, an object-oriented design is expected. Also during this period consideration will be given to how the test images will be obtained or generated (video image boards, etc.).

Phase II: Write and test simulation software, and integrate any hardware identified in Phase I. Identify, test, evaluate and report on a range of candidate compression and error correction schemes under a variety of channel conditions.

Phase III: The successful compression technique(s) will transition into an applique for transmission by a JTIDS terminal using existing Reed-Solomon encoding or unencoded formats.

Commercial Potential: This work has applications in HDTV.

N94-095TITLE: Develop A Strategic Industrial DUAL-USE Domestic Capability for High Performance 6-in and 8-in Silicon-on-Sapphire (SOS)

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: To develop a viable, affordable domestic capability of dual-use high performance, high device-quality, very thin layer (0.03 to 0.1 micrometer) silicon on sapphire substrates for use by the U.S.

semiconductor/integrated circuit industry in the fabrication of high-performance electronic components required by both the military and the commercial market of the late-mid nineties-early 2020's. These requirements cannot be met by current silicon wafers; they can, however, be satisfied by thin film silicon on insulator (TFSOI). And sapphire is the most optimum insulator.

DESCRIPTION: Today, the diameter of Sapphire substrates is no greater than 5-in. Very soon, all domestic suppliers of microchips will migrate to the 8-in and larger diameters. To accelerate SOS acceptance by industry-at-large, the supply of high quality, large diameter-sapphire is required to insure the manufacturability, affordability at competitive prices and realize the economic impact (yield, cost/cm^2 of processed silicon die).

Phase I: The technical issues hampering the growth of large diameter sapphire substrates will be clearly defined and solutions established experimentally demonstrating unequivocally the manufacture of large-sized sapphire substrates (6- and 8-in. in diameter), monocrystalline, free of defects, dislocations, lineages and other crystalline imperfections.

Phase II: Pursuant the availability of defect-free large-diameter (6- and 8-in) sapphire, the potential contractor shall develop the techniques to provide highly uniform (less than 5% total thickness variation across the whole wafer) thin film (0.03 to 0.1 micron) silicon on sapphire (TFSOS).

Phase III: The technique will be transitioned to the Joint Directors of Laboratories (JDL)/Tri-Service Technology Panel on Electron Devices (TPED)/Reliance Project as the implementation substrates for radiation-hardened high performance signal and data processors (Office of Naval Research PE 0602234N, Project RS34M40, Microelectronics Block CS2A). Another possible application is improved, low power, low-cost cellular communications.

Commercial Potential: Exists in the computers, communications, multimedia, wireless personal communications/telecommunications industries.

N94-096TITLE: Human-Computer Interaction with Voice/Eye Tracking

CATEGORY: Exploratory Development; Human - Systems Interfaces

OBJECTIVE: To develop a human-computer interface (HCI) that integrates voice recognition and eye tracking to interact with a 3-D display on a UNIX graphics workstation.

DESCRIPTION: Eye tracking and voice recognition are now viable technologies, but they are not integrated together. Since they are new technologies, the HCI for their integration with each other and with the computer interface has not been developed. Once this HCI integration is accomplished these technologies can be used as needed.

Phase I: Using available eye tracking and voice recognition devices, develop an interactive interface on a computer platform of choice. Investigate various HCI techniques to control 3-D scenarios, including pointing, selecting, menu control, activating buttons and potentiometers or knobs, inputting data, changing scene characteristics such as color and size, and moving objects around. Based on Phase I findings, propose a Phase II system that would optimize the HCI eye tracker-voice recognition interface on a 3-D UNIX graphics workstation.

Phase II: Develop a system and techniques that would optimize the HCI eye tracker-voice recognition interface on a 3-D UNIX graphics workstation that is adaptable to various scenarios that use 3-D models, 3-D rendered images, and simulation software on various forms of displays including head mounted and large projected displays. Prepare detailed documentation to guide potential system users through the HCI techniques, details on the setup, interface, and operation of the developed system.

Phase III: These concepts will be transitioned to an ASW sonar and surface search radar system. Major commercial application to benefit from these concepts are medical computer systems, entertainment industry (virtual reality), and disabled persons support systems.

Commercial Potential: The technology has immediate application in medical systems, entertainment industry (virtual reality), and disabled persons support systems, and future application in generic computer interfaces for offices and manufacturing.

N94-097TITLE: Tactile and Proximity Sensing Sheet

CATEGORY: Exploratory Development; Human-System Interfaces

OBJECTIVE: Develop a lightweight, low power collision detection/ tactile feedback distributed sensor sheet that conforms to a variety of surfaces to facilitate control of a multiple-degree-of-freedom robotic system in cluttered environments.

DESCRIPTION: For typical robotics applications, the devices available for sensing contact with or proximity to an object only produce discrete, directional information about the environment relative to the sensor's location on the robotic system. This limits maneuverability of multiple-degree-of-freedom systems in cluttered environments. An ideal solution for this problem would be to develop a sensor "sheet" that provides information physically similar to that of human skin (where the skin provides tactile, force and temperature information, and the hairs provide proximity information).

Phase I: Conduct a six month study that will determine the operational requirements, preliminary design, and feasibility of this sensor sheet. Determine the types of sensors to be used, the power and processing requirements, and performance metrics. The proposed sensor sheet should emphasize simplicity wherever possible, provide, as a minimum, tactile and close proximity (less than 2 inches) information, and should be flexible enough to conform to contoured surfaces.

Phase II: Build a prototype system based on the design proposed in Phase I. Perform rigorous testing on the sensor sheet to determine performance and system reliability. Establish any difficulties associated with heat dissipation, processing, and sensor interference. Document test results and provide suggestions for improvement. Summarize results in terms of performance metrics established in Phase I.

Phase III: The resultant sensor shall be transitioned to a Government Laboratory for integration with available robotic system testbeds. Potential commercial applications include manufacturing, hazardous waste disposal, virtual reality I/O products, and the medical profession.

Commercial Potential: This sensor can be applied to any system which requires collision detection and avoidance capabilities, as well as continuous tactile feedback information for fine motion control. It could be used not only on a robotic system, but also as a means of providing a comfortable lightweight "suit" for interfacing with a human (in this case it would be an effector sheet). This would be particularly useful for Virtual World as well as training simulator applications. It could also be used in hazardous environments where contact with a particular object or explosive could be fatal if quick action is not taken. In the medical field, this sensor sheet should be used by handicapped or paralyzed individuals who can not sense pain or collision.

N94-098TITLE: Photonic Noise and Vibration Monitoring System

CATEGORY: Advanced Development; Light and Optical Systems

OBJECTIVE: Develop a small, low cost, very low power, robust unit for detecting mechanical noise (and other modes of) vibration and radiated signals for equipments and platforms, assessing the condition of and displaying same (e.g. failure of pump seal, excessive generator noise, engine preignition).

DESCRIPTION: Current implementations of noise and vibration (signal) monitoring use hybrid analog and digital technology. The need is more sensors count and processing capacity which is a limitation for digital technology.

Phase I: consists of concept exploration, a photonics adaption feasibility study, selection of approach, followed by the design and production of demonstration prototypes.

Phase II: primarily addresses the certification of the broad application and dual use theory; economies of cost and production engineering. It will produce additional prototypes units, provide for both military and commercial demonstrations, technical and operational testing additional sensor types and complimentary processing.

Phase III: will focus on transitioning of technology to both direct end use and embedding in larger surveillance systems, e.g. the all optical surveillance system. Defense technology conversion funds will be requested to make production cost and units sizes drop, while increasing reliability and performance.

Commercial Potential: There is a potential commercial market for units in continuous service, personal vehicles, home appliances, etc.

N94-099TITLE: Diamond Electronic Packaging Technology

CATEGORY: Research; Materials

OBJECTIVE: To develop a process for burying metal in polycrystalline diamond substrates that would be suitable for the fabrication of a hermetic electronic package.

DESCRIPTION: The increase in computational density in present and future electronic systems increases the amount of power that is used to operate these systems. Current high speed semiconductor circuits dissipate up to 10 W/cm= with predictions of future devices dissipating up to 100 W/cm= by the year 2000. If the military and commercial markets are to benefit from advances in semiconductor technology, innovative research for advanced materials used for thermal management in electronic packaging must be performed. One of the most promising materials for thermal management is polycrystalline diamond (PD). PD has a thermal conductivity of 1000-1800 W/m K, higher than any other prospective packaging material. PD is currently being used as a heat spreader in many applications, but has not been used as material for an electronic package due to lack of buried metalization.

Phase I: Develop and demonstrate process for incorporating buried metalization in PD films. The buried metalization used is to be suitable for the distribution of electrical signals such as used in conventional electronic packaging.

Phase II: Develop and demonstrate process for multilayer metalization with vias for inter layer signal conduction. Multilayer metalization and vias are to accommodate 0.012 inch lines on a 0.025 inch pitch. To demonstrate developed process, a typical lead frame style electronic package will be constructed.

Phase III: Transition to commercial high power, high speed digital electronics such as DEC ALPHA or digital signal processing applications. Transition to Navy Microelectronics Block Program, ARPA Physical Electronics Packaging.

Commercial Potential: Commercial potential for a diamond electronic package is high due to diamond's high thermal conductivity and low dielectric constant (Er=5). This makes a diamond electronic package desirable for high power and high speed applications.

N94-100TITLE: Antimultipath Capability for Global Positioning System Receivers

CATEGORY: Exploratory Development; Navigation, Guidance and Vehicle Control

OBJECTIVE: To develop a subsystem to automatically protect GPS receivers from the degrading effects of multipath
propagation.

DESCRIPTION: Global Positioning System (GPS) and differential GPS navigation receivers have found widespread military and commercial use following Operation Desert Storm. Their accuracy has become so good that the propagation environment at L-band is the principal source limiting accuracy in some applications. Multi-path propagation due to ship superstructure, reflection from the sea, hills, etc., causes pseudorange errors due to code clock jitter or false lock by the receiver channels. Attempts to solve the multipath problem by adaptive nulling arrays are expensive and require multiple antennas. There exists a requirement for a GPS receiver subsystem to suppress the unwanted multipath components, thereby permitting the existing GPS signal processing system to function as it would in the absence of multipath.

Phase I: A feasibility study will be performed to evaluate the concept and to optimize the parameters for C/A and P-code use. Computer simulation will be employed to verify the design concept and to evaluate the limitations of performance for the candidate design with several multipath scenarios.

Phase II: Implementation of Phase I design in the fabrication of two engineering development models capable of being evaluated in a controlled laboratory and tested in a ship, air or shore environment. Test data to be collected to verify antimultipath performance capabilities. Data to be collected with both C/A and P-code signals and with a simple (FRPA) antenna and (if GFE available) an ECCM (CRPA) antenna array. Test data and implementation documentation will be provided in a final evaluation report.

Phase III: This product in hardware or software form would lend itself to commercialization as well as to Navy applications. Technology advancement in DSP chips will make low cost commercial applications attractive and competitive with the MLS at airports.

Commercial Potential: Exists for automatic IFR weather landing system for commercial aircraft; highly accurate land surveying.

N94-101TITLE: Ceramic Composite Electronic Packaging Technology

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: To develop a process for laminating a low temperature cofired ceramic (LTCC) with a dielectric constant less than 5 to a highly thermally conductive ceramic substrate such as aluminum nitride (AlN).

DESCRIPTION: Ceramic materials such as aluminum nitride have a relatively high thermal conductivity (180 W/m-K) but have a high dielectric constant (8.5 - 8.7). It is desirable to have a low dielectric constant material supporting signal i/o because the signal transit time is inversely proportional to the square root of the dielectric constant. LTCC materials have a low dielectric constant but suffer from a poor thermal conductivity (1 - 2 W/m-K). The combination of these two materials provides an optimal solution to the trade off between high thermal conductivity and high speed operation normally encountered in electronic packaging.

Phase I: Develop and demonstrate process for hermetically bonding LTCC to AlN. The minimum sample size used to demonstrate this process shall be 2 inch by 2 inch. The reliability will be demonstrated by subjecting samples to 100 temperature cycles of -65_C to 150_C.

Phase II: Further develop and demonstrate process for laminating a picture frame of LTCC material to AlN. The picture frame of LTCC must contain buried metalization similar to that found in a ceramic electronic package. The multilayer metalization with vias for inter layer signal conduction. Multilayer metalization and vias shall accommodate 0.012 inch lines on a 0.025 inch pitch. To demonstrate developed process, a typical lead frame style electronic package will be constructed. This package shall contain a fixed impedance i/o structure at 50 ohms.

Phase III: Transition to ARPA MMIC phase III, Global Positioning Systems, Distributed Wireless Networking, or other applications fixed impedance, requiring mixed signal or ultra high speed digital packaging solutions.

Commercial Potential: Commercial potential for a ceramic composite electronic package is high due to AlN's high thermal conductivity and LTCC's low dielectric constant (Er=5). This makes a ceramic composite electronic package desirable for high power and high speed applications.

NAVAL CIVIL ENGINEERING LABORATORY

N94-102TITLE: Mobile Battlefield Power Support System

CATEGORY: Exploratory Development; Energy Storage

OBJECTIVE: Utilize advanced technology to develop a mobile hybrid modular high quality power system with reduced pollution, acoustic and thermal signature and which is compatible with standard power requirements of existing government field equipment.

DESCRIPTION: Generators produce excessive noise, heat, and pollution, requiring electrical sources to be located farther from the user. An alternative family of low signature power systems would provide forward command posts with complete electrical support without the need for labor intensive sound and heat shields, while also reducing the need for logistic support in bulk fuels. A modular system design would allow the system to meet various load demands and configurations. Man portable units in the 3, 7.5, 15, 30, and 60 KiloWatt size ranges (larger KW sizes achieved through modularity) would also support the increasing need of for tactical command and control (C2) power supplies. The ideal system should operate from within USMC tactical operations center tentage.

Phase I: Submit an initial architecture design of the mobile modular power system, identifying fuel sources appropriate for deployment to the field and interface capabilities/requirements to make the designed system compatible with existing equipment. Include as part of the design package a unit which would be man-portable, and the modular ability to expand or reduce the load handling capacity of the system. Show that the design will comply with environmental regulations for air and noise pollution, using the strictest state and federal regulations as a guideline.

Phase II: Continue development of the prototype modular power system, demonstrating operation under a load profile representative of field requirements. Demonstrate performance of the man-portable module and life cycle performance expectancies. Improve design to be operable in all weather conditions, reduce maintenance, and improve reliability. Also improve the quality of the power supplied, making it dependable for computer applications. Demonstrate environmental compliance with the strictest state and federal air quality standards, noise and pollution control requirements.

Commercial Potential: Commercial potential exists in the successful demonstration of reliable high quality power supplies which significantly reduce noise and air pollution while providing adequate and varied load profile performance. The modular nature of this system will allow for the application of this power supply to various load requirements.

N94-103TITLE: Man Portable Vehicle Barrier

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: Develop Vehicle Barrier that can be deployed by several people without the aid of lifting/handling equipment. The barrier will have the option of being deployed by vehicle or helicopter when circumstances dictate. The barrier will perform on hard and soft surfaces without surface preparation. The barrier will employ the weight/mass of the vehicular threats to stop the vehicle.

DESCRIPTION: There are many vehicle barriers in commercial/Government use. All of these barriers rely on their own weight, size, and mass to dissipate a vehicle's kinetic energy. None of the current barriers in use address the need to deploy barriers on a short notice by only a few people. Without the aid of some type of handling equipment it would be impossible to deploy them at all.

The barriers that have been developed as man portable have proven to be highly ineffective. The systems rely only on tire deflation as a means to stop vehicle threats. The deflation of a vehicle's tires at high speed does not effectively disable the vehicle. A vehicle can continue to run on deflated tires and the barrier can be averted by filling the tires with foam or other materials in anticipation of such an action.

Phase I: Determine operational/physical requirements. These requirements will be based on intended uses, available materials, and methods of deployment. Evaluate existing concepts. Investigate possible abstracts of concepts. Select most desirable concepts for prototype design, test, and evaluation.

Phase II: Prove barrier design theory through modeling and testing. Develop proven design and provide prototype fabrication drawings for barrier system. Manufacturer a working prototype of the designed barrier, conduct full scale tests and provide test results report.

Phase III: The product is expected to be transitioned to other services within the Government requiring portable vehicle barriers. This would encompass all military branches of service, Justice department, Department of Transportation, Treasury Department, Department of Energy. and the Secret Service.

Commercial Potential: Potential applications for temporary traffic control is believed to far exceed the need for permanent controls. Military applications are include temporary and/or advanced base operations requiring traffic control. May fill temporary needs until "permanent" structures are built.

N94-104TITLE: High Reliability Remote In-Line Fuel Booster Pump

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Investigate and develop reliable, remote (at sea) in-line, self powered, booster pump.

DESCRIPTION: In-line pumping technology is currently focused on land based units that are too heavy. In an amphibious operation near shore bathymetry may require an oil tanker to anchor miles off shore and that distance may exceed the capabilities of existing systems to efficiently transfer products ashore. An in-line booster pump may be stationed 2 miles from either the shore or the ship. Attending to the remote pumping station will increase man power requirements for assault unit. In order to reduce the maintenance burden, a reliable, remotely operated and monitored, product line sensing, self-powered, pumping system must be developed.

Phase I: Investigate state of the art technology in pumps and power supply. Determine characteristics and requirements to achieve the goals of the objective. Develop specifications for the self powered pump and sensors.

Phase II: Design and fabricate prototype system for lab and field testing. Develop tests, evaluate criteria for the prototype.

Phase III: Conduct the test and evaluation of the prototype system. Develop the design specifications for a field system.

Commercial Potential: Uses include temporary product transfer in remote areas, at-sea, or for emergency replacement of existing pumping facility. Development may extend to in line processing.

N94-105TITLE: Use of Microseisms to Predict Seismic Ground Motion Amplification

CATEGORY: Exploratory Development; Terrestrial Sciences

OBJECTIVE: The objective is to develop a means to determine seismic ground motion amplification at marginal sites using microseism recordings and fourier analysis eliminating the need for soil sampling, soil testing and traditional dynamic response analysis.

DESCRIPTION: The Navy sustained a $125 million loss during the Loma Prieta earthquake as a result of amplification of ground motion in marginal soils. Current procedures for predicting seismic ground motion amplification are inadequate to accurately predict the amplification and requires soil tests to determine material properties. Microseismic data can be recorded on soil and on rock and a transfer amplification function can in theory be developed. If this is achieved, a revolutionary breakthrough will be made by eliminating the reliance on soil testing to determine a site's properties and then using those properties in an analysis. Use of microseism data will permit the direct computation of a site amplification function through the recorded time history data converted to spectra from which an amplification transfer function is determined. However, major fundamental unknowns exist in our ability to use the low amplitude microseism data to predict amplification under large magnitude earthquakes. Nonlinear ground response effects and magnitude scaling are key factors which must be evaluated before we can consider microseism data as capable of predicting site amplification for earthquakes.

Phase I: Microseisms are the numerous small earthquake events which occur daily. Strong motion data such as the 1989 Loma Prieta event recorded on Treasure Island and Yerba Buena is to be processed by Fourier analysis to compute a transfer function which will serve as a full scale benchmark of actual observed amplification. Yerba Buena is a rock outcrop while Treasure Island is a site of known high amplification. Instrumentation is to be installed on Treasure Island and on the bed rock at Yerba Buena Island in the same locations as the earthquake strong motion instrumentation is installed and microseism data is to be recorded. Results will be evaluated and reported.

Phase II: Some nonlinear effects of the ground response which will influence the amplification functions are expected. An independent method using material properties and nonlinear analysis will be used to validate microseism amplification results and predictions. The nonlinear response and earthquake magnitude effects which will influence the amplification functions are to be evaluated using finite element analysis and wave propagation analysis. A fundamental part of this research is to develop an understanding of the basic process of site amplification.

Phase III: Develop procedures, equipment and supporting documentation to permit systems to be obtained and procedures defined for conducting analysis. Provide technology transfer in the form of training sessions at Navy Engineering Field Divisions.

Commercial Potential: This research has full potential for non-DOD applications. It will impact civilian construction both at waterfront areas and at other sites where high plasticity clays are found. Users are the civil engineering profession and construction industry.

NAVAL RESEARCH LABORATORY

N94-106TITLE: Bond and Etchback Silicon on Insulator (BESOI) Materials for Enhanced Fully Depleted CMOS Applications

CATEGORY: Exploratory Research: Electronic Devices

OBJECTIVE: Gain the advantages offered by BESOI (Bond and Etchback Silicon On Insulator) materials of low capacitance and fully depleted field effect transistors to develop high speed silicon integrated circuits.

DESCRIPTION: Analyses indicate that fully depleted Si MOSFETs (Metal Oxide Silicon Field Effect Transistors) fabricated in silicon-on-insulator materials will give substantial speed improvements over bulk designs. However, there is little experimental work to demonstrate that the gains can be economically realized in practice. This project will demonstrate these gains by building an integrated circuit utilizing fully depleted deep sub-micrometer gate length FETs on BESOI material. The primary technological issue to be addressed is the ability to produce uniform, undoped, thin (500˜ to 1000˜ thick) superficial silicon on insulator layers.

Phase I: Deliver a final report which: 1) Determines the optimum technique to produce the BESOI material on 150 mm diameter substrates that can be upgraded to 200 mm diameter substrates; 2) Identifies a supplier of the BESOI material; 3) Proposes a demonstration circuit; 4) Performs a first cut analysis to support that choice; 5) Proposes a process flow for fabrication of fully depleted submicron silicon FETs; and 6) Outlines a testing matrix to verify device performance gains and uniformity.

Phase II: Fabricate fully depleted FETs and demonstration circuit on 150 mm diameter substrates. Perform detailed analysis of the fully depleted FETs and demonstration circuit. Using these results, refine the device and circuit models. Provide 50 working test circuits to the government.

Phase III: A navy funded Phase III effort is anticipated.

Commercial Potential: If performance gains and device uniformity are realized, the thin SOI market could be $1B by year 2000.

N94-107TITLE: High Voltage Field Effect Switching Transistor

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: To develop a high voltage field effect switching transistor.

DESCRIPTION: This High Voltage Field Effect Switching Transistor (HVFET) would be used to construct High Voltage Modulators for Radar transmitters.

Radar transmitters use pulsed Magnetrons, Traveling Wave Tubes or Extended Interaction Oscillators/Amplifiers. The drive pulses are provided by High Voltage Modulators, which are usually very

expensive and complicated. As switching elements are currently used vacuum tubes, thyratrons or Silicon Controlled Rectifiers (SCR's), which all have significant drawbacks.

Recently, in an exploratory developments carried out under contract to NRL, VARIAN has developed a working model of a Magnetron modulator, using paralleled strings of cascaded field effect switching transistors, employing commercially available transistors with relatively low drain voltages. Therefore, very many transistors were required, making the design expensive and relatively large.

The millimeter wave EIKA tube which creates 1 Kw pulses at 94GHz requires a 3 kV keying pulse at its grid. The modulator that supplies this switching pulse is commercially available. It uses vacuum tubes as switching elements. The design is very complex; the modulator costs upwards of $ 40k.

Clearly, a better switching element is needed. The proposed switching transistor would have these specifications:
Complementary Pair, one NPN and one PNP transistor, enhancement types:

Peak source/drain voltage	5 Kv
On resistance, max.	10 Ohm
Peak Current (pulse)	5 A
Gate Threshold Voltage, max.	100 V
Power Dissipation min.	100 W
Turn On - Time, max.	20 ns

Phase I : Theoretical Study to arrive at required technology

Phase II: Manufacture of 10 each PNP/NPN transistors

Phase III: Construct Lab Model of modulator for EIKA tubes as proof of concept.

Commercial Potential: Proposed devices have application in commercially built radars for commercial, industrial, military and private uses, further for flyback switching transistors in TV sets.

N94-108TITLE: Enhanced Eye Tracker

CATEGORY: Exploratory Development; Electronic Devices

OBJECTIVE: Improve the real-time performance of the available eye trackers by providing enhancements that reliably and consistently provide an eye position at least 60 times a second.

DESCRIPTION: NRL currently uses an Applied Science Laboratories eye tracker, which calculates an eye position for each video frame 60 times a second. However, there are often brief periods during which the eye tracker fails to identify the eye position correctly. These are much less serious for the non-real-time experimental uses for which such systems were originally developed than for use in a real-time user-computer interface, such as that being developed at NRL. The eye tracker was designed primarily for collecting eye position data that would be analyzed retroactively. The real-time capability needs enhancement. Improvements in eye tracking technology are thus sought to improve the reliability of every single eye position in the data stream.

Phase I: Analyze the real-time capability of existing corneal reflection/pupil eye trackers such as the Applied Science Laboratories equipment, which represents the current state of the art.

Phase II: Develop and implement improvements or new approaches to oculometry that consistently provide more robust eye position measurements at least 60 times a second with no lost positions.

Phase III: The enhancements will be transitioned to the eye movement testbed at NR, for use as an input device to a computer system that recognizes object selection by eye gaze. This improvement would make eye gaze a reliable computer input techniques and greatly expand the use of eye gaze in computer interfaces. Enhancements could be added to the existing equipment at NRL or new equipment could be provided to replace it.

Commercial Potential: The technology has application in the private sector in faster and more reliable communication via computer for handicapped individuals who have no verbal communication capabilities and only restricted movement.

N94-109TITLE: Non-Linear Optical and Solid State Laser Materials

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: To develop materials suitable for direct or frequency converted operation of laser-pumped (especially diode laser) laser operation with tunable or fixed frequency operation from 260nm to 12um wavelength.

DESCRIPTION: Laser and frequency converted solid state laser sources have operated at wavelengths across this whole range of interest but generally with poor efficiency or average power or both. While reasonable one micron sources exist and these have been efficiently converted to 530nm to 2um at reasonable average power, outside this range the average power capability declines abruptly to a few watts or less. Deficiencies are most notable in the deep ultraviolet (<350nm) or the mid-wave IR (2-5um) or long wave IR (8-14um).

Phase I: will consist of evaluation and characterization of the fundamental properties of the proposed material to show suitability of the material for the proposed application as well as evaluation and selection of appropriate growth technology. An estimate of likely obstacles to successful growth such as color centers, undesired valence state of dopants' impurities and proposed methods of resolution will also be performed.

Phase II: will consist of development of growth processes to demonstrate capability to produce crystals at a large enough size scale and of a quality to allow experimental evaluation of suitability for applications.

Phase III: production of crystalline laser and/or EO materials on a commercial basis to support Navy and commercial programs.

Commercial Potential: The materials developed here will have utility for devices such as compact blue/green lasers for read/write optical disc (CD) memory devices, compact IR sources for pollutant sensing and industrial process monitoring and improved industrial and medical lasers.

N94-110TITLE: Large Length, High Frequency Detector

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: The goal of this work is to develop new, large-area, high-bandwidth, 840 nm wavelength, single-element photodetectors for coherent systems. Previously, low-speed, large-area photodetectors have been developed. This work is to develop high-speed, large-area, photodetectors for use in coherent systems critically needed for tactical Navy aircraft. Technical goals are given in Table I. Additional information about the applications can be obtained from NRL Codes 5721, 5730, or 6813 if necessary.

DESCRIPTION: The photodetectors will be used in coherent systems as heterodyne detectors. The design goals of the photodetectors are given in Table I. These items include the short term and long term goals for the bandwidth, dimensions (the larger of large dimension goals should be seriously addressed in the short term), dynamic range, wavelength, transfer characteristic, uniformity across the focal plane, the maximum optical signal, minimum signal-to-noise ratio, and sensitivity. Bidders should have adequate clearance so that selected contractors can receive classified information at the Secret level. Contractors will not generate classified information.

Phase I: will be a design phase during which the contractor will develop the first level design to be used for the short term goals and develop an outline of a suggested approach for the long term goals. The deliverable will consist of a final report. Either or both sensitivity levels given in Table I may be addressed.

Phase II: The deliverable hardware will be 40 packaged photodetectors fabricated to satisfy the performance goals. All delivered hardware shall be completely tested for all performance goals. A complete final report describing all technical work in detail shall be delivered.

Phase III: A Navy funded Phase III is expected.

Commercial Potential: The large-area, high-frequency detector may have application to laser radar for environment monitoring and to laser ranging.

Table I. Coherent Photodetector Needs

Parameter	Photodetector A		Photodetector B	
	Short Term	Long Term	Short Term	Long Term
Frequency (bandwidth)	1.5 Ghz	5.0 Ghz	1.5 Ghz	5.0 Ghz
Dimension (large)	1 mm	5 mm	1 mm	5 mm
(small)	50 mm	100 mm	50 mm	00 mm
Dynamic range[Ü]	40 Db (10^4)	60 Db (10^6)	40 Db (10^4)	60 Db (10^6)
Wavelength	0.80 mm	0.80 mm	0.80mm	0.80mm
Transfer characteristic	linear	linear	linear	linear
Uniformity	10 %	5 %	10 %	5 %
Maximum optical signal	67 Mw	67 Mw	1.1 Mw	1.1 Mw
Min signal-to-noise	10 Db (10^1)	10 Db (10^1)	10 Db (10^1)	10 Db (10^1)
Sensitivity[*]	220 Nw	22 Nw	3.7 nW	370 nW

[Ü]Useful dynamic range above minimum signal-to-noise ratio optical power level.
[*]Determined on basis of heterodyne factor $2(P_sP_r)^{1/2}$. P_s: power in signal beam; P_r power in reference beam.

N94-111TITLE: Fiber Optic Biosensor

CATEGORY: Exploratory Development; Medical Devices

OBJECTIVE: Design and fabricate fiber optic biosensors and fiber optic immunoprobes for detection of infectious disease agents.

DESCRIPTION: Rapid, highly sensitive fluorescence immunoassays can be performed at the surface of an optical fiber using evanescent wave sensing techniques. A portable fiber optic biosensor is required which employs a diode laser and reusable, but easily replaced fiber probes. The device should analyze multiple fiber probes simultaneously and produce a sensitivity comparable to ELISA with response times of 10-15 minutes.

Phase I: Design portable fiber optic biosensor and test breadboard.

Phase II: Build manufacturable prototype of instrument capable of testing multiple fiber probes and develop fiber optic probes suitable for mass production.

Phase III: Test antibody-coated fiber optic probes and fiber optic biosensor for analysis of serum samples for an analyte of concern for safety testing.

Commercial Potential. The technology has application for blood banking, diagnosis of infectious disease, pollution control, detection of biological warfare agents, and process monitoring.

N94-112TITLE: Altimeter Applications in Shallow-Water Areas

CATEGORY: Exploratory Development; Ocean Sciences

OBJECTIVE: Develop techniques, particularly automated techniques, for extracting oceanographic information in shallow water and coastal regions from satellite altimeter data.

DESCRIPTION: Currently and in the near future there will be an unprecedented wealth of satellite altimeter data, both from U.S. (e.g. TOPEX-Poseidon, GEOSAT Follow-On) and foreign (e.g., ERS-1) satellites. At the same time, the U.S. Navy will be shifting the focus of its interest to shallow-water areas. Various problems such as loss of tracker "lock" for tracks proceedings from land to sea, sometimes for several seconds (which translates to tens of kilometers or more), has reduced the amount of altimeter data available near coastlines. However, new altimeter systems and new data analysis techniques should improve this situation. The deep-water application of altimetry presented a set of unique problems, and it can be expected that a new set of problems will be associated with the shift to shallow water.

Phase I: Develop recommendations concerning techniques, and conduct a pilot study to illustrate the value of selected techniques.

Phase II: Develop a system, incorporating the most successful techniques and procedures, and test that system in a geographical area or areas specified by the Government.

Phase III: Transition the system to the Government. Conduct/participate in an operational evaluation, in preparation for a potential transition to operational use.

Commercial Potential: Oil companies drilling in the Gulf of Mexico, and other shallow-water areas, have a need for the type of information about oceanographic features and conditions that altimetry can provide.

N94-113TITLE: Tunable, Short-Pulse and Compact Source of X-Rays

CATEGORY: Research; Physics

OBJECTIVE: Develop a compact, tunable source of ultrashort pulse x-rays based on the interaction of an electron beam with a pulsed laser.

DESCRIPTION: At the present time, conventional x-ray tubes are broadband and generate x-rays over a large solid angle. Therefore, these sources have relatively low brightness and, as a result, large and unwieldy x-ray machines are required in materials processing, condensed matter research and in medical applications. Similarly, in vivo microscopy of living organisms is limited by a lack of bright sources of x-rays in the water window. The laser synchrotron source (LSS) has the potential to remedy this situation by providing a compact, powerful and tunable generator of x- rays.

Phase I: Conduct a six month study to design a laser synchrotron source for use in materials processing, condensed matter and medical research. The design must be compact and make use of the lowest energy electrons possible, consistent with the desired wavelength. The brightness of the x-rays generated is a key figure-of-merit for this project.

Phase II: Conduct experiments based on the Phase I design parameters to demonstrate the generation of x-rays. Characterize the radiation by measuring the brightness, the pulse duration and the wavelength. Demonstrate tunability of the x-rays over a limited wavelength band. Facilities at NRL may be made available for the Phase II portion of the program.

Phase III: Transition to industry.

Commercial Potential: The technology has applications in the private sector for materials processing, medical procedures, and in x-ray microscopy.

N94-114TITLE: Compact, Tunable Infrared Source of Radiation

CATEGORY: Research; Physics

OBJECTIVE: Develop a compact, tunable source of infrared radiation based on the interaction of an electron beam with a diffraction grating.

DESCRIPTION: There is currently a lack of powerful, compact and tunable radiation sources operating in the infrared (IR) and far-infrared (FIR) wavelength regimes. There are many gaps in the wavelength coverage provided by conventional lasers, and their power is often limited. Free-electron lasers based on magnetostatic wigglers and operating in the IR are not suitable for Naval use, due to their large size and weight. A diffraction-grating-based free-electron laser (FEL) can fulfill the Navy's need for a truly compact and tunable source of IR with high-power capability.

Phase I: Conduct a six month study to design a grating-based FEL operating in the IR. The design must be compact, using moderate energy, high quality electron beams. The output power and efficiency are key figures-of-merit for the design.

Phase II: Conduct experiments based on the Phase I design parameters to demonstrate the generation of the IR radiation. Characterize the radiation, i.e., wavelength, power, and efficiency of generation. Demonstrate tunability over a limited wavelength band. Facilities at NRL may be made available for the Phase II portion of the program.

Phase III: Transition to industry.

Commercial Potential: The technology has application in the private sector for chemical analysis, surgery and air traffic control.

N94-115TITLE: Carbon Fiber Reinforced Phthalonitrile Resin Fabrication

CATEGORY: Exploratory Development; Materials and Processes

OBJECTIVE: To develop advanced composites based on phthalonitrile polymer resins for high temperature applications.

DESCRIPTION: Polymeric composites are seeing increasing use in primary and secondary components for aerospace and marine applications due to their high specific strength and stiffness versus metals. The high density of steel severely limits its use in aerospace applications, and while titanium is less dense, it is expensive and costly to process. Thus, replacement of these metals by organic polymeric composites would effect substantial weight, cost, and energy savings, and improve performance. In addition to their limited temperature capability, conventional composite matrices suffer such shortcomings as complicated logistics of handling due to low temperature storage requirements of the prepregs, poor processability, brittleness, significant knock-down factors due to water absorption and reduction in the glass transition temperature (T_g), and delamination resulting from water penetration into the interface between the matrix material and the reinforcing fiber. The chemical principles used in the successful design of the phthalonitrile resins appear to have yielded a breakthrough in the desired performance, processing, shelf-life and cost characteristics, setting the stage for detailed engineering and optimization studies.

Phase I: (a) Optimization of conditions for prepregging, sizing and fabrication
(b) Mechanical, thermal, solvent testing

Phase II: (a) Part selection/design
(b) Tooling fabrication
(c) Prototype part fabrication

Phase III: Provide detailed engineering and optimization of parameters of detailed parts.

Commercial Potential: The phthalonitrile resins will provide advanced materials to meet numerous Naval needs for lightweight, high-performance and advanced aircraft, missiles, and marine vessels; engine component applications; heat resistant and flame resistant composite components for usage in the vicinity of an aircraft engine; intrinsic electrical composite conductors as EMI shields and RAM for aircraft and marine applications; high temperature molding materials for the fabrication of electronic devices; and temperature sensors. The phthalonitriles have projected low cost in high volume commercial-scale production. The phthalonitrile-prepolymer is presently being produced at the pilot-scale level and can be purchased for $150/lb.

N94-116TITLE: Focal Plane Array Radar Experiment

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Conduct test of pattern detection potential of 94 Ghz focal plane array radar incorporating existing airborne instrumentation.

DESCRIPTION: A MMW array of receiving elements placed in the focal plane of a MMW lens is analogous to IR and video cameras. Each element of the focal plane detector surface defines one of many "beams" simultaneously receiving energy scattered (or emitted in a passive mode) from the corresponding directions. Focal plane array elements suitable for the active/passive concept have already been demonstrated [1] in the form of a 1" square, 4X4

element "tile" on monolithic GaAs. An array of such tiles would be placed in the focal plane of a 2 to 3 foot Rexolite lens. In the active mode, an EIO transmitter illuminates the set of .2 degree beams with 10 us pulses at about 1000 per second. Energy received at each element is range-gated and integrated for an exposure time slightly less than the normal 1/30 second TV frame interval. Stored video will be conventionally sampled and displayed on a TV monitor.

It has been shown [2] that reliable, real-time detection of important target patterns can only be accomplished by such a radar. Although the cost of a focal plane array radar will eventually be comparable to conventional radars, hard evidence of this claim is needed prior to model development.

Phase I: A 4-month study will result in a test plan involving airport runways, ship wakes, and other topology typical of militarily important targets. The study will also focus on computer models to provide means for extrapolating single-beam experimental data to expected multiple-beam images of a focal-plane array radar.

Phase II: At least one light twin-engine aircraft with suitable 35 Ghz and 94 Ghz instrumentation is known to exist. Side-looking 94 Ghz radar video will be recorded for important target configurations; conventional video from the same targets will be recorded with the radar in the scanning mode for comparison.

Phase III: Results of the test will be analyzed and assembled with supporting data from earlier similar experiments at X-band. About 8 months should be adequate for Phase II and III.

Commercial Potential: All-weather landing monitors are of interest to commercial airlines.

References:1. W.M. Waters, "Monolithic GaAs Antenna/Detector Array for 94 Ghz Imaging", 1992 NRL Review, p.162.
2. W.M. Waters, "Airborne Target Pattern Detection", (In review, IEEE, AESS), Oct 1992
3. M.A. Dornheim, "MMW Radar Shows Commercial Utility", Aviation Week, Nov 2, 1992, pp.55-59

N94-117TITLE: Tunable (UV to IR) Narrow Band Filter

CATEGORY: Research; Sensors

OBJECTIVE: Develop a narrow band, tunable filter with high out-of-band rejection that can be manufactured over a wide range of the spectrum, for detection of optical signatures in the space, terrestrial and laboratory environments.

DESCRIPTION: Emission spectra can provide essential information about radiating objects (e.g., the sun, earth, laboratory plasma), providing that specific diagnostic lines can be suitably isolated. Narrow band optical isolation filters are needed for this. Most such filters are the Lyot type, manufactured in Germany from optical calcite, the sole existing source for which is the Nanking Optical Works in China. Aside from the lack of a US source, the Lyot filter has other shortcomings. It is complex, fragile and limited to the 5000 to 8000 Angstrom bandpass. As well, side-band suppression is not always adequate. Utilizing holographic or other modern optical techniques, it should be possible to develop a narrow band filter with a bandpass as narrow as 0.125 Angstrom that could be manufactured for use at any wavelength in the region from the UV to the IR, tunable for at least 1 Angstrom about the central wavelength. Furthermore, it should be relatively small, lightweight and sturdy, constructed of material that can withstand long exposure to the space environment and is relatively insensitive to vibration. Wavelength stability should be better than 0.05 Angstrom, and peak transmission at least 10%.

Phase I: Develop a concept/breadboard filter as described above with tunability at red wavelengths. Demonstrate that the capability can be extended to the ultraviolet spectral region.

Phase II: Develop the techniques to fabricate the required narrow band, tunable filters at multiple wavelengths across the spectrum. Fabricate the filter(s) into a small, robust package for field deployment, including in the vacuum environment. Demonstrate long term stability in wavelength and performance under harsh operating conditions, and over long periods of operation.

Phase III: Transition to a commercial device that can be easily deployed for a wide variety of optical sensing applications, such as in solar and terrestrial observatories, as well as optical fiber laboratories.

Commercial Potential: Filters of this type have important applications in fiber optic communication, where narrow bandpasses make possible multi-channel communication. There is a need to establish a US source of these filters for scientific and commercial application, since no such source is now available.

N94-118TITLE: Integrating Diamond UV, X-ray and Particle Detectors.

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Develop device structures using diamond as an active electronic material that allow the fabrication of integrating 2 dimensional imagers similar to silicon CCD's but designed around diamond's strengths and weaknesses.

DESCRIPTION: Diamond based sensors for UV, X-ray, and particle detection promise to deliver high quantum efficiency in these regions without suffering the dark current, radiation damage, contamination susceptibility, visible light sensitivity,
and mechanical fragility of silicon detectors. Such sensors are useful in scientific and military missions as well as medical and industrial applications. Great progress has recently been made in the growth of diamond and in the fabrication of electronic devices in natural and synthetic diamond. Solar blind, low dark current response has been observed in diamond photoconductors, and integrating photoresponse has been seen in diamond MIS devices. However, diamond suffers from a lack of shallow dopants.
It also lacks a native oxide. This facilitates stable, VUV detection but makes it difficult to fabricate high performance charge transfer devices.

Phase I: Describe a diamond device that performs one function required for the construction of an integrating imager- ie photosite, storage well, pixel readout technique, etc. Conduct a study using computer simulation or laboratory demonstration as appropriate to determine the expected performance of the proposed device. Provide a schematic of a complete imager design that would incorporate the proposed device. Perform a comparison to known competing designs. Designs which are inherently incapable of exceeding silicon devices in at least one parameter or cannot be integrated into an imager design will not be considered.

Phase II: Fabricate the structure studied in phase I along with any required support devices to demonstrate that the expected performance can be achieved. Characterize the device with quantum efficiency measurements in the relevant spectral region or electrical measurements as appropriate. Deliver several devices to NRL for further study along with a report describing possible complete imager designs.

Phase III: Design and fabricate an imager using methods developed in Phase II. This imager should be useful for scientific or industrial applications and should have at least some of the following attributes: more than 100x100 pixel arrary size, pixel size less than 50 microns, negligible dark current and visible light response, quantum efficiency over 20% in the region of interest (not necessarily the entire UV, X-ray, particle spectrum), dynamic range $>1000:1$, fabricated in currently available synthetic diamond.

Commercial Potential: The requested imager has great potential for use in X-ray imaging for industrial and medical applications. Closely related products include diamond DRAM's that are similar to silicon DRAM's but require no refreshing and hence, consume less power.

N94-119TITLE: Affordable Phased Array Radar for Ship Self Defense

CATEGORY: Exploratory Development; Sensors

OBJECTIVE: Develop an affordable phased array radar for short-range air-defense using the principles of a Diode Lens (Bulk Phaseshifting)

DESCRIPTION: Under the ONR Surface Surveillance Block (RL1B), NRL is investigating the applications of affordable phased array technology for short-range air defense. A planar phased array for scanning in one dimension is currently being assembled. A promising method for adding two-dimensional scanning in an affordable

manner is the incorporation of a diode lens in front of the one-dimensional-scan phased array. To reduce the size, weight, cost, insertion loss and to increase its bandwidth of the diode lens, a research study should be performed.

Phase I: Conduct a 6 month study of risk reduction associated with diode lens antenna. The risk reduction objectives are (1) Reduce the size, weight and insertion loss of the diode lens (2) Increase bandwidth of the diode lens. To reduce the size, weight, cost and insertion loss of the diode lens, a research study should be performed to increase the maximum phase shift per diode strip to 45 degrees (It is presently 22.5 degrees) and increase the spacing between diode strips.

Phase II: For an affordable phased array radar, the combination of a diode lens (to scan in the elevation plane) and a slotted waveguide array with a high power phase shifter associated with each column (in order to scan the beam in the azimuth plane) should be integrated. Thus, in phase II a diode lens will be built, integrated, and tested with NRL's 6.2 ONR radar.

Phase III: Low-altitude, low-observable, anti-ship missiles are a serious threat to the U.S. surface Navy. NAVSEA has recently created a new program office (NSEA-06D) to deal with this problem. An affordable phased array will help solve these problems.

Commercial Potential: The technology has application in the private sector in Air Traffic Control.

N94-120TITLE: Cavity-type Radiometer (UV to Far IR) System for High Precision Sensing

CATEGORY: Research; Sensors

OBJECTIVE: Utilize state-of-the-art, cavity-type radiometers to develop a sensing system with spectrally flat, linear response, high stability and high sensitivity for high precision long term monitoring.

DESCRIPTION: The energy balance of the terrestrial environment depends on the incoming solar radiation and outgoing terrestrial radiation. Environmental changes may result from very small (tenths percent) changes in total incoming solar radiation or from larger (few percent) changes in incoming ultraviolet radiation. Small changes in energy balance over long periods of time must be detected independently of instrumental drifts. State-of-the-art cavity, electrical-substitution radiometers have been developed that promise to achieve this, but they have yet to be integrated into an operational, robust system for field use on remote platforms.

Phase I: Develop a concept/breadboard radiometric sensing system with flat spectral response from the UV to the far IR, capable of reliable long term monitoring. The radiometer sensitivity should be significantly increased over existing cavity-type radiometers. Ultraviolet filters to use with the radiometer s
should be identified and incorporated into the system design, and have high out-of-band blocking when the sensor is illuminated with solar radiation.

Phase II: Fabricate the radiometric sensing system by combining a number of the radiometers and ultraviolet filters (for redundancy), into a small, compact,robust sensing device which requires modest resources, is suitable for field applications that may include ground or space deployment, in both vacuum and ambient environments, and that maintains its precision after extensive operation.

Phase III: Transition to a commercial instrument that can be easily deployed for a wide variety of radiometric sensing applications.

Commercial Potential: High-sensitivity, stable, radiometers that operate with flat response over a wide spectral region are needed as laser power meters to accurately measured the output of low-power (milliwatt) diode and gas lasers. They are also are needed to accurately and efficiently measure the emittance from material surfaces, in the production of various coatings and surfaces. A reliable, robust radiometric standard has commercial application in transferring NIST calibration standards to laboratory and field sites. Thus this small, robust radiometric sensor has dual-use application.

NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER

N94-121 TITLE: Human Performance Feedback Network

CATEGORY: Advanced Development; Communications Networking

OBJECTIVE: Develop a performance feedback network for the aggregation and reporting of human performance data.

DESCRIPTION: Measures of Effectiveness (MOE) are quantitative expressions of how well an item of equipment or system performs in a combat role. Though humans play a critical role in the successful functioning of complex Navy systems, measures for assessing their ability to function as part of the system are often ignored. Current Navy research is focused on correcting this problem. However, the collection of human performance data is only one aspect of the problem. A means to aggregate the data and a communications network which rapidly transmits data in a useable form to training and operational commands is required.

Phase I: Conduct a 6 month study to determine the feasibility of developing a feedback network which rapidly provides human performance data to both Navy training and operational commands.

Phase II: Develop a prototype communications network which rapidly provides human performance data to both Navy training and operational commands.

Phase III: The prototype communications network will be transitioned to operational use. Options for commercialization of the network for the private sector will be available.

Commercial Potential: This technology will be readily transferable to either civilian vocational schools or industry for data networking purposes.

N94-122TITLE: Systems for Producing Readable Technical Text

CATEGORY: Exploratory Development; Training Devices

OBJECTIVE: To develop a computer-based system to aid writers of technical documentation, such as training materials and technical manuals, to produce optimally clear and readable materials. The system would integrate several systems recently proven to be effective by research, into a single system operating on a standard PC.

DESCRIPTION: The Navy and other services have supported considerable research investigating how to improve the readability of technical documentation to enhance user comprehension. This includes the work of Thomas Bever (U. of Rochester) on text formatting, David Kieras (U. of Michigan) and Bruce Britton (U. of Georgia) on computer-based text critiquing systems, and George Miller (Princeton U.) on the lexical WordNet database and associated `filter' that tells the writer when rare and unfamiliar words are being used. These systems represent a considerable advance over current commercial software because they are based on the latest cognitive and linguistics theory. Now, they can be incorporated into a single, user-friendly, system for writers. Since current standards for technical documentation often require the use of a readability formula, the system should also incorporate the capability to compute an accepted readability formula. The contractor should have expertise in computational linguistics and HCI interface design.

Phase I: Based on an assessment of the existing applications, design a system to aid writers and demonstrate insofar as possible by linking together existing software. System design should consider the following design issues: (a) -Design of the writer's interface; (b) -The optimal type of feedback to writers that affects text usability; (c)-Providing writers the option and the rationale for choosing between an approach (e.g., Kieras) which requires conforming to language that the system can parse, or an approach (e.g., Britton) that aids writers to do a similar manual analysis of their text; (d) -How to advise writers about preparing text for readers' cognitive strategies; (e) -How writers can use readability scores in conjunction with other system facilities to improve writing.

Phase II: Build integrated system and make available to Navy for testing by authors of training materials. Conduct a test and evaluation.

Phase III: Make the system available for preparation of technical text materials. Commercialize for use in 1 -preparing industrial training/technical materials and materials for civilian educational use.

Commercial Potential: The technology has potential for transfer to educational systems, commercial training, and publishing technical material in general.

N94-123TITLE: Damage control training in a Virtual Environment

CATEGORY: Advanced Development; Training Devices

OBJECTIVE: Demonstrate techniques for integrated Damage Control (DC) team training in a Virtual Environment

DESCRIPTION: The skills for recovering from a shipboard casualty when under attack are critical to the survival of the ship. Training these skills is difficult since integrated team practice for Damage Control, Engineering, and Combat Systems personnel in a shipboard environment is not performed on a regular basis, and is not an experience that can be practiced to improve performance. Virtual environment technology may be suited for training teams in a simulated dangerous shipboard environment. The demonstration must support multiple participants experiencing a mass conflagration situation, real-time instructor intervention, and embedded instructional techniques.

Phase I: Relate VE techniques to existing multimedia and instructional system development techniques to determine the methods of developing and evaluating team skills in a virtual environment. Identify the strengths and weaknesses of the VE approach, and estimate the options and relative difficulty of each aspect of the approach. Develop system specifications for a prototype VE capability for TSS team training.

Phase II: Develop a prototype Virtual Environment Damage Control training scenario and evaluate its training effectiveness. The scenario must allow students to experience the consequences of their decisions, and should, with practice, improve their responses to rapidly changing Damage Control, Engineering, and Combat Systems events.

Phase III: The prototype VE training system will be integrated into a Damage Control training course.

Commercial Potential: The technology has application in the private sector for police, fire, and emergency disaster training.