NAVY
Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). 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 362 SBIR
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-8528

All SBIR proposals written in response to topics in this solicitation **should be submitted to the above address** and must be received by the date and time indicated in Section 6.2 "Deadline Of Proposal" appearing in the front part of this DOD solicitation.

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy primarily through science and technology dual-use, critical technology topics. A total of 31 Science and Technology (S&T) areas has been identified (see Table 1). While all of these areas may not be funded equally during the annual DOD SBIR solicitations in which the Navy participates, topics will be funded according to a priority it has established to meet its mission goals and responsibilities.

This solicitation contains a mix of topics. **Please read the information contained on this page of the solicitation carefully before sending your proposal.** The Navy's part of the solicitation which is readable and retrievable from the INTERNET under the ONR Homepage (address--http://www.onr.navy.mil), contains topics which permit small businesses to submit their solutions to Navy requirements. We are providing proposers the opportunity to send proposals on diskette for this solicitation. From the ONR Homepage on the INTERNET on the SBIR Bulletin Board (address -http://web.fie.com/web/fed/onr/down/onrdn.013.htm), you may "pull down" the Navy part of this DOD solicitation and "pull down" into your computer an SBIR format for filling out your SBIR proposal on disk which can be mailed to the above address together with a single signed hard copy. All proposals sent on disk should be written using one of the following software packages: WordPerfect 5.1, 5.2, 6.0; WordStar 2000 1.0, 2000 2.0, 2000 3.0, 3.3, 3.4, 4.0, 5.0, 6.0, 7.0; MultiMate 4.0; MS Word for Windows 1.0 or 2.0; MS Word 4.0, 5.0 or 6.0; or Display Write 4.0 or 5.0. You may ask technical questions through the SBIR Interactive Topic Information System (SITIS), see Section 7.2 of this solicitation. A listing of companies selected for award negotiations for this Navy SBIR solicitation will be listed on the INTERNET on the Navy SBIR Bulletin Board.

When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Be sure that you clearly identify the topic your proposal is addressing. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of successful Phase I effort will be eligible to participate for a Phase II award. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office (at the above address) for proper processing. Phase III efforts should also be reported to the SBIR program office noted above.

The Navy will provide potential awardees the opportunity to reduce the gap between Phases I & II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. The Navy will not award Phase I contracts in excess of $70,000 (exclusive of the Phase I option). The Phase I Option should be the initiation of the demonstration phase of the SBIR project (i.e. initial part of Phase II). The Navy will also offer a "fast track" into Phase II to those companies that successfully obtain third party cash partnership funds ("fast track" is described in Section 4.5 of this solicitation). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 maximum demonstration phase of the SBIR project (i.e. Phase II); 2) a transition or marketing plan (formally called "a commercialization plan") describing how, to whom

and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan or further R&D if the transition plan is evaluated as being successful. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II option will be limited to 40 pages. The transition plan should be in a separate document.

Evaluation of proposals to the Navy will be accomplished using scientific review criteria. Evaluation and selection of Phase I proposals will be based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY	SCIENCE
Aerospace Propulsion and Power	Computer Sciences
Aerospace Vehicles	Mathematics
Chemical and Biological Defense	Cognitive and Neural Sciences
Command, Control, and Communications	Biology and Medicine
Computers	Terrestrial Sciences
Conventional Weapons	Atmospheric and Space Science
Electron Devices	Ocean Science
Electronic Warfare	Chemistry
Environmental Quality and Civil Engineering	Physics
Human-System Interfaces	Electronics
Manpower and Personnel	Materials
Materials and Structures	Mechanics
Medical	Environmental Science
Sensors	Manufacturing Science
Surface/Undersurface Vehicles	
Software	
Training Systems	

NAVY SBIR PROGRAM MANAGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT	PHONE
001-006	Mr. Douglas Harry	703-696-4286
007-016	Mr. Joseph Johnson	703-640-4801
017-019, 028, 032-033, 035-036, 052-053, 058	Ms. Cathy Nodgaard	703-604-2437 x6309
020-021 x103	Mr. Curtis Snyder	301-826-7850
022-025, 045-051	Ms. Carol Van Wyk	215-441-2375
026-027	Mr. Walt Kahl	301-826-7870
029-030	Mr. Peter (Pete) O'Donnell	908-323-7566
031, 037-044, 060-068	Mr. Eugene (Gene) Patno	805-989-9209
055-056	Ms. Janet Wisenford	407-380-8276
057	Ms. Patricia Schaefer	703-767-6263
034, 130-132	Mr. Donald Wilson	301-394-1279
054	Ms. Beth Klapach	301-743-4953
059	Mr. Jack Griffin	203-440-4116
069-129	Mr. William (Bill) White	703-602-3002
133-136	Lcdr Paul Knechtges	301-295-0885
137-138	Dr. Meryl Baker	619-553-7681
225-227	Mr. Nicholas (Nick) Olah	805-982-1089

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OFFICE OF NAVAL RESEARCH

MARINE CORPS

NAVAL AVIATION TEAM

N96-040IR Target Polarization Discriminator for IR Seekers
N96-041Digital GPS Translator Ground/Remote Based Processor
N96-042A Robust Real Time Kinematic Differential Global Positioning System (KDGPS) Algorithm for High Dynamic Vehicles (7-11 G's)
N96-043Near-Field Radar Signature Modeling for EW/End-Game Simulation Applications
N96-044Very Low Bit-Rate Error-Resilient Video Communication
N96-045Biodegradable Batteries
N96-046Common Modularized E-O Sensor Payload
N96-047Moveable Focal Plane Array (MFPA) for Compensating Aircraft Forward Velocity
N96-048Tunable MWIR Hyper-Spectral Imaging for Low Observable Target Detection from an Airborne Platform
N96-049Software Metric To Predict Real-Time System Throughput
N96-050Prototype Transition Environment for Complex Software Systems
N96-051Advanced SAR Processing Techniques
N96-052Helicopter Onboard Sensor Training
N96-053Interface Unit Enabling Utilization of Aircraft Tactical Tape in Aircrew Simulators
N96-054Portable Tele-training/Technical Assistance
N96-055Software Package for Speaker Independent or Dependent Continuous Speech Recognition
N96-056Virtual Vertical Aircraft Signal Trainer (VVAST)
N96-057A Hybrid Immersive/Non-Immersive Virtual Environment Workstation
N96-058Weapons Impact Assessment Technology
N96-059Fuel Combustion Inhibitor (FCI) as a Non-Lethal Cruise Missile Payload
N96-060High-Temperature-Superconductor (HAS) Antenna Cooling
N96-061Development of CL-20 Based Explosive for Exploding Foil Initiators (EFI)
N96-062Advanced IR Augmentation
N96-063Multi-Dimensional Solid Propellant Rocket Stability Prediction (MSSP)
N96-064Low Cost, Hot Gas Turbine Powered Hydraulic Power Supply
N96-065Mini-Metrology System to Provide TROPO Inputs for GPS Error Reduction.
N96-066Computer Code for Predicting Warhead Booster Performance
N96-067Separable Platform Glint/ Cross Polarization Target Signature Modeled RF Augmenter
N96-068High Speed Scene Signal Processor Accurate Fuzzy Logic/Neural Network/Data Compressor High Speed Scene Signal Processor

NAVAL SEA SYSTEMS COMMAND

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N96-070Integration of Specifications Information into a Product Model
N96-071Object Oriented Data Base for Combat System Ship Design
N96-072Automated Human Systems Integration Tools for Reduced Ship Manning
N96-073Robust Distributed Broadband Network Control System Development
N96-074High Power Multi-Layer Frequency Selective Filters
N96-075Tools to Develop, Deliver and Exchange Electronic Technical Information in Support of New Research and Development (R&D) Projects
N96-076Facility for Radiative Susceptibility and Emission Testing
N96-077Shock Resistant Single-Mode Fiber Optic Connector
N96-078Solid State Tritium Monitor
N96-079RF Voltage Measurement System
N96-080Computerized, Interactive, Generic Sub Systems vs. Total Ship System Design Program
N96-081Reclamation/Reuse of Pyrotechnic Ingredients
N96-082Low Cost Seeker (LCS) for Naval Surface Fire Support
N96-083Modular Guidance Control Unit for Spin-Stabilized Projectiles
N96-084Operational Training for FFG-7 Anti Air Warfare (AAW) Combat System
N96-085Microwave Removal/Conversion of High Explosives from Loaded Munitions
N96-086Miniature Eye-Safe Laser Designator and Receiver

N96-087Composite 5"/70 Barrel Component for MK-45 Gun Upgrade
N96-088Inertially Guided Micro-machined Navigating Device with Application to Submunitions
N96-089Oscillator Stabilization in Shock and Vibration Environments
N96-090Signal-to-Noise Ratio Meter
N96-091Nanosecond Opto-electrical Switches
N96-092NTDS Archival Tool Using RAID Technology
N96-093Standard Forth Generation Language for Interface Specification and Simulation
N96-094MCM Dynamic Planning Tool
N96-095Real-Time Pixel Array Processing Architecture (PAPA)
N96-096Wide Dynamic Range Absolute Pressure Sensor
N96-097VMEbus Supportability/Test Software Tools
N96-098Enhanced Air Quality Management
N96-099Reverse Osmosis (RO) Systems Applications
N96-100Database driven 3D Compartment Arrangements
N96-101Fuel Cell for Replacement of Submarine/ Battery Diesel Generator Emergency Power
N96-102Active Vibration and Acoustic Control
N96-103Materials Research In Sliding Electric Contacts
N96-104Dynamic Control of Undersea Vehicles
N96-105Depth Keeping Digital Algorithm for Control of Undersea Vehicles in Shallow Water
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N96-107Micro Electro-Mechanical Systems (MEMS) for Shock Physics
N96-108Permanent Magnet Motor Systems
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N96-110Flow Noise Reduction Techniques to Enhance Underwater Sonar Performance
N96-111Simulation Based Concurrent Planning and Development System
N96-112Integration of Operational Simulation with Functional/Behavioral Simulations
N96-113Methods for the Networking and Control of Military Data
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N96-115Low-Cost, Lightweight Rocket Nozzle Materials for Tactical Missiles
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N96-119Transmit/Receive (T/R) module cost reduction through the use of Taguchi design of experiments
N96-120Continuous Wave Mid-Infrared Laser Sources
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N96-122Broadband Acoustic Processing Technologies
N96-123Multisource/Multireceiver Tactical Decision Aid
N96-124High Pressure Gear Pumps for Improved Wear Resistance
N96-125Peacetime Use of the Adaptable High Speed Undersea Munition (AHSUM)
N96-126Low Cost Underwater Mateable Fiber Optic Connector
N96-127Advanced Laser Source for Fiber Optics
N96-128Independent Verification and Validation (IV&V) Tool to Monitor the Effects on Navy Enlisted Skills and Knowledge Resulting from Ongoing Changes in Training Technology
N96-129Massively Parallel Processing for Ship Self Defense

STRATEGIC SYSTEMS PROGRAM OFFICE

N96-130Thermal Enhanced Electronic Component Bond
N96-131Global Positioning Satellite (GPS) Simulator for Re-entry Body Application
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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND

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BUREAU OF NAVAL PERSONNEL

N96-137Determining the Optimal Mix of Manpower
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NAVAL FACILITIES ENGINEERING CENTER

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N96-140Tag Initiated Communications System for Real Time Asset Monitoring
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N96-143Very Low Cost Miniature Radio Tag with ASIC Architecture

NAVY 96.1 TOPIC DESCRIPTIONS

OFFICE OF NAVAL RESEARCH

N96-001TITLE: Technology for Affordability

OBJECTIVE: The objective of this project is to develop innovative process technology, concurrent engineering or manufacturing capable of effecting change in aircraft, ships, boats, or components thereof that will be cost effective, reliable, and maintainable.

DESCRIPTION: At the present time the manufacturing and engineering sectors of the country have been slow to transition new developments into production. Typically low volume implies high cost, and there is a dependence on low yield production of critical components. As a rule, activities above the factory floor drive costs, and there are high maintenance costs associated with new developments. Proposals are sought that will provide innovative developments in manufacturing and engineering systems; e.g., design for six sigma manufacturing, integrated product and process development, manufacturing processes/fabrication maturation, and advanced industrial practices (e.g., benchmarking and best practices--technical and business, etc.), that will effect the Navy and overall industrial production. A minimum of three Phase I awards will be made.

PHASE I: Identify improvements to be developed, and detail where and why they will be effective.

PHASE II: Choose one of those improvements, develop a working model/prototype, and demonstrate its performance characteristics. Develop a commercialization (Phase III) plan, including descriptions of specific tests, evaluations and implementations to be performed.

PHASE III: Implement the Phase III plan developed in Phase II.

COMMERCIAL POTENTIAL: Private sector applications and benefits must be inherent in the objective of the proposed effort.

N96-002TITLE: Power Electronic Building Blocks (PEBB) Technology

OBJECTIVE: Develop enabling technologies for low cost, reliable, and easily manufactured, modular electrical power systems for current and future Navy applications.

DESCRIPTION: The Navy uses electric power in almost all platforms and systems. Advances in many systems areas are limited by affordability issues with the distribution, conversion and control of electrical power. Most current systems require the use of hybrid technology (i.e., electrical and hydraulic) and local manual controls which limit flexibility, and reliability. Advances in solid state electronic switching devices promise to make all-electric solutions feasible. This will not only make systems smaller, more capable and reliable but, with the application of sensor and communications technology, this will also create opportunities for distributed, remote and/or automated operation. However, if new power systems have to be designed for each new system, applications will be limited by affordability. Utilization of these advances will be cost prohibitive, unless the potential number of power electronics systems can be collapsed into a small family. Power conversion is the core of all power electronics issues, and most power circuit topologies are very
similar. This fact can be used to enable a leap forward to some form of modular power building block. A broad range of scientific technological and engineering issues need to be addressed:

Flexible power circuit topologies
Semiconductor materials and devices
Internal signal processing and control technology
External control and communications technology
Flexible, reconfigurable electric power distribution bus and bus connections
Packaging emphasizing low cost manufacturing, cooling and EMI suppression

Affordability, maintainability, sustainability must be integrated with reliability into a standardized high performance modular power systems. These devices would be re-configurable & re-programmable to handle all types of electrical power tasks. They would be scaleable from the low kilowatt to high megawatt switching power ranges. They would be able to communicate status to the outside world and receive situational information and commands over some form of bus. They will have built in intelligence & sensing, to enable them to operate or shut down safely in emergencies or when disconnected from the primary data bus/network. This SBIR will investigate and develop power electronics enabling technologies on a wide front to use them in the broader context of ONRs PEBB program.

PHASE I: Phase I will: (1) examine the issues relevant to the Navy, specifically and the power electronics industry in general; (2) investigate enabling technologies in the areas outlined above; (3) do feasibility studies; (4) develop conceptual and physical model and/or designs that accelerate the investigation of the above issues; (5) develop diagnostic and characterization technologies, tools and methods that monitor and address the above issues; and (6) identify a set of applications for the Phase II developmental model.

PHASE II: The second phase will (1) include detail designs; (2) develop appropriate prototypes and evaluate against simulations and models; (3) carry out an evaluation program and test against assumptions and models proposed in Phase I; (4) evaluate system applications for next generation units; and (5) identify manufacturing issues for large scale production.

PHASE III: Implement the technology in the PEBB program, and develop the manufacturing process to economically mass produce the units. Work with the PEBB to transition the technology to the various Navy power electronics initiatives.

COMMERCIAL POTENTIAL: The PEBB technology is intended to have a wide range of commercial applications. The technology can be used in building automation, factory automation, electric vehicles, and co-generation, to name a few.

REFERENCES:

1. H. Stevens, "Advanced Ship Machinery" Proc. National Power Electronics Workshop, NSWC, 16 Nov. 1994;
2. A.J. Tucker, "The More Electric Initiative and Power Electronics Building Block", Proc. National Power Electronics Workshop, NSWC, 16 Nov. 1994;
3. K. Shenai, R.S. Scott, and B.J. Baliga, "Optimum Semiconductors for High-Power Electronics", IEEE Trans, Electron Devices, vol. 36, no. 9, pp. 1811-1823, Sept. 1989;
4. "Proceedings of the Control Technology Workshop: The Regulation and Distribution of Power in Large Systems," Virginia Center for Innovative Technology, Herndon, VA, 24-25 April 1995.

N96-003TITLE: AEW CMD Surveillance Modeling/Simulation

OBJECTIVE: Develop a high fidelity AEW (Airborne Early Warning) sensor model incorporating space-time processing for enhanced detection of small, cruise missile (CM) sized targets.

DESCRIPTION: The addition of space-time adaptive processing to future Navy AEW radar systems could enable the detection of low RCS CM targets. This surveillance capability would provide for wide area search, and allow potential cuing to fire control assets. To exploit this technology, a high fidelity sensor simulation model is required, which can incorporate space-time transfer characteristics that have been developed off-line through other simulation and measurement programs. The sensor simulation model should be workstation based, run in real-time, and operate with physics based, deterministic background scenes and scenarios. Graphical displays should be provided allowing the user to observe radar outputs in PPI format, as well as control sensor parameters to enhance detection of small targets without an unacceptable high false alarm rate.

PHASE I: Develop the detailed architecture design for the workstation-based simulation, and demonstrate via a pilot program the rudiments of the proposed capability.

PHASE II: Develop the workstation-based simulation, incorporate the space-time transfer characteristics, and perform simulations of various tactical environments.

PHASE III: Produce the workstation demonstrated in the Phase II effort. Includes transition to other Navy programs such as Theater Air Defense (TAD), that will exploit high fidelity, physics based modeling.

COMMERCIAL POTENTIAL: The simulation modeling approach allows surveillance functions such as FAA air traffic control and local airport surface traffic monitoring to be interleaved; new sensor concepts can be accurately evaluated using realistic, deterministic background scenes.

REFERENCES: Cruise Missile Defense Advanced Concept Technology Demonstration (CMD ACTD) Phase I (Mountain Top) dated Aug 1994

N96-004TITLE: Equations of State of Energetic Materials

OBJECTIVE: To develop E,P,V and T,P,V equations of state of unreacted explosive and propellants, for use in predicting initiation and detonation phenomena in energetics and propulsion systems, where E,P,V, and T, are the specific internal energy, pressure, and specific volume, and temperature, respectively.

DESCRIPTION: The development of munitions and propulsion systems of high performance that are also invulnerable to accidental detonation is of major concern. The physical mechanisms of energetics/propellants initiation-to-detonation under various stimuli can be qualitatively explained by the complex phenomena of formation and reaction of "hot spots" formed in the energetic material. Inasmuch as the reaction of such hot spots is temperature dependent, any development of physical models for understanding the processes encountered require accurate E,P,V and T,P,V equations of state of unreacted energetics/propellants. Such equations of state, which are needed in codes that model warhead performance as well as initiation, explosion, and/or detonation of munitions and rocket motors by impacting fragments, blast waves, and slow and fast cook-off, have been studied far less than those of the energetic products.

PHASE I: Develop theoretical models of E,P,V and T,P,V equations of state of unreacted energetics (e.g., TNT, HMX, and RDX) that are applicable from the high-pressure (hundreds of kilobars) to the very low-pressure (1 bar) regimes and compare with available experimental data.

PHASE II: Continue improvements in the theoretical models developed in Phase I and apply them to more complex energetics and propellants. Develop alternative models, as necessary, for these more complex energetic materials. Compare the models for accuracy against available experimental data. Show how these equations of state influence the determination of the initiation characteristics and transition to detonation when employed with existing hot spot and other initiation models in computer code simulations.

PHASE III: The equation of state models developed in Phase II will be transitioned in safety and munitions development, as well as munition lethality and platform survivability, programs.

COMMERCIAL POTENTIAL: Knowledge of energetic transition-to-detonation under different stimuli has great implications on production, transportation, and storage of safe explosives used in the mining, excavation and demolition industries.

N96-005TITLE: Shipboard Deployable Surface Target

OBJECTIVE: Demonstrate technology required for an affordable, self-contained, expendable, ship deployable target that is capable of being remotely operated at high speeds in rough seas.

DESCRIPTION: Navy surface combatant ships need a technology alternative to realistic training in support of gun firing. Current surface ship targets do not offer realistic training due to: (1) extreme sea state limitations; and (2) they cannot be hit or expended due to their high costs. In addition, current surface targets are environmental hazards and unsafe whenever hit or expended. Advanced simulation technology of surface threats, with use of remote controls and radar reflectors from personal type water crafts, offer a potential solution. This solution would provide a high speed target that can be ship deployed, and is expendable for the estimated cost of $15K.

PHASE I: Conceive and describe an affordable surface ship target that can be deployed by a surface combatant that offers realistic training in support it's gun firing. The conceived target must be affordable (less than

$15K) and expendable. It must also be capable of remote operations in rough sea states and environmentally safe. The contractor will define the required technologies, hardware, software, and other target system requirements.

PHASE II: Develop, test and prototype the shipboard deployable surface target defined in Phase I. Define manufacturability and producibility of end product. Begin development of commercial market.

PHASE III: Deliver prototype shipboard deployable surface target to the fleet. Transition to commercial applications.

COMMERCIAL APPLICATION: The development of the conceived target system offers significant cost-savings to the commercial sector under current global and environmental conditions, and wherever realistic, expendable targets are required, such as, transportation safety.

REFERENCES: FY95 NSAP Task R-16-95, Shipboard Deployable Surface Target; COMNAVSURFLANT 082130Z May 95..

N96-006TITLE: Intelligent Voice Recognition for Communications Priority Control

OBJECTIVE: Develop and test a methodology for an automated speech recognition system that can independently function as a centralized or decentralized component of the combat systems tactical information network.

DESCRIPTION: Recent technological advances in speech recognition systems provide credible speaker independent, connected speech processing. However, speech recognition systems do not perform additional processing based on the recognized speech or pattern. The proposal should address a hierarchical system that uses speaker independent connected speech using government furnished syntax from standard communication protocols. The system shall capture the utterances to synthesize, localize, classify, prioritize, alert, and catalog mission essential watchstation communications. Successful implementation of such a system will increase the confidence and reliability of the battle group for shared tactical communications. In summary, a speech recognition system is needed that is speaker independent (does not have to be trained or calibrated to the speaker's voice) which has the capability to process the verbal information, commands and syntax encountered in a tactical situation to accomplish information transfer (including automatic prioritization, classification, alerts, and mission cataloging) of watchstation communications.

PHASE I: Define a prototype speech recognition system. Define technical performance and reliability requirements the fault tolerant system modules must meet. Define the system tactical interfaces, data input/output requirements.

PHASE II: Develop, test and prototype tactical watchstation voice recognition system interface modules. Perform design verification and testing for manufacturability and producibility based on the requirements of Phase I. Begin development of commercial market.

PHASE III: Develop, test and integrate modules developed under Phase II into a combat systems tactical information network. Conduct system integration testing. Transition to commercial production. Deliver to fleet.

COMMERCIAL POTENTIAL: Software and related hardware developed will provide enhanced capabilities in situations using combinations of voice and digital inputs from multiple sources, such as: Hospital emergency rooms, 911 Operators and dispatchers, Air traffic controllers, Police/Fire dispatchers, Trucking agents, Merchant sea carriers, Voice mail operations.

MARINE CORPS

N96-007TITLE: Composite Material Modeling for Blast Protection

OBJECTIVE: To develop a composite material model or existing model interface that will provide designs for vehicle blast deflectors and data on acceleration during mine encounters and secondarily the attenuation or defeat of fragment penetration/blast.

DESCRIPTION: The USMC has been developing crew/vehicle protection kits to provide increased crew survivability for tactical wheeled vehicles. Commonly encountered threats include on-route large blast mines with an additional threat of off-route fragmentation mines. While the USMC is achieving success against the threat levels of mines/fragmentation with conventional steel/aluminum protection kit fabrication, there are payload and mobility penalties associated with these protection kits. This research area is targeted at investigating ways to reduce these penalties while still providing the same level of crew/vehicle protection or improving the energy absorption performance of deflectors. Modeling and Simulation will provide a tool for paperless design and assessment of complex composite materials which show promise for reducing vehicle protection penalties while still meeting/exceeding survivability criteria. The composite material should mitigate 50% of mine energy, through absorption (material deformation) and blast deflection. Vehicle vertical and lateral acceleration should be minimized. The following are typical loading curves from a mine blast under a steel/aluminum protection kit:

Max Pressure Over Time	Max Stress Over Time
3000 ATM @ .074 millisec	67K PSI @ 5 millisec
1400 ATM @ .23 millisec	71K PSI @ 15 millisec
150 ATM @ .58 millisec	72K PSI @ 25 millisec
	60K PSI @ 30 millisec

PHASE I: Phase I will address the full matrix of tradeoffs for materials, performance, performance penalty, and manufacturability. The proposal must address, in detail, contemporary techniques for composite technology assessment. Existing blast models must be summarized with potential for integration. The Phase I proposal must contain at least an outline of the Phase II proposal direction.

PHASE II: Composite fabrication and evaluation will be conducted with designs generated by the model. Of primary importance is the blast/acceleration protection offered by the composite material as compared with vehicle weight penalty. The model will be assessed against existing Army field data for validation and performance. Phase II will also address properties to make the model user friendly. The model effort will be directed toward accuracy and also versatility in application, such as the rapid, low cost application of modeling techniques to different vehicles and materials or configurations.

PHASE III: The final composite material model should be completed and validated. The commercial marketing plan submitted with Phase II should clearly specify additional uses for the model and simulation effort. It is desired that the product become available and have adequate documentation to facilitate DoD use.

COMMERCIAL POTENTIAL: Lightweight composites are finding many applications in the recreation industry. Security issues are increasing in the commercial sector which would provide ample opportunity for a lightweight ballistic material application. The aerospace industry is growing, with a high need for lightweight extremely resilient materials for satellite/space flight payloads. Ways of modeling these materials supports the commercial/DoD direction of paperless cost effective design.

REFERENCES:

1. "Army Material Command (AMC) Polymer Matrix Composites Assessment", August 1991
2. University of Delaware Center for Composite Materials, Annual 93-94 Report LH-92-80711-001
3. "Lightweight Hull Floor Program", General Dynamics Land Systems Division, Jan 1993 (produced for NSWC Carderock)
4. "Computer Programs for Structural Analysis", Engineered Materials Handbook, Composites, May 1933, ASM International Vol I.
5. "Computer-Aided Composite Design", Advanced Composite Magazine, March/April 1992
6. "Blast Simulation and Analysis", Science Applications Int. Corp., 30 May 94
7. "Development of Mine-Resistant Vehicles", SAIC, 2 July 93
8. "Blast and Structural Simulation/Analysis for Development of a Centerline Blast Deflector for the Cab of an M723A2, 5 Ton Cargo Truck", SAIC, 2 May 94

N96-008TITLE: Corrosion Prevention and Control - Cold Application Hole Filler

OBJECTIVE: The objective of this topic is to identify a product to easily repair holes in sheet metal.

DESCRIPTION: Marine Corps tactical ground equipment is subjected to a harsh marine and operational environment. Wheeled vehicles, such as trucks and High Mobility Multi-Wheeled Vehicles (HMMWVs) get holes in the sheet metal due to corrosion, operational environment or artillery. A patching material with the same strength and flexibility as the surrounding metal that can be easily used is needed. The product should use a cold-application process and hand-tools. Currently new sheet metal is welded to the existing item. The repaired area must be worked until the repair is cosmetically acceptable. This process is very time consuming and requires extensive safety equipment.

PHASE I: Explore options to repair holes in sheet metal. Identify products that could utilize a cold-application process and no electric tools. Product must resist corrosion and accept primer and topcoat after repair is completed.

PHASE II: Using the results of Phase I, develop an easy to use product for maintenance personnel.

PHASE III: Implementation into existing maintenance procedures.

COMMERCIAL POTENTIAL: The auto repair industry would be able to use this process instead of welding new metal to the existing body part. The process should be safer and simpler than existing methods.

N96-009TITLE: Entity Development Relative to Environmental Stimuli

OBJECTIVE: To develop a set of Marine Corps simulation objects that include features to interact with other simulation objects and respond to environmental stimuli.

DESCRIPTION: The end states articulated in the Marine Corps Modeling and Simulation Master Plan require authoritative representation of USMC simulation entities/objects germane to a synthetic littoral battlespace. Specifically, each of the eight end states requires modeling of Marine Corps units and equipment referred to as entities; and, the objects that populate the littoral environment (i.e. man-made and natural features in the littoral area). The entities must possess attributes that effectively represent the entity's behavior/performance in synthetic environments for analysis and training applications. Synthetic environments are constructed using models of physical environmental phenomena.

PHASE I: Investigate technology to enhance the current set of USMC simulation objects to respond to environmental stimuli. The proposal must address current techniques for representing environmental effects on simulated entities and the process by which the software is verified and validated. The Phase I proposal must contain the Phase II effort in at least outline form.

PHASE II: Employ the enhanced objects in operational scenarios will be developed for training and analysis simulations. The modeling effort will be directed at high fidelity representation of physical environmental phenomena and the effect of the environment on operations. The inventory of Marine Corps objects should be completed.

PHASE III: The final product should be a complete and validated set of simulation objects that can be employed in a variety of scenarios.

COMMERCIAL POTENTIAL: The methods developed for integrating environmental phenomena with simulated entities for modeling large complex operations can be employed to enhance the utility of other simulations including: Fire Fighting, Law Enforcement, etc.

REFERENCES:

1. Marine Corps Modeling and Simulation Master Plan, 23 Jul 94

N96-010TITLE: C2W Applications for Radio Frequency Weapons (RFW).

OBJECTIVE: The objective of this topic is to determine the application of RFWs in the C2W arena specifically communications countermeasures.

DESCRIPTION: Radio Frequency Weapons (RFW) are a family of weapons that includes High Powered Microwave (HPM) and Ultra-Wideband (UWB) devices. RFWs placed in close proximity to electronic equipment may have a greater effect on Command and Control (C2) equipment than conventional jamming without the unwanted side effects such as C2 fratricide or electromagnetic interference with friendly C2 systems.

PHASE I: Explore the application of HPM and UWB technology to satisfy the requirement to provide improved communications countermeasures to the Ground Combat Element (GCE) . At a minimum the devices should be able to generate sufficient power density to jam tactical radios in the HF through UHF frequency band. The ultimate goal is to provide a weapon capable of causing circuit disruption or damage.

PHASE II: Using the concepts developed in Phase I, demonstrate the ability of the RFW devices to interrupt C2 networks and equipment.

PHASE III: Integrate the identified technology into existing delivery devices within the T/E of the GCE and Combat Service Support.

COMMERCIAL POTENTIAL: Application of this research to commercial products would include security systems and law enforcement agencies. Applications ranging from communications to detection systems are envisioned.

REFERENCES:

1. Former Soviet Radio Frequency Weapons Programs; L. L. Altigilbers, J. D. Pryor, M. D. J. Brown
2. Investigation of Chaos, Fractal, and MultiFractal, Signal Behavior in Electronic Devices Exposed to High Power Microwaves; L. L. Altigilbers, J. D. Pryor, M. D. J. Brown

N96-011TITLE: Emissions Reduction for Hybrid Electric Vehicles

OBJECTIVE: The objective is to reduce visible and NOX emissions of future hybrid electric vehicles.

DESCRIPTION: Hybrid electric vehicles are being developed for both commercial and military applications. The operation of the vehicles engine, which cycles on and off based on power need and electrical energy storage, greatly impacts the suitability of the platform to its commercial or military use. A very large percentage of noxious fumes and visible smoke generated by an internal combustion engine is produced during the starting and shutdown of the engine. Engine control strategies that work with the hybrid electric control strategies can address and minimize pollution and visible emissions through techniques such as high-speed engine starting, fuel retarding, and engine load management. The emission requirements will determine the on-off operation and the duty cycle of the engine which ultimately affects fuel usage and fuel efficiency.

PHASE I: Explore software and hardware based solutions to accurately and in real-time provide engine operation strategies for minimal emissions and pollution. An 80 kilowatt turbocharged, diesel engine driving a permanent magnet generator shall be used for baseline purposes. Electrical schematics, hardware concept drawings, and software and logic flowcharts shall be delivered at completion of Phase I.

PHASE II: Using the chosen control strategies, a brassboard system with software loaded/embedded shall be developed and delivered, with interface information, for on-vehicle test purposes.

PHASE III: Ruggedize, miniaturize, implement and test in hybrid-electric vehicles.

COMMERCIAL POTENTIAL: The Clean-Air and Zero Emission vehicle mandates that take effect in 1998 are requiring electric and hybrid-electric vehicles in increasing numbers. Minimal pollution is the legislative prerogative, while minimal smoke emission is strongly desired even when it is not a pollution contributor.

REFERENCES: Peugeot XUD-11ATE engine technical description

N96-012TITLE: Very Rapid Synthetic Urban Environment Generation for use in Virtual Reality Training Preview and Rehearsal Simulators

OBJECTIVE: To develop a mechanism for very rapid synthetic urban environment generation for use in virtual reality training, mission preview and rehearsal simulators.

DESCRIPTION: A small compact device is needed by infantry and reconnaissance small units or platforms. It must capture urban terrain and cultural feature information for processing for effective rendering in synthetic environment displays. The processing function will enable the feature representation to hold dynamic attributes appropriate to ground combat. The ultimate goal is to provide a patrol leader the ability to enter an urban sector, capture digitized information and images, conduct a real time down load and provide a dynamic database for virtual reality immersion

PHASE I: Explore the application of technology to satisfy the requirement to provide very rapid generation of synthetic urban environment databases. The Phase I proposal must contain the Phase II effort in at least outline form.

PHASE II: Using the concepts developed in Phase I, demonstrate the ability of the devices to capture, manipulate and display dynamic urban terrain databases.

PHASE III: Integrate the identified technology into existing systems within the T/E of the GCE and CSSE.

COMMERCIAL POTENTIAL: This technology would be useful to other emergency service organizations, law enforcement, urban planners, real estate developers.

REFERENCES: Marine Corps Modeling and Simulation Master Plan, 23 Jul 94

N96-013TITLE: Expeditionary Containerized Warehousing Equipment

OBJECTIVE: To develop a lightweight mobility platform and intelligent manipulators to facilitate field deployable containerized warehousing.

DESCRIPTION: The USMC presently has no automated means of unstuffing combat service support containers delivered to forward areas of operation (AOA). Materials come to an AOA in a variety of packaging, primarily 8x8x20' containers and palletized loads. Containers are arranged in open storage areas, and contents are distributed as needed by a labor intensive and equipment intensive process. The USMC wants to expand expeditionary capabilities to include autonomous order filling from inventory stocks. Autonomous order filling is a multi-level problem. Asset identification systems exist within the DoD, and proposers can assume that the location of an item will be known. This information could be downloaded from a variety of deployed sources to an autonomous pick-and-pack system. Some technology areas to fulfill the mission include the routing of the load-collection vehicles, autonomous terrain navigation, selection of multiple items from multiple containers, handling of materials of differing sizes and shapes, and also for terrain mobility with the collected loads. Loads vary, but an example upper-end load is a pallet of ammunition weighing 2000 lbs.

PHASE I: Proposers should address all areas of the problem. The proposal may include some commercially available solutions for integration into the developmental system. Demonstration of knowledge of existing technologies will be weighted. The platform must have a level of mobility to traverse minimally prepared surfaces, including light vegetation, mud, and natural terrain contours. Proposers who demonstrate some core hardware success in Phase I will be weighted. The Phase I proposal must have at least an outline of the projected Phase II developmental cycle.

PHASE II: The proposer's core solution will continue into advanced development and prototyping. Commercially available hardware solutions will be integrated into the proposer's developmental core solution, creating an overall increased USMC combat service support capability. Parameters of USMC operations, such as weight and cube of the proposed system will be addressed in detail in the Phase II solution, resulting from work with the USMC in Phase I. The end of Phase II will be a demonstration of this integrated technology, with interim demonstrations occurring at appropriate review points. Phase II must address in detail the corporate marketing plan.

PHASE III: Commercial venture with possible consideration for military acquisition. Phase III should guarantee a commercial availability of the developmental system for competitive solicitation and unit availability for independent testing by government installations.

COMMERCIAL POTENTIAL: Efficient warehousing has been the source of much success and investment for many commercial industries in the last 10 years. Autonomous warehousing is also a growing market. No effective way of doing outdoor warehousing with the same proficiency has emerged. Gardening and lumber industries are examples of outdoor based businesses which would benefit greatly from an affordable outdoor warehouse retrieval system.

N96-014TITLE: Robo Fuel

OBJECTIVE: The objective is to develop an autonomous robotic refueler for dispensing fuel to fossil fuel burning vehicles. Removing the required human interface for refueling will reduce or eliminate some of the environmental impact associated with fuel transfer. Autonomous refueling will remove military personnel form potentially hazardous environments while increasing the efficiency of the refueling process.

DESCRIPTION: Robo fuel will consist of more than just a robotic arm with a fuel hose attached. Robo fuel will be a system which includes the robotic arm, but also incorporates modifications or adapters to the receipt vehicle fuel system. The major components of the system are:

- robotic arm 15 - 20' long, with fuel conduit and bayonet type nozzle on the end
- positioning beacon on the receipt vehicle which the robotic arm will sense and locate the refueling port
- information transfer connection so the robot can dispense the required amount of fuel
- adapter kit to incorporate double sealed (double sealed so outer seal prevents dirt and water from entering the system, the inner seal prevents fuel leakage from the tank) bayonet fitting on receipt vehicle
- information transfer connection which tells the robot the allowed flowrate for the receipt vehicle

The concept of operation is that a driver can pull into the station (or a mobile refueler can be brought along side) and be responsible only to get the vehicle refueling port within some allowable proximity of the robotic arm. At this point, the driver turns on the positioning beacon which wakes up the robot. The robotic arm will sense the position of the refueling port and automatically "stab" the bayonet nozzle into the port. The information contacts are made automatically at this point, and the receipt vehicle communicates to the robot the required amount of fuel and the allowable refueling rate (large trucks and heavy equipment for example can accept fuel at a much higher rate than automobiles). When the receipt vehicle is "full" the arm retracts into its neutral position awaiting the next vehicle. Robo fuel can be built as an attachment to existing refueling vehicles, built into a dedicated refueling vehicle, or as a stationary system. The fuel conduit in the robotic arm can be a fixed length, or variable length with the bayonet nozzle and hose removable in the event that the arm cannot reach the receipt vehicle's refueling port and manual refueling is required.

PHASE I: Select or develop a robotic arm of sufficient length,stiffness, and freedom of movement to support this concept. Select the position locator beam/beacon, bayonet nozzle and receipt fitting, and information transfer connection.

PHASE II: Fabricate prototype system which has the ability to locate the refueling port, identify required quantity and allowable flowrate.

PHASE III: Refine the prototype system based on the results of Phase II. Fabricate and deliver a pre-production prototype assembly for mounting on a Light Armored Vehicle (LAV). Deliver pre-production receipt adapter kits for installation on at least three different tactical vehicles (yet to be defined). Provide drawings for suggested modifications to future vehicle fuel systems to incorporate the robo fuel receiver concept.

COMMERCIAL POTENTIAL: With everybody wanting faster and easier services, this could be employed by the gas station industry. The customer could drive up, insert his/her bank card into a fixture located at the drivers window, then receive fuel without leaving the vehicle. The system will be environmentally friendly because the bayonet nozzle would allow true vapor recovery, and should eliminate spilled fuel. The system also has application to any commercial organization that operates a fleet of vehicles which are serviced at a central location. While the vehicle is receiving fuel, maintenance data (vehicle identification, odometer reading, etc) could be transferred to a central computer for improved maintenance scheduling. The military could benefit from this system just as a commercial fleet. Additionally, the military can benefit from a refueler mounted system by enabling them to refuel in hazardous environments (tactical or NBC) as well as allowing them to refuel an entire convoy more rapidly regardless of the weather or light conditions.

N96-015TITLE: Semi-active Suspension for Wheeled Vehicle

OBJECTIVE: The objective is to provide improved mobility for light vehicles in rough terrain environments.

DESCRIPTION: Future commercial and military vehicles (which may be based on commercial chassis' or components) will desire improved mobility. One unit of measure to determine improvement is reduced vibration transference to the driver. Current technology for suspension systems on light vehicles uses passive damping and spring systems which are harsh for small vehicles. Adaptive damping and springing without overly complex or expensive control systems (no terrain look-ahead), that can be fitted with existing spring or shock systems, offer mobility improvements at an affordable cost.

PHASE I: Explore and detail an actuation system mounted to a coil spring system for a four-wheel, 5000 pound vehicle that can adjust the spring and/or damping rate while the vehicle is on the move. Electrical schematics, hardware concept drawings, and software and logic flowcharts shall be delivered at completion of Phase I.

PHASE II: Using the chosen design for a suspension approach and technology, a vehicle set of components shall be developed and delivered, with interface information, for on-vehicle test purposes.

PHASE III: Ruggedize, implement and test in vehicles.

COMMERCIAL POTENTIAL: Sport vehicles, after-market modifications, and racing enthusiasts all desire improved speed-over-terrain while retaining vehicle control and sustaining minimal personal discomfort. Technology trends have shown that specialty components that improve performance generally make their way into production automobiles 5-7 years after introduction and demonstration.

N96-016TITLE: Automated Flight Delivery System

OBJECTIVE: Enhance capability to precisely deliver logistic supplies (5,000 to 15,000 lbs or greater per vehicle) to remote locations, regardless of aircraft landing constraints.

DESCRIPTION: The automated flight delivery system: 1) should easily fold and store compactly, 2) is highly maneuverable with a high lift to drag ratio, 3) should deploy from flying aircraft, 4) should navigate autonomously to target, 5) will deliver varied cargo without damage, (6) should be able to land on all terrain with the cargo, and (7) should be able to be returned to a designed point by self-propulsion.
This flight delivery system should be inexpensive and capable of rapid attachment to the load. The delivery system should be completely self-contained, requiring no load modifications/special features other than fitting a weight/cube window. The delivery system should be able to be redeployed in a minimum amount of time from the forward austere environment.

PHASE I: Investigate application scenarios, develop a functional specification, develop system configuration criteria, identify guidance system costs/availability, evaluate concepts, and report on the results. Proposers reaching the hardware stage within Phase I will be given weighted consideration. The Phase I proposal must contain the Phase II effort in at least outline form.

PHASE II: Develop a proof of concept prototype, test and demonstrate the prototype, plan Phase III, and report.

PHASE III: Phase III will require military program sponsorship. For successful advance to this phase, a successful proof-of-concept must have been demonstrated, and the USMC sponsor for this SBIR effort will have coordinated transition to demonstration/validation. The contractor must support a successful Phase III transfer by maturing the product to a point for commercial consideration, including manufacturability and cost.

COMMERCIAL POTENTIAL: The private sector industry of supply service to remote locations can benefit from this technology. For example, the National Science Foundation conducts research in Antarctica with the private sector providing all logistic supplies during the summer months (no supplies are provided during the winter months). With an automated flight delivery system, the supplies may be delivered at almost any time by an aircraft that disgorges the system and cargo over the camp. The system would then glide to the landing zone safely and

reliably. This system can also be used for delivery of emergency supplies to disaster relief or rescue efforts through out the world.

N96-017TITLE: Improved Dynamic Derivative Development

OBJECTIVE: Develop a single technique/method for determining the most representative Dynamic Derivatives for aircraft throughout the entire flight envelope.

DESCRIPTION: Numerous sources are currently used to acquire predicted Dynamic Derivatives. These sources have included wind tunnel forced oscillation tests, rotary balance test, analysis and flight test data extraction. None of these sources has yielded Dynamic Derivatives that have been considered representative of the actual aircraft, nor have any of the predicted derivatives had any correlation with each other.

PHASE I: Determine primary and secondary sources for acquiring high fidelity Dynamic Derivatives that will accurately reflect actual aircraft characteristics. As part of this process, provide an assessment of all current capabilities for acquiring such data, and why each method is desirable or undesirable, with examples. Propose plan to validate results in Phase II. This plan should include use of simulation and/or flight test results to demonstrate the improved fidelity (enhanced flight safety) gained with the desired source(s).

PHASE II: Validate primary and secondary sources for acquiring/determining the Dynamic Derivatives. Produce software that can be used to rapidly develop the appropriate derivatives for each aircraft type from data derived from selected tests. Source code remains proprietary.

PHASE III: Produce software in a commercially and governmentally acceptable format that will enable the user to expeditiously determine dynamic derivatives recommended sources. (Effective 01 Oct 95, many of the critical facilities used by both sectors to gather this type data will be closed by NASA as part of downsizing. Some of these facilities will be privatized. As such, the product of this SBIR could be utilized by the vendor to support DOD/Commercial aircraft development from the private sector in a more profitable mode of operation.)

COMMERCIAL POTENTIAL: A single source for acquiring these derivatives will improve productivity and reduce costs for developing high fidelity simulations of aircraft. Improved dynamic derivatives will also aid design of aircraft and reduce potential re-design cost after aircraft is flown. Safety of flight will be improved by higher fidelity assessment capability of critical flight regimes. Privatized use of wind tunnel facilities will enable vendors to use this capability to support commercial and DOD developments.

N96-018TITLE: Improved Wind Tunnel Test Technique

OBJECTIVE: Develop a test technique and identify the best facility that can be used as the primary source for high fidelity Dynamic Derivative development.

DESCRIPTION: A wind tunnel test technique (and associated facility to gather the data) is needed to obtain Dynamic Derivative data about all aircraft axes which would be more representative of actual aircraft motion, both linearly and non-linearly. Currently, many techniques and facilities are utilized, but frequently yield inconsistent data. In addition, none of these data accurately predict actual aircraft characteristics.

PHASE I: Determine the primary test facility/technique which should be utilized to gather Dynamic Derivative data about aircraft axes. This determination should also identify all current test procedures for all applicable test facilities. Assess limitations imposed in each of these facilities that contribute to problems associated with the acquisition of accurate data. Provide proposal to validate technique in Phase II, clearly demonstrating that the selected technique should be used as the primary data source. (This should include conducting tests, as needed, to verify test procedures. Incorporate data in representative simulation. Utilize flight test data, where applicable and available, to substantiate that improvements in test procedures has improved the quality of high angle of attack aerodynamic databases.)

PHASE II: Validate that the selected test facility/technique yields the highest fidelity Dynamic Derivative data. Identify software and hardware modifications that each facility can incorporate to improve this data

acquisition. Develop software, as needed, for automated test procedures that can be utilized to improve the efficiency and accuracy of acquisition of the test data.

PHASE III: Produce the software and/or provide the hardware that can be utilized to improve the wind tunnel test and automated test techniques. Utilize techniques on developmental tests within the Government. Tailor procedures to meet specific needs of both commercial and Military organizations. Hardware/software could be used by company in privatized operation of existing wind tunnels.

COMMERCIAL POTENTIAL: Accurate wind tunnel test procedures are critical to development of both commercial and military aircraft. Software developed in conjunction with hardware improvements developed in this program are directly applicable to commercial aircraft, since both the Military and Commercial sectors utilize the same wind tunnels to develop each product. Software and hardware can be packaged and sold to both Government and Commercial sectors. Source code remains proprietary to developer. In addition, a majority of wind tunnels utilized by the Government and Industry are NASA facilities. (Effective 01 Oct 95, many of the critical facilities used to gather such data by both Government and Industry will be closed by NASA as part of downsizing. Some of these facilities will be privatized. As such, the technique/facility identified in this SBIR could be utilized by the vendor to support DOD/Commercial aircraft development from the private sector in a more profitable mode of operation.)

N96-019TITLE: Improved Wind Tunnel Data Reduction Procedure

OBJECTIVE: Develop a universally accepted data reduction procedure for data acquired in dynamic wind tunnel testing. These tests include rotary balance, forced oscillation and plunging type techniques.

DESCRIPTION: Develop methodology and software tools that can be utilized to reduce data and provide the aerodynamic coefficients as a non-linear function of aircraft rotational rate and dynamic data as a function of aircraft angular rates. Currently, data is not provided to the DOD or Industry in a format compatible with flight simulations, and as such, has not been used properly to predict aircraft motions.

PHASE I: Determine the optimum method/procedure for reducing dynamic wind tunnel test data into a format that can be used readily by DOD and Industry. As part of this development, identify aerodynamic coefficients requiring improvement and that contribute significantly to high angle of attack databases. Document how these procedures differ from existing techniques and how they will improve the quality of data reduction. Identify tests that can be accomplished in Phase II that can be used to demonstrate how these procedures will be validated. (This should include a proposal to demonstrate how these procedures can be universally applied to all aircraft types from various test facilities. Verify that the data produced from these procedures more accurately replicates actual aircraft characteristics by correlation with flight test results (as available).

PHASE II: Validate that the data reduction procedures developed in Phase I provide the highest fidelity data from each wind tunnel test. Develop the software that will enable DOD/Industry to reduce this data readily. Conduct tests as necessary and/or utilize existing data to verify new procedures to produce improved simulations and prediction techniques. Provide details on how the software developed to support this data reduction is unique such that one unified procedure for data reduction can be used by commercial and Government users.

PHASE III: Provide data reduction method and software developed in Phase II in a commercially and Governmentally acceptable format. Incorporate data reduction procedures in developmental tests. Tailor procedures to meet the needs of both commercial and Military organizations. Source code remains proprietary to vendor.

COMMERCIAL POTENTIAL: Improved wind tunnel data reduction procedures are directly applicable to the design of both commercial and Military aircraft, since the same wind tunnels are utilized for both developments. A universally accepted procedure will improve productivity and efficiency in wind tunnel testing. (Effective 01 Oct 95, many of the critical facilities used by both parties will be closed by NASA as part of downsizing. Some of these facilities will be privatized. As such, the product of this SBIR could be utilized by the vendor to support DOD/Commercial aircraft development from the private sector in a more profitable mode of operation. Since the product should be one that can be used by commercial and Government sectors, the vendor has a significant market available to sell their product.

N96-020TITLE: Innovative Lightweight Recuperative Gas Turbine Turboshaft Engine Development

OBJECTIVE: To develop an Innovative, Lightweight Recuperative Gas Turbine Engine System For use in Unmanned Aerial Vehicles

DESCRIPTION: Current recuperators used on gas turbine engines operate with a thermal efficiency near 80% but incur a weight penalty due to their being constructed of stainless steel. The heavy weight of the recuperator negates any increase in brake specific fuel consumption (BSFC) gained by its use. An innovative and lightweight recuperator system must be conceived in order for the UAV community to benefit from the decreased BSFC generated by the recuperative technology. Specifically, a turboshaft system that meets the following specifications is required:
Maximum power range from 60 to 120 shaft horsepower
Recuperator thermal efficiency greater than 90%
System power to weight ratio not less than 1:1
BSFC not greater than 0.5 lb/hp-hr over entire operating range

PHASE I: Conceptual designs shall be generated and validated through bench testing or with a pre-production prototype design. A weight reduction plan (if required) must also be generated for Phase II implementation.

PHASE II: Fabrication and test of pre-production system that meets all system requirements described above to verify system performance.

PHASE III: The technology developed will be transitioned to commercial manufacturers for applications involving small turboshaft engine in which fuel savings are important.

COMMERCIAL POTENTIAL: This technology can be used by the private sector to replace conventional turboshaft engines in order to lower operating costs by drastically reducing fuel consumption costs. Applications include UAVs, generator sets, fire pumps.

REFERENCES: Unmanned Aerial Vehicles Master Plan 1994

N96-021TITLE: Innovative Small, Heavy Fuel Engine Concepts

OBJECTIVE: To examine breakthrough, state of the art, innovative small heavy fuel engine concepts to determine feasibility of concept

DESCRIPTION: The Navy desires to consider advanced innovative small internal combustion engine concepts that will advance the present sate of the air (power to weight) in the 25-100 horsepower range with applications including unmanned aerial vehicle, generator sets and portable fire pumps. Innovative concepts shall focus on both JP-6 and JP-8 fuel (heavy fuel) operation and lightweight construction. Engine concepts shall have power to weight ratios approaching 1.0 and brake specific fuel consumption not exceeding 0.7 lbs/hp-hr.

PHASE I: Conceptual designs shall be generated and validated through theory, analysis and subscale testing.

PHASE II: Fabrication of full scale designs and experimental verification of the concept.

PHASE III: Produce limited numbers of pre-production engines for field demonstrations and validation.

COMMERCIAL POTENTIAL: Numerous uses of small gasoline engines would be replaced by equivalent performing diesel fuel engines that are inherently safer.

N96-022TITLE: Reinforcement Learning For Flight Control

OBJECTIVE: To develop and demonstrate the use of reinforcement learning for flight control optimization in either the design process or through on-line learning.

DESCRIPTION: To date, most of the research that has been done in applying learning to flight control has used some form of supervised learning. However, recent advances in reinforcement learning have demonstrated it to have strong potential for improving control systems through design optimization or on-line learning. For flight control, reinforcement learning may be used to optimize either inner loop tasks such as primary command and stability augmentation or outer loop tasks such as automated trajectory control for weapons delivery or terrain following/terrain avoidance. If it is an inner loop controller it must provide acceptable pilot handling qualities. In all cases, it must be sensitive to real-world implementation issues such as validation and computational overhead.

PHASE I: The proposed reinforcement learning algorithm shall be demonstrated on a flight control element of a simplified high performance aircraft model.

PHASE II: The reinforcement learning technique shall be demonstrated on a medium or high fidelity nonlinear aircraft model with sufficient complexity for a proof of concept. This aircraft should exhibit both static and dynamic instabilities, disturbances, sensor noise, and uncertainties in its plant dynamics.

PHASE III: Phase III will develop a software package for use by government and industry to apply the proposed reinforcement learning algorithm to a wide range of control systems.

COMMERCIAL POTENTIAL: There is currently a strong demand for learning controllers in a variety of areas including aircraft, robotics, and computer-integrated manufacturing. As a result, the methodology and software package should have strong commercial potential, if successful.

REFERENCES:

1. M. Steinberg, "An Initial Assessment of Neural Networks & Fuzzy Logic for Flight Control," *Proceedings of the 1994 American Control Conference*, 1994.

2. D. White, D. Sofge (ed.) *Handbook of Intelligent Control: Neural, Fuzzy, and Adaptive Approaches*, Van Nostrand Reinhold, New York, 1992.

N96-023TITLE: Optimized Ejection Seat Control Theory and Microprocessor Controller

OBJECTIVE: The development of both an ejection seat controller and an analysis tool which will model free stream dynamics of the ejection seat with the implementation of feedback control of propulsion and aerodynamic control surfaces.

DESCRIPTION: A microprocessor controller and control law shall be developed to interface with the aircraft and provide feedback control of ejection seat propulsion and aerodynamic devices as well as event sequences such as parachute deployment. By modeling the seat aerodynamics, aircraft proximity effects, and mass properties, optimized control gains shall be developed utilizing a linear quadratic regulator (LQR) or other suitable approach. Feedback control is anticipated to incorporate attitude and heading, and to maintain acceleration levels within human tolerance when possible.

The final configuration of the seat controller shall be approximately 100 cubic inches and mounted on the seat. It shall be exposed to harsh environmental conditions and it must operate under high acceleration and vibration conditions. The unit shall contain all software and hardware necessary to interface with the aircraft and provide ejection seat control.. The control algorithm shall be applied to the controller hardware specifically developed for escape system propulsion actuation and event sequencing. The control theory shall also be used as an escape systems analysis tool. For Phase I, the configuration of the control theory analysis tool shall operate on a stand alone computer workstation (UNIX or PC).

PHASE I: The effort for Phase I shall concentrate on developing the basic tools and models, including the implementation of the seat system aerodynamics and mass properties. The offeror shall evaluate various analysis tools (software) or develop analysis methods specifically for the use with escape systems, both ejection seats and capsules. It is expected that a usable analysis software and data shall be delivered at the end of this phase. For Phase I, the offeror shall also identify the basic micro-computer architecture which shall meet the computational and speed requirements for control of an ejection seat.

PHASE II: If Phase I is successful, the offeror shall fully develop the analysis tools so that any change in configuration (aerodynamics or mass properties) could immediately be evaluated, and a new gain schedule developed. Initial implementation of the control theory shall also be investigated through the trade study of available microprocessor hardware. The software and hardware systems shall demonstrate real time operation. Deliverables at the end of Phase II shall include the final analysis software with manuals, as well as a developmental microprocessor system with operational control algorithms.

PHASE III: If Phase II is successful, it is anticipated that a Phase III effort will be funded to fabricate the controller hardware and software which shall be adaptable to developmental escape systems.

COMMERCIAL POTENTIAL: This topic and the technology spin-offs could offer commercial potential in the area of control theory design and air vehicle auto pilots.

REFERENCES: MIL-S-18471G

N96-024TITLE: Adaptive Lumbar Support/Alignment System

OBJECTIVE: The objective of this topic is to develop an adaptive lumbar support/alignment system to optimize the vertical alignment of the lower spinal column during aircraft ejections and helicopter crashes.

DESCRIPTION: During the early stages of an ejection, an aviator can be exposed to injurious levels of acceleration induced loads along his or her spinal column. Consequently, fractures of the lower thoracic and upper lumbar vertebrae have been documented as one of the most dominant major injuries which occur prior to ejectee egress from the aircraft. Similar statistics have been observed during helicopter mishaps. Among the numerous injury-related factors, which include weight, height, age preexisting conditions, etc., researchers have consistently identified poor posture (i.e., poor alignment of the spinal column prior to ejection) as a major causal factor in G_z-related injuries to the lower spinal column. Analytical and empirical investigations have demonstrated that the proper alignment of the lower spinal column can significantly reduce the potential for injury. Recent technological advances may enable the development of a small, light-weight device which can be used to adaptively reorient the aviator's lower spinal column prior to ejection or helicopter impact. Easy retrofit of the device into existing ejection hardware and crashworthy seating is desirable. Proposers should include a preliminary design of an adaptive lumbar support/alignment system as part of their proposals.

PHASE I: At the end of the six month effort, Phase I should result in a detailed conceptual design, analysis, and proof of concept.

PHASE II: Develop and deliver a fully functional prototype lumbar support/alignment system that fulfills the Phase I objectives.

PHASE III: Refine the prototype hardware and deliver pre-production units.

COMMERCIAL POTENTIAL: This item has commercial applications in the automotive industry.

N96-025TITLE: Lightweight Composite Sandwich Structure for Navy Aircraft

OBJECTIVE: Develop lightweight composite sandwich structures, fabricated of woven preform and resin transfer molding (RTM), that retain no moisture and eliminate corrosion with improved damage tolerance.

DESCRIPTION: The benefits of weight, cost, and supportability savings for high performance air vehicles can be realized if the structural components are designed and fabricated with improved structural integrity. Sandwich structures utilizing honeycomb cores are considered most weight efficient. But retention of moisture with honeycomb core degrades the structural integrity leading to premature failure of the component. Development of composite sandwich structures fabricated of appropriately woven preform and resin transfer molding or similar process could provide cost effective sandwich structural components that retain no moisture, eliminate corrosion, and improve damage tolerance. The woven preform should be such that it will allow passageways for moisture drainage in the sandwich. The sandwich structures should contain no moisture-retaining material in the core, such

as foams or similar materials. The entire sandwich should cured in single cure operation without any secondary operation such as bonding. The materials for fabrication should have nominal properties similar to fibers AS4 or IM6 and resin 3501-6 or 977-3. The basic strength parameters, such as effective transverse shear, flexural, and twisting stiffnesses should be comparable to that of honeycomb sandwich. Practical consideration should also be given to the supportability of the sandwich structures. The developed sandwich structures will be applicable to both DoD and commercial aircraft.

PHASE I: Develop woven preforms and methods for resin transfer molding or similar processes to fabricate specimens and perform preliminary analysis and tests for stiffnesses and strengths applicable to Navy aircraft environment.

PHASE II: Improve the weaving pattern and fabrication technique and perform analysis and comprehensive tests for stiffnesses, strengths, and damage tolerance. Develop appropriate repair methods for supportability.

PHASE III. Develop and fabricate representative components and subcomponents for Navy and commercial aircraft. Perform analysis and tests for strength and damage tolerance

COMMERCIAL POTENTIAL: Presently honeycomb sandwich structures are used in commercial aircraft. Development of proposed sandwich structures will improve structural integrity considerably, and reduce substantially the repair costs related to corrosion, impact damage and debonding.

REFERENCES:

(1) H. Ray, "Investigation of Advanced Lightweight Sandwich Structural Concepts," Report NAWCADWAR-93064-60, NAWC-AD, 1993.

(2) C. Libove and R. E. Hubka, "Elastic Constants for Corrugated-Core Sandwich Plates," NACA, TN2289, Feb 1951.

(3) H. G. Allen, Analysis and Design of Structural Sandwich Panels, Pergamon Press, 1969.

N96-026TITLE: Aircraft High Alpha Dynamic Analysis

OBJECTIVE: Develop system identification algorithms and software for complete nonlinear analysis of aircraft high angle of attack dynamics.

DESCRIPTION: High angle-of-attack control and maneuverability are important concepts for combat effectiveness of the new class of fighters such as F-18, F-22 and JAST. A thorough understanding of aircraft departure characteristics and super maneuverability requires analysis of large amplitude aircraft motions at high angles-of-attack. At present, there is a lack of analytical methods for investigating the stability and control properties of aircraft during such highly nonlinear maneuvers. The objective of proposed Phase I and II research is to develop algorithms and software for complete nonlinear analysis of high alpha dynamics. These techniques will predict dynamic phenomena such as wing rock, tumbling, post-stall gyrations, limit cycles, chaotic motions and other types of bifurcations, using high alpha aerodynamic and propulsion data. In addition, their application to Pilot Induced Oscillations (PIOÕs) and controller designs to improve high alpha characteristics will also be investigated

PHASE I: Provide a feasibility study which develops the theory and algorithms required for the identification of the non-linear high angle of attack aerodynamic characteristics.

PHASE II: Develop, test and operationally demonstrate the identification methods formulated under the Phase I SBIR effort.

PHASE III: Produce the non-linear system identification methods demonstrated in the Phase II effort. This will be the transition from development to application for major aircraft programs such as the F-18 E/F and V-22.

COMMERCIAL POTENTIAL: Successful development of software will help fighter aircraft designers and engineers in rapidly analyzing various aircraft designs and anticipating stability problems prior to flight test. In addition this effort will also improve the ability of aircraft training systems provide high fidelity training in high angle of attack flight. This is expected to save millions of dollars in the design of fighter aircraft and the development of flight control systems. The nonlinear analysis techniques will also apply to other systems which

exhibit bifurcations, stall and chaotic motions. Such systems include helicopters, turbine engines, electric power systems, submarines and a large class of vibration problems in nonlinear mechanical systems.

REFERENCES: MIL-STD-8785C

96-027TITLE: Innovative Lightweight Unmanned Air Vehicle (UAV) Fuel Injection System

OBJECTIVE: To Develop a Lightweight Fuel Injection System for Use in UAV Heavy Fuel Engines.

DESCRIPTION: Fuel injection systems currently designed for automotive and diesel applications are too heavy for use on UAVs, where any additional weight is a penalty. Specifically, a system that meets the following specifications is required:

Operation on JP-5 and JP-8 fuels without lubrication additives
Engine operating speed range from 500 to 7000 RPM
Maximum output power range of 20 to 100 HP
Injected Fuel Volume Turndown Ratio of 10:1 (idle to max)
Adjustable injection timing
Adjustable injection duration
Fuel infection pump operational life greater than 500 hours
Minimum fuel injection pressure of 5000 psi
Constant fuel injection pressure (no variation with speed)
Total system weight (injection pump, injectors, injection lines, fuel filters and fuel pumps) not to exceed 10 pounds

PHASE I: Conceptual designs shall be generated and validated through bench testing or with a pre-production prototype design. A weight reduction plan (if required) must also be generated for Phase II implementation.

PHASE II: Fabrication and test of pre-production system that meets all system requirements described above to verify system performance.

PHASE III: Transition technology to commercial manufacturers for applications involving small engines (less than 100 horsepower).

COMMERCIAL POTENTIAL: This technology can be used by the private sector to replace gasoline engines with lower cost heavy fuel engines in areas such as generator sets, motorcycles, pumps welding machines, etc..

N96-028TITLE: THERMAL INVESTIGATION OF ARRESTING HOOKS

OBJECTIVE: Develop capability to analyze the variables contributing to the cracking of the arresting hooks and improve the manufacturing processes

DESCRIPTION: Utilizing modeling techniques, analyze the material and thermal variables contributing to cracking of arresting hooks during hard face coating, fusing and heat treatment, and improve the manufacturing processes to eliminate cracking.

PHASE I: Develop an analytical model to evaluate the material and thermal variables that impact the manufacturing of the arresting hooks. Analyze the material and thermal properties contributing to cracking of arresting hooks during hard face coating, fusing and heat treatment through computer modeling utilizing finite element analysis to account for the difference in the geometry and mass of the hooks, heating rate, coefficient of thermal expansion and contraction and other applicable material and thermal properties. Coating variables have to be incorporated. Temperature distributions have to be established. The analytical results will be validated against the experimentally tested results.

PHASE II: Refine/Improve hard face coating and heat treatment processes and validate against the analytical results. Prove the process doable in a production environment. Develop statistical process control

requirements. Develop non-destructive inspection techniques to examine the base metal through various coating thicknesses and establish the base metal structural integrity..

PHASE III: Validate the processes developed including the statistical process controls for all the currently procured hooks.

COMMERCIAL POTENTIAL: The approach in the development of computer modeling and the resulting optimized processes to produce hooks under statistically significant process controls should find excellent other military, commercial and industrial applications.

N96-029TITLE: Low Energy Aircraft Launch Assist Device

OBJECTIVE: To develop an advanced launch assist device for both the Navy sea based and Marine Corps land based current and future Conventional Take-Off and Landing (CTOL) aircraft, Vertical Short Take-Off and Landing (VSTOL), and Advanced Short Take-Off and Vertical Landing (ASTOVL) aircraft.

DESCRIPTION: For the last 70 years, the Navy has used some type of catapult to help propel carrier based CTOL aircraft to their required launch speed within the confines of the flight deck.. The first catapult was a cable type driven by a flywheel. Follow-on types included pneumatic, explosive and hydraulic. These were all indirect drive mechanisms. Today's aircraft carriers employ direct drive steam powered catapults. These systems were developed in the 1950's, are heavy, large, inefficient, manpower intensive, are completely dependent on the ship's propulsion system, reduce the structural life of all seabased airframes and are at the limit of their performance capabilities. The Navy desires that it's future seabased tactical aviation platforms be physically smaller and more efficient in terms of space utilization, machinery and operations. For aircraft launch and recovery operations this means making more efficient use of the flight deck real estate (i.e. reducing the area required for launch and recovery) and in reducing the impact to ship operations (i.e. reducing the required wind over deck). US Navy efforts conducted in the 1970's, along with operational experience gained by other Navies, demonstrated the tremendous benefits provided by utilizing Ski-Jump technology in the launch of VSTOL aircraft. Benefits in terms of reduced take-off distance, increased payload capability and reduced stress imparted to the airframe have been demonstrated. Studies have also shown that similar benefits are to be gained for CTOL aircraft by incorporating a launch assist device into the ski-jump. In addition to supplying kinetic energy to the aircraft, the launch assist device would also serve to act as a guide for STOVL aircraft allowing takeoffs in out-of-wind/ship motion conditions and provide aircraft directional control when approaching minimum single engine control speeds. This type of configuration would also be extremely beneficial for Marine Corps CTOL and VSTOL aircraft launch operations from Expeditionary Airfields.
A low energy aircraft launch assist device is needed to permit the launching of CTOL, VSTOL and STOVL aircraft from future seabased tactical aviation platforms and landbased Expeditionary Airfields. This device must fully integrate with a ski jump. To minimize the ship impact, in terms of lost deck spots, and to optimize the launch angle for different aircraft, the ski jump will be a curvilinear ramp fully adjustable from 0 degrees through 8 degrees. The launch device must function within this constraint. The length of the launch assist device must be contained within the total length of the ski jump which will not exceed 200 ft. The device must operate with closed loop feedback control. The energy output of the device must be adjustable from 5 to 60 million ft lbs. The device must be compatible with the current method of coupling to the aircraft. Due to extensive experience with indirect drive systems, direct drive is preferred. The prime power for this device must be compatible with sources available aboard ship and at an Expeditionary Airfield.

PHASE I: During Phase I, the contractor shall determine the optimum launch assist device for launching aircraft in combination with a ski jump based on a technology trade-off study. The contractor shall then proceed with a conceptual design of the launch assist device.

PHASE II: The contractor shall provide a detailed design of the launch assist device. The contractor shall also provide a working scale hardware model of the device. The model should be based on a 1/4 energy scale. The contractor shall use the model to demonstrate the required scaled and adjustable energy output and how it would integrate and operate with an adjustable ski jump.

PHASE III: A transition to an advanced development program by the contractor will provide a full scale launch assist device, capable of being integrated into a full scale ski jump and launching representative aircraft.

COMMERCIAL POTENTIAL: This technology can be applied to automotive crash testing or any other application which requires the rapid acceleration of large bodies.

REFERENCES: NAVAIR 51-15ABD-1, Technical Manual, Operation Instructions, Catapult Type C Mark 13 Mod 1 for CVN68 through CVN71, and Type C Mark 13 Mod 2 for CVN72 and CVN73.

N96-030TITLE: Electric Power Transfer

OBJECTIVE: To develop an advanced concept for use in linear motors which would permit the transferring of electrical power from a stationary source to a moving member and that is inherently reliable, safe, and electromagnetically compatible.

DESCRIPTION: The purpose is to develop an advanced electrical power transfer concept that can be utilized to implement advanced electrical systems on aircraft carriers. The present technology of transferring electric power does not allow for an efficient, safe, and reliable method of transferring power. This becomes evident when observing that brushes are one of the highest maintenance items for electric motors and generators, even in a protected environment. The electric power transfer concept to be developed shall have the capability of providing electrical power from a stationary source to a moving platform in an inherently efficient, safe, reliable, and electromagnetically and electrically compatible manner. (An analogous geometry would be an electric locomotive, with a power bus alongside the track and brushes attached to the locomotive, providing the power transfer). The projected length of travel would range from 5 feet to approximately 500 feet and is environmentally exposed, velocity of the moving platform would range from 0 m/s to 100 m/s. The characteristics of the electrical power include ranges from DC to 400 Hz, up to 5 KV, up to 1 MW, 3 phase.

PHASE I: The contractor shall determine, through analysis, the optimum concept for transferring electrical power, given the constraints. The contractor shall identify the technologies involved and the approach to overcome the risks associated with implementing the proposed concept and technologies. The contractor shall provide a preliminary design of the concept.

PHASE II: The contractor shall develop working scale models which demonstrate the feasibility of the proposed technologies. The contractor shall provide a detailed design of the proposed concept.

PHASE III: A transition to an advanced development effort by the contractor will provide a full scale electric power transfer system, capable of meeting the aforementioned requirements.

COMMERCIAL POTENTIAL: An advanced electrical power transfer concept has wide applications in electric motor and generator technology. An advanced electric power transfer concept would have a significant impact on efficiency and maintainability, which could have dramatic effects on the overall electrical industry. Direct applications include materials handling, elevators, and mass transit systems. Another advanced technology application includes magnetic levitation (MAGLEV).

N96-031TITLE: Magnetic Resonance Imaging for Materials Applications

OBJECTIVE: Develop methods and assess present day technology for the use of Magnetic Resonance Imaging (MRI) in the characterization of baseline and aged rubber and composite materials.

DESCRIPTION: Composite materials and cured rubber formulations are used increasingly for Navy and DoD applications. The characterization of defects and study of aging in these materials generally involves some form of destructive analysis. Many of the currently used methods do not provide the necessary data required to determine shelf life, detect material stress features, or determine the detrimental effects of, for example, water or jet fuel absorption. MRI has been used to study composite and rubber materials and the results to date have been used to identify mechanism of solvent ingress, to map stress regions, to determine cure state, and to non- destructively identify material defects. This effort will allow us to assess the technology for transition to Navy and DoD materials issues and to get a head start on materials characterization for future platforms and weapons programs.

PHASE I: Provide a feasibility study which develops methods for studying small scale (20 mm) samples of composite case and liner materials. Samples with known defects, solvent ingress, or damage will be compared to baseline materials and, in addition, state of cure of composites, liners, and rubber formulations will be assessed. We will also provide specific samples containing weld lines or bond lines and samples displaying heat damage. The methods proposed to evaluate samples will be tested and a report will describe the success or failure of these test methods.

PHASE II: Transition test methods described above to large scale materials like composite case weapons or aircraft structural parts.

PHASE III: Implement test methods at a Warfare Center or Depot.

COMMERCIAL POTENTIAL: MRI was transitioned from a laboratory curiosity to the medical diagnostic field over the past 15 years. Developments in materials diagnostics are now at the laboratory curiosity stage and the transitions to industries such as the tire and rubber industry and the food processing industry, as well as a host of others, are moving forward.

N96-032TITLE: Light Weight High Voltage Power System

OBJECTIVE: Replace the current High Voltage Power Supply System with one of the same KVA rating but with fewer or lighter power modules for weight reduction and improved reliability.

DESCRIPTION: The Navy currently uses a high voltage power supply consisting of eight, 90 lb, 30 KVA, 270VDC power supply modules to support a strategic communications aircraft. These modules convert aircraft AC input power to DC power that is applied to Radio Frequency (RF) Power Amplifier Modules (PAMs). Subsequently, the PAM uses the 270VDC power to amplify an RF drive signal from another source. The 270VDC PAM incorporates both soft start and soft stop capability to minimize damaging stress which reduces reliability of aircraft AC power sources. Given the obvious advantages in decreasing the weight of avionics systems, reducing the weight of aircraft power amplifiers offers a cost effective means of achieving that goal. This effort will increase the voltage per pound of power amplifier for all power amplifier users.

PHASE I: Provide a feasibility study which analyzes existing rectifier/filter, multipulse power supply topology for weight reduction possibilities. Additionally, alternate high voltage power supply switcher topologies should be considered.

PHASE II: Develop, test and operationally demonstrate the high voltage power supply requirements under the Phase I SBIR effort.

PHASE III: Produce the demonstrated high voltage power supply in the Phase II effort.

COMMERCIAL POTENTIAL: New lighter weight power supplies can be used with other avionic applications.

REFERENCES: Rockwell Document No. HPTS-1002-1, dated 09 April 1993

N96-033TITLE: Massively Parallel Processing for Image Processing

OBJECTIVE: To develop a high quality imaging capability for use in developing real-time military and commercial imaging applications. The system utilizes a 64K Massively Parallel Processing (MPP) board, together with Operating System (OS) software installed on a HP-748 workstation. The system provides the workstation with the capability of generating real-time high fidelity, high pixel density and high refresh rate graphic images.

DESCRIPTION: A critical situation has developed across a broad range of service programs involving the time it takes to produce high quality graphic images for use in real-time military applications. To solve this problem, a 64K MPP board together with OS software will be developed and installed on a HP-748 workstation. Achieving this goal provides the following benefits: (1) the removal of the speed bottleneck involving image processing by producing high fidelity, high pixel density and refresh rate images in real-time, (2) provide the developer with a dual use accelerator board for use in developing vertical military and civilian applications and (3) provide the

developer a platform for developing 256K and 1024K MPP boards aimed a achieving the goal of one processor per pixel. The development effort needed to achieve these goals involves the following:

PHASE I: Requirement definition development from liaison with workstation manufacturer and software algorithms producers. Analysis of specific software with respect to the underlying native parallelism in the mathematical algorithms. Applications developed linking the MPP board OS and libraries to the host processor OS and application software. MPP chip development and procurement. MPP chips are ready for use. Module specification will be given for multichip modules of 4K chips in a ASIC design. After fabrication and testing the ASIC chips will be incorporated in the 64K processor board.

PHASE II: The MPP board specification will be finalized, followed by the design layout phase, fabrication, assembly and testing. The MPP board baseline will have 64K processors implemented with 16x4K processor multichip modules each incorporating 16x256 processor VSLI MPP chips. The specification, design, implementation and testing of integrated MPP-host system OS and programming tools. Installation of MPP64K processor board, OS, libraries and application specific software installed on a HP-748 workstation. The prototype system will be performance tested and demonstrated using application specific software.

PHASE III: Product developed through this SBIR initiative can be used by aviation system program managers in the Navy, Air Force, and Army, as well as the commercial sector to implement new training technologies and to enhance systems currently in use. The system has direct application to telemedicine since high speed imaging is required for practical implementation of medical imaging system.

DUAL USE COMMERCIALIZATION: Use of the MPP board, OS and support software in developing military and commercial applications such as accelerator hardware platforms for multiple software products, realistic aviation-related simulators, biomedical imaging and telemedicine applications and real-time virtual reality training environments.

N96-034TITLE: Smart Search Planning Algorithm

OBJECTIVE: A methodology is sought for performing an optimal search, over a pre-defined irregular geographical area, for a hunter/seeker missile, attack aircraft, or UAV to find an imprecisely located or moving target.

DESCRIPTION: A proof-of-concept is sought for a method of computing an optimal search pattern over terrain. It is assumed that a temporal probability distribution of target(s) locations is given. The interaction of sensor with the terrain will cause the search swath to vary. Thus sensor characteristics (swath,depth-of-view, weather effects), terrain and features (terrain masking, tree lines, bridges, ridge lines), sensor/target interaction (pixels on target), and the airborne platform's turning constraint must be considered in determining the effective search pattern. The definition of optimality should be user definable based upon time (or total pathlength), probability of target detection, and value of the target (in a multiple target scenario). A prototype implementation would be developed in C or C++ (commercial requirement) and would be able to run on equipment consistent with Navy combatant computer architectures.

PHASE I: Conduct a feasibility analysis study and establish the requirements (data, computer hardware, databases, and display technology) for performing an optimal covering,
assuming only one target.

PHASE II: Expand on the Phase I study to include multiple targets and multiple airborne platforms and implement a prototype to demonstrate the concept. Of interest would be
the computing time requirements, since the ultimate goal would be to perform this operation in near-real-time, e.g. seconds.

PHASE III: Enhance the prototype to accept real-time data and integrate it to communicate with existing and under development military systems.

COMMERCIAL POTENTIAL: Search and rescue operations, logistics enhancement, and delivery route optimization.

REFERENCES: The Tactical Movement Analyzer (NSWCDD/TR-94/99).

N96-035TITLE: Innovative Approaches to Unmanned Aerial Vehicle (UAV) Detection of Minefields

OBJECTIVE: The use of land mines in regional conflicts has become a significant threat. The objective of this effort will be to investigate and demonstrate innovative approaches to minefield detection that are capable of being hosted on a UAV platform. Detection system can be used commercially to locate artifacts, buried items and precious metals.

DESCRIPTION: This effort will study the use of UAVs with Ground Penetrating Radar's (GPR) and advanced signal processing techniques to detect the presence of minefields. Innovative approaches must address current GPR limitations of limited range detection, clutter suppression, and object recognition. Innovative approaches must be capable of being implemented as an UAV payload. Based on study results, a prototype of an UAV minefield detection payload system will be fabricated and demonstrated.

PHASE I: Develop a UAV minefield detection concept that addresses traditional GPR limitations. Conduct laboratory performance measurements that validates concept viability.

PHASE II: A detailed design of a UAV minefield detection payload and ground processor system will be developed. This design will maximize the use of existing system equipment and off-the-shelf' hardware and software. A prototype of the minefield detection system will then be fabricated and demonstrated in a realistic field exercise. Data will be gathered to validate minefield detection performance.

PHASE III: Transition to advanced development for use in commercial and military ground search systems

COMMERCIAL POTENTIAL: The non DoD and commercial potential to use UAVs to support worldwide minefield clearing operations is significant.

REFERENCES: ASTAMID Mission Need Statement, Cards Reference No. 0592

N96-036TITLE: Unmanned Aerial Vehicle(UAV) Cellular Phone Relay For Distributed Command, Control And Communication And Intelligence Dissemination

OBJECTIVE: Develop a low cost/lightweight cellular phone relay system for UAV.

DESCRIPTION: Future military operations involving highly mobile forces ashore will require communications that must be flexible and reconfigurable to meet rapidly changing command and control requirements. Deployment time, terrain limitation, distance, responsiveness, and survivability will heavily tax the capabilities of available communication extension assets. The UAV based communications relay system can provide a cost effective, re-usable and flexible means of connecting widely dispersed tactical units. Commercial cellular phones can be adopted as a warrior's personal communications tool. Expeditious information exchange between various users including voice, data, facsimile, and freeze frame imagery is possible utilizing the existing commercial technology. In the theater of operation where the mobile phone infrastructure does not exist and is very time consuming or costly to set up, the UAV based cellular relay can serve as a highly effective personal communications system to quickly interconnect hundreds of users across the battlefield. The UAV cellular relay system will be comprised of three segments: airborne relay, ground support segment, and many individual mobile phone elements. The ground support segment co-located with the UAV ground controller, will be connected to the commercial telephone exchange and/or defense data network and fed into the mobile base station. The UAV airborne relay will serve as switching/broadcasting range extension system in connecting many mobile subscribers. It will allow the commanders to reach out to any suitably equipped lower echelon force for effective command and control, while a small tactical unit can assess the intelligence database rapidly within the theater and ask for combat service and fire support.

PHASE I: Investigate the adaptation of cellular communication technology for UAV applications. Conduct a feasibility study and perform architecture definition, technology trades and requirements analysis.

PHASE II: Develop prototype hardware, and demonstrate a UAV based cellular communication relay system which must be low cost and easy to deploy by the troops.

PHASE III: Produce the complete UAV cellular communications relay system and market the product.

COMMERCIAL POTENTIAL: The UAV cellular communications relay can be used to restore/reconstitute mobile phone service as an immediate replacement for lost cell towers, and to coordinate disaster relief/search and rescue effort during Federal Emergency Management Agency (FEMA) operations, etc.

REFERENCES: UAV Master Plan 1994

N96-037TITLE: Reconfigurable Antenna Using High Temperature Superconductor

OBJECTIVE: Demonstrate a reconfigurable antenna using High Temperature Superconductor.

DESCRIPTION: The transition in High Temperature Superconductors (HTS) from the normal to the superconducting state has been shown to be achievable and fast with optical power. Using this phenomena, a reconfigurable antenna could be created to allow for a multifunctional antenna system in a relatively small size and weight package. HTS wafers of up to six inches are becoming available on the open market. New advances in small size lasers could reduce the size and weight of the system. HTS used at VHF frequencies can effectively decrease the size necessary for good performance at low frequencies. Any and all methods for creating a reconfigurable antenna using HTS should be considered.

PHASE I: Develop sufficient data to demonstrate feasibility of an innovative reconfigurable design using HTS as the transitioning material. Provide a report describing the demonstration antenna and possibilities for its system functionality.

PHASE II: Fabrication and demonstration of a reconfigurable HTS antenna. Provide a definition of and enough data to prove the antenna's system functionality.

PHASE III: Integration of the demonstrated antenna into a selected system for demonstration.

COMMERCIAL POTENTIAL: The multifunctional potential of reconfigurable antennas could reduce the size and weight of commercial satellite communications systems, thus reducing launch costs.

REFERENCES:
1. MTT 39(9), 1499-507
2. IEEE Trans. Appl. Supercond., 3(1)2848-2851,1993

N96-038TITLE: On-Focal Plane Processing Techniques for Infrared Detector

OBJECTIVE: Develop innovative on-focal plane electronic processing architectures to improve the information bandwidth and data relevancy of today's advanced infrared focal plane arrays.

DESCRIPTION: Currently available infrared focal plane arrays produce massive quantities of data which must be processed in order to make use of the actual target-based information contained in the imagery. Such a large volume of data, if handled by conventional computing resources poses a stressing condition on such computers, and increases the cost, weight and power of resulting systems. Innovative processing architectures are sought to improve the relevancy of data produced from such arrays. Other potential results of this work could be improvements in application-specific tasks to which these new architectures are applied (i.e., spectral processing, FPA non-uniformity correction, target typing, etc.).

PHASE I: Perform a feasibility study which asserts a technique for on-focal plane processing, and perform preliminary designs and performance evaluations for such architectures. The on-focal plane processing techniques advanced must indicate a path to producibility of such devices in following phases of the program.

PHASE II: Develop, test and operationally demonstrate a prototype system which makes use of an on-focal plane processing operation in the satisfaction of a well-defined application. The performance parameters to be demonstrated would conform to those asserted in the Phase I portion of the program, and a path to dual-use commercialization of the instrument or technology should be firmly established.

PHASE III: Coordinate efforts to manufacture instruments which make use of on-focal plane processing techniques which would result in systems which may be made available to a variety of military applications.

COMMERCIAL POTENTIAL: Miniature hand-held imaging and processing systems resulting from the incorporation of on-focal plane processing architectures would find applications in a wide variety of commercial applications including hand-held infrared imaging spectrometers, instruments which may be programmed to detect fugitive emissions, clutter-suppressing detection systems for early warning night vision applications, etc.

N96-039TITLE: Miniature Tunable Mid-Infrared Laser

OBJECTIVE: To develop a miniature, high peak power, high repetition rate, tunable mid-infrared laser.

DESCRIPTION: This project will develop an all solid-state powered miniature laser emitting in the 1.5-3.5 micron spectrum. The laser will be capable of high repetition rates up to 25KHz, producing multi-kilowatt peak power pulses.

PHASE I: The contractor shall provide a feasibility study which analyzes the tradeoffs affecting the design and performance of such a laser. The extension of the passband out to 5 microns should also be considered. The contractor shall provide a prototype design for the laser, with documentation of the design and the related theory.

PHASE II: During Phase II, the contractor shall construct and demonstrate a working laser. The laser shall emit in the 1.5-3.5 micron spectrum at pulse repetition frequencies of 25 Khz. The individual pulse peak power shall be in the kilowatt regime.

PHASE III: This technology has applications in both the countermeasure arena as well as the weapon seeker and fuzing arenas. In Phase III, integrate the technology into a fieldable system for one or more of these applications.

COMMERCIAL POTENTIAL: The medical industry is actively developing laser sources in the 2 micron spectrum. There are also numerous systems fielded that use the coherent nature of laser light to measure wind velocities and wind shear. Wavelengths longer than 1.5 microns are typically considered eye-safe for these applications. The laser developed under this program would, therefore, be suitable for unrestricted commercial use.

N96-040TITLE: IR Target Polarization Discriminator For IR Seekers

OBJECTIVE: Provide via electronic and optic means IR polarimetric measurement capability on the surface of IR detectors for target feature discrimination. A stokes parameter determining filter will be interposed in the optic field before the detectors to alter the IR detection. The filter has electrically controllable capabilities that are used in conjunction with the IR digital processor to extract target features such as skin location, engines, plumes, and hot spots.

DESCRIPTION: A wafer sandwich of polarized filter material with pass band in the near, mid and far infrared regions that has multiple layers of electronically selectable polarization material at 0^o 90^o and 45^o is inserted in the optical path just before the cold shield or on the surface of the detector array. For scanning arrays the filter should be stationary. Polarizing material is built on to the detectors for horizontal, vertical, cross and cross polarization delayed. The polarization filters are placed in either optical beam for all pixels or for adjacent pixels or on each pixel. Polarization is selected electrically. Pictures are taken in each polarization state and the stokes parameters computer, 3 stoker parameter pictures were created for each scene. The filter polarization preference is commanded by the IR Digital Processor and the stokes parameters computer. Then alternate IR scene frames are subtracted such as U-V to extract specific IR scene features. Hot burning gases are randomly or circular polarized, thus 0^o linear polarized detection level when subtracted from a 90^o polarized detection level yields a small residual of the burning gas but retains the linear polarized IR energy emanating from the low graze angle portions of target surfaces. Thus the high energy random clutter signal is removed from the scene and other distinct target geometric features retained.

PHASE I: Research literature and Naval development reports for IR polarimetry materials, measurement and studies. Construct a digitally commanded filter for stokes parameter and polarization measurement of IR emanations by focal plane array and scanning array IR detectors. The digital controlled filter should have two polarization states for each polarization layer - selected polarization preference and no polarization preference. If materials with at least bistate polarization selectability are not available then digital selection of fixed polarization preference modified pixels in the array will be used. The required software and hardware to perform the stokes parameters and differential polarization computations shall be developed. The developer shall build up a suitably modified IR focal plane array or a suitable optical filter for placement in the optical path of a IR focal plane array or scanned array of IR detector. An installation of suitable optics for laboratory demonstration shall also be provided. The number of pixels shall be sufficient for measurement of target parameters, for example 64 by 64. The IR bandwidth shall include a region in 2.9 to 5.2 micro meters or 8 to 12 micrometers.

PHASE II: Develop test and operationally demonstrate for the Weapons community an IR target polarization discriminant IR detector and optics. The detector and optics shall be sufficiently developed that it can be installed in weapons seekers with minimal modification. The software and software shall be developed to a state of readiness that airborne trails can be performed to tailor the design to the tactical need. Documentation shall be sufficient the design can be incorporated into some existing weapon system.

PHASE III: Design and manufacture an IR target polarization discriminant seeker for use in a Naval Weapon system. Design and manufacture components for an IR polarization discrimination module for installation in Naval weapons systems as a subcontracted item.

COMMERCIAL POTENTIAL: This IR polarimetric component is readily employable in manufacturing process control and as an imager for robotics and machine control.

REFERENCES: "Fundamentals of Infrared Detector Operation and Testing", by John David Vincent, Wiley Interscience publisher. Project Long Jump, NAWCWPNS, China Lake CA., 1988-1990. Infrared Polarimetry for Target Discrimination and Polarimetric Components Testing, Dr. Soe-Mie F. Nee, 6/94, NAWCWPNS, China Lake, CA.

N96-041TITLE: Digital GPS Translator Ground/Remote Based Processor

OBJECTIVE: Develop a low cost, accurate, fast GPS digital translator ground based processor system.

DESCRIPTION: Current ground based GPS digital translator computer processors, using differential corrections, are large, non-portable, and prohibitively expensive. There is an immediate need for a low cost, small, portable, IBM PC or compatible based, ground based GPS digital translator processor for real time and post-mission vehicle trajectory calculations. The processor system should be capable of processing digital translator GPS and differential correction data and producing a state vector type output at a 30 Hz rate for each highly dynamic, tracked weapon or vehicle. The system should be able to process and output this state vector type data for 10 different tracked objects. The processor system should have the capability of functioning as a stand alone, remotely operated system with its own display system, power director/uninterruptable power supply, and human interface devices such as keyboard and mouse.

PHASE I: Perform a feasibility study of applications of new technologies to improvements to GPS data processors, more efficient algorithms and software design, and determine and identify hardware to meet these requirements.

PHASE II: Develop a bench top prototype processing system using proposed hardware and software and demonstrate that the system meets requirements using digital GPS translator inputs.

PHASE III: Develop, package, and deliver a complete digital GPS Translator Ground/Remote Based Processor System as required including full documentation, sources of all commercial software and hardware, algorithms, and new software source code to the Government.

COMMERCIAL POTENTIAL: GPS application technologies in both the government and commercial sectors are widely needed. This system could be used to track and locate both government (military) and commercial (civilian) aircraft, water craft of all sizes, trucks, cars, and trains (manned or unmanned).

N96-042TITLE: A Robust Real Time Kinematic Differential Global Positioning System (KDGPS) Algorithm for High Dynamic Vehicles (7-11 G's)

OBJECTIVE: Provide a real time algorithm to generate KDGPS data using carrier phase data for submeter Time Space Position Information (TSPI) data in real time.

DESCRIPTION: Present high dynamic real time local differential GPS systems rely primarily on inertial aided code GPS data, e.g. Range Application Joint Program Office (RAJPO) GPS. This and other systems provide accuracy data at two meters RMS in the horizontal, four meters RMS in the vertical, a nominal signal-to-noise ratio of 38 Db-Hz, a nominal Horizontal Dilution of Precision (HDOP) of 1.5, and a Vertical Dilution of Precision (VDOP) of 2.5 at 9 G's. Given the improvements to GPS capabilities of the Joint Program Office (JPO) and other commercial GPS systems that are imbedded on Tactical vehicles, these levels of accuracy are no longer adequate for use as a test measurement system for test and evaluation ranges. The application of carrier phase KDGPS processes that have demonstrated accuracies at the decimeter level are needed. The effort will provide a robust algorithm and a system to use carrier phase processing for high dynamic vehicles and will provide decimeter horizontal and vertical accuracies at the above-specified conditions.

PHASE I: Provide a feasibility study which develops an algorithm to provide real time KDGPS data, carrier phase GPS data, and identifies the hardware that this algorithm will need to provide the required data. This algorithm should be robust, modular, and have an open architecture design to facilitate integration into high dynamic test vehicles.

PHASE II: Develop, document, test and operationally demonstrate the algorithm formulated in Phase I of this SBIR on a prototype assembled system.

PHASE III: Provide a fully documented and operating algorithm and system demonstrated in Phase II.

COMMERCIAL POTENTIAL: This algorithm can be use by geophysical companies for mapping and precise location of resources.

REFERENCES: Lachapelle, Cannon, Lu, Ambiguity Resolution on the Fly- A Comparison of P-code and High Performance C/A Code Receiver Technologies. Proceedings US Institute of Navigation (ION), Albuquerque, NM, 16-18 September 1992.

N96-043TITLE: Near-Field Radar Signature Modeling for EW/End-Game Simulation Applications

OBJECTIVE: Develop A Near-Field Computer-Aided Radar Signature Model for Radar-Guided Weapon Systems ECM/End-Game Simulation Analysis.

DESCRIPTION: Existing near-field radar cross section (RCS) computation algorithms are typically based on first-order high frequency methods, which do not take into consideration the multiple-bounce and mutual shadow effects. In particular, those algorithms can not be used to calculate scattering from a cavity such as an engine inlet or a sensor box. However, the cavity scattering and material coating are known to be crucial contributors in fuzing and ECM end-game scenario. Their inclusion in the computer simulation modeling is thus a must.

PHASE I: To explore and identify near-field modeling techniques; provide an innovative plan for solving the above problems; and deliver a near-field RCS computer software that contains as many of the above features as possible.

PHASE II: To complete the development of the near-field modeling software with all the features included; verify its validity; and package it in a user-friendly, menu-driven form with detailed manuals.

PHASE III: Interface with government furnished software and demonstrate the operation of algorithms in an synthetic virtual environment for EW effectiveness evaluation.

COMMERCIAL POTENTIAL: This research and development effort has potential application to collision avoidance of commercial aircraft.

N96-044TITLE: Very Low Bit-Rate Error-Resilient Video Communication

OBJECTIVE: Develop a reliable real-time video communication system suitable for channels with a limited bandwidth.

DESCRIPTION: The primary focus of this project is on exploratory development of incorporating error resilience and error concealment technology in the state of art video compression technology. The algorithm should have the ability to compress the image at a bit rate comparable to the current MPEG standard, while being robust against channel error rate ranging from 10-2 to 10-5. The algorithms should be run on commercially available image and signal processing hardware for the speed of development and minimization of cost. The real-time video compression platform should also be easily upgradeable for increased resolution and frame rate.

PHASE I Explore and identify cooperative channel and source coding scheme
develop the-state-of-art low bit rate video coding, and provide an innovative error localization and concealment technology

PHASE II Apply the techniques developed in Phase I and create prototype hardware for feasible demonstration with real video test data.

PHASE III Demonstration of the developed hardware in existing Navy Tactical Aircraft, and technology transfer to commercial applications.

COMMERCIAL POTENTIAL: This research and development effort has great potential for mobile multimedia communication, cellular videophone, wireless video link, deep space video transmission, etc.

N96-045TITLE: Biodegradable Batteries

OBJECTIVE: To develop a new type of battery that is biodegradable in the marine environment.

DESCRIPTION: Batteries, both rechargeable and disposable, are generally tossed out after use, even though many contain hazardous materials. Recent battery development work has identified the potential of using polymers for the electrolyte and cathodes in batteries. Simultaneously, research has shown the potential of forming polymers that are biodegradable. The combination of these technologies would result in high capacity biodegradable batteries.

PHASE I: Investigate battery technology and biodegradable polymer technology to identify materials that could be suitable for battery components, and that will degrade after use in the marine environment or with land disposal. Develop a strategy for biodegradable material replacement for batteries that will maintain or exceed the ampere-hour ratings, voltage, and voltage vs. percent discharge ratings of existing batteries both on a per mass and per volume basis Priority is for disposable batteries; replacement in rechargeable batteries is a secondary goal.

PHASE II: Demonstrate the effectiveness of using biodegradable materials in battery test cells and demonstrate the biodegradability of the materials.

PHASE III: Develop into useable biodegradable batteries.

COMMERCIAL POTENTIAL: There is a vast commercial market for both disposable and rechargeable batteries. Improper disposal of current batteries causes environmental harm while proper disposal as hazardous materials substantially increases their costs. Biodegradable batteries would have similar purchase cost to current batteries, but require no special treatment for disposal.

REFERENCES:

1. Abraham, K.M. and M. Alamgir, "Room temperature polymer electrolytes and batteries based on them," Solid State Ionics 70/71 (1994), pp 20-26, North Holland/Elsevier.
2. Freemountle, M., "Organic Cathode Spurs Battery Energy Storage", Chemical & Engineering News, pp 5-6, 20 February 1995.

3. Meyer, J.M. and D.L. Kaplan, "Biodegradable Materials: Balancing Degradability and Performance", Trends in Polymer Science, Vol 2 No. 7, July 1994, pp 227-235.
4. Apler, M., et. al. ed, "Biomolecular Materials by Design", Vol 330 (1993 MRS Fall Meeting, Boston, MA), Materials Research Society, 1994, ISBN 1-55899-229-4.

N96-046TITLE: Common Modularized E-O Sensor Payload

OBJECTIVE: The objective of this topic is to develop a reconfigurable sensor payload for multiple Naval platforms which is upgradeable to include laser radar (LADAR) systems as well as infrared sensors.

DESCRIPTION: Present Forward Looking Infrared (FLIR) systems are highly specific to a given platform and are not interchangeable between platforms nor easily modified with different sensors as new technology becomes available. There is a need to develop a modularized E-O sensor payload that can be easily reconfigured with new sensors and has a growth capability to add new sensors to existing equipment within the payload.

PHASE I: Develop the conceptual design for a modularized E-O sensor payload incorporating the latest staring mid-wavelength infrared technology appropriate for Navy operational conditions. The payload shall be designed in a fashion that easily permits modifications of or replacement of the FLIR, addition of laser range finder/designator, and includes the capability of upgrading the system to add a LADAR for μ-Doppler non-cooperative identification.

PHASE II: Develop a prototype airborne system reconfigurable for multiple Naval platforms.

PHASE III: Implement the technology developed into a fieldable system.

COMMERCIAL POTENTIAL: A modularized E-O sensor payload would enable lower cost, more flexible implementation of E-O sensor suites used by law enforcement agencies. Payloads could be replaced or upgraded without replacing the entire payload, resulting in significant cost savings.

N96-047TITLE: Moveable Focal Plane Array (MFPA) for Compensating Aircraft Forward Velocity

OBJECTIVE: To significantly reduce the complexity and increase the performance of high pixel density Focal Plane Arrays (FPA) used in imaging sensors

DESCRIPTION: Provide Forward Motion Compensation for FPA type sensors used in high performance, reconnaissance aircraft. In addition, compensation shall be implemented for random motions due to vibrations and other inflight perturbations. Powerful processing techniques are presently utilized to perform this function but have inherent limitations. Simplified kinematic/electromechanical approaches are to be considered.

PHASE I: Develop a conceptual design for an MFPA that involves performance modeling of a generic airborne optical sensor system. Modeling shall address the benefits and assess tradeoffs associated with varying the design parameters of the MFPA. A design shall be implemented that illustrates the detailed approach developed for achieving the required performance. System/subsystems/component and concepts shall be developed and tradeoffs shall be defined for selecting the optimum design approach that validates the objectives of this effort.

PHASE II: Develop a prototype array for integration into a Naval platform

PHASE III: Implement the technology developed into a fieldable system

COMMERCIAL POTENTIAL: This technology would have commercial application to Law Enforcement and the need to provide accurate evidentiary materials for prosecution. Cartographic, high acuity imagery would now be attainable in a digital format, that has been heretofore, unachievable. In addition, the availability of high resolution, multi-spectral imagery would have application to land resource managers, environmental protection, urban planning projection tool, and any commercial need for real-time, high resolution imagery collected in an airborne platform.

N96-048TITLE: Tunable MWIR Hyper-Spectral Imaging for Low Observable Target Detection from an Airborne Platform

OBJECTIVE: The objective of this topic is to demonstrate improved target detection capabilities for mid wavelength infrared (MWIR) imaging systems using tunable hyper-spectral techniques.

DESCRIPTION: The low observable target, such as a sea skimming or terrain following missile, have a contrast ratio that varies significantly over the diurnal cycle. Detection of targets that are buried in sea and ground clutter can be enhanced with the use of infrared hyper-spectral tunable imagery. Hyper-spectral imaging involves dividing the total spectral sensitivity band of an imaging system into several spectral sub-bands, and collecting the imagery from each. Various image processing techniques that compare the images in the sub-bands is performed to detect features or targets that have very low contrast in the total spectral sensitivity band. The objective of this effort is to develop a new and innovative airborne MWIR hyper-spectral imaging system that can be adaptively tuned over the diurnal cycle to the spectral band where the signal to clutter ratio is maximized. This sensor will be flown on the Navy's P-3 Airborne Test Bed and evaluated against low observable targets buried in deep clutter.

PHASE I: Develop a conceptual design for a tunable MWIR hyper-spectral imaging system utilizing the latest staring focal plane array technology that can be integrated into the optical station on the Navy's P-3 Airborne Test Bed.

PHASE II: Develop a tunable MWIR hyper-spectral imaging system, integrate it with the optical station on the Navy's P-3 Airborne Test Bed, and perform airborne evaluation of the system against low observable targets buried in deep clutter.

PHASE III: Transition the system to the fleet as well as to the consumer market place.

COMMERCIAL POTENTIAL: This technology has many applications in the commercial market such as environmental and resource monitoring, bioflouoscopic surgical instrumentation, auto exhaust emissions monitoring, etc.

N96-049TITLE: Software Metric To Predict Real-Time System Throughput

OBJECTIVE: The objective of this research will be to develop a software metric(s) that can be used to predict via indirect means the throughput of a real-time system early in its development.

DESCRIPTION: DOD has repeatedly experienced cost overruns and long schedule delays on mission critical software projects when it is found that the real-time task timing requirements can not be met. DOD has mandated software reserve requirements be budgeted and monitored. Budgeting is done in the requirements and design phases; however the monitoring is done in the system integration phase when actual code is available for direct measurement. When a throughput problem is found this late in the product development or inevitably causes cost overruns and schedule delays. A method is needed to predict the throughput problems earlier to maintain cost and schedule.

PHASE I: Development of the theory behind what a throughput metric will be measuring and how that relates to the throughput that is being predicted. Development of set of software metrics based on the theory. Select a set of software complexity metrics and random metric that will enable a double blind experiment. Perform a double blind experiment using the metrics on a set of small homogeneous software programs. A set of undergraduate software projects could be used for this purpose. report on the strength of the inference between what software characteristics each of the metrics measured and the indeterminate throughput the metric is predicting. Select a set of real world Navy real-time software development projects for further experimentation that will provide a broad exposure for the metrics i.g.; Ada and other high level languages, large and small software development projects, standalone and embedded systems.

PHASE II: On Navy projects selected in Phase I, gather, analyze, test and demonstrate the robustness and effectiveness of predicting throughput problems. Perform the same double blind type experiment done in Phase I.

PHASE III: Produce automated metric extraction tools for both military and commercial software development environments. This will be the transition point into Navy software development projects.

COMMERCIAL POTENTIAL: A metric tool developed from this research can be used in commercial real-time software development.

REFERENCES: DOD-STD-2167A

N96-050TITLE: Prototype Transition Environment for Complex Software Systems

OBJECTIVE: Perform research for development of a software development environment which supports a smooth transition between rapid prototyping and full-scale development for large complex systems. Perform research leading to refinements of the environment which optimize maintenance activities for such systems.

DESCRIPTION: It has been proposed that user interface development tools (UIDTs) can be used equally well for rapid prototyping and full system development; it has been further proposed that such tools can accommodate a smooth transition between these two activities. While several such tools have shown adequate support for these activities for small scale, single-application systems, no corresponding demonstration has been made for large systems. Indeed, such tools are notorious for their inability to scale up to the multi-user, multi-application, even multi-language requirements of large Government systems.
Recent technology developments suggest that a certain class of UIDT, that of user interface management systems (UIMSs) may offer significant improvements in the development and maintenance of such systems. Research areas include: methods of defining prototypes for large systems; techniques affecting the transition of such prototypes into delivered systems; study of the special facets that are unique to the large system development and maintenance problem; and techniques for accommodating these facets.

PHASE I: Phase I will result in concept papers, proof-of-concept, and detailed project plans for the remainder of the project.

PHASE II: Phase Ii will result in a fully-functional prototype of the development/maintenance environment, with a preliminary evaluation of its efficacy in supporting the stated objectives.

PHASE III: During Phase III, the system will be put into project use.

COMMERCIAL POTENTIAL: Government agencies spend billions of dollars annually on the development of large, complex software systems, and even cannot be overstated. Any development environment that can pare the cost of developing and maintaining such systems would be of benefit to literally hundreds of Government contractors looking to hone their competitive edge. Benefits can also be immediately realized by such an environment in domains in the private sector, such as banking, process control, and health care.

REFERENCES:
(1) Bass, L., Coutaz, J., DEVELOPING SOFTWARE FOR THE USER INTERFACE, Addison-Wesley, Reading, MA, 1991 (2) Hardy, EJ, Klein, DV, "The Serpent UIMS," in Proceedings, EUUG Autumn 1990 Conference, Nice, France, October 1990
(3) Klein, D. V., "Developing Applications with a UIMS," in Proceedings, USENIX Application Development Symposium, Toronto, April 1994.

N96-051TITLE: Advanced SAR Processing Techniques

OBJECTIVE: The objective of this topic is to improve SAR processing, particularly in the low frequency UWB/UHF region, through new and novel analysis and processing techniques.

DESCRIPTION: Synthetic Aperture Radar (SAR) imaging is being used increasingly in a broad spectrum of all-weather military and nonmilitary applications. Bands of interest include X band but also include greater interest of late in the Ultrawide Band (UWB) UHF frequency range. Areas of importance to the Navy littoral surveillance mission span from wide area surveillance and target cuing to target ID and accurate geolocation. Also of increasing

interest are terrain characterization and mapping, particularly in rugged forested regions for military as well as commercial and environmental application. As the spectrum of potential geographic regions of interest grows, more robust analysis, processing, and modeling techniques are required in order to accurately characterize targets and clutter in the respective terrain environments. Novel, robust analysis approaches to optimal focusing, statistical characterization, RFI/interference rejection (particularly for low frequency foliage/ground penetration systems), and image formation/registration will be of greatest interest and impact for future systems.

PHASE I: Explore new and robust modeling and analysis techniques in order to demonstrate the greatest feasibility of improving the SAR image formation process and image product with the overall goal of extracting optimal information from terrain scenes over various littoral region types. As a minimum, algorithms should be provided, preferably with prototype codes, for demonstration of feasibility and evaluation.

PHASE II: Using the technique(s) developed in Phase I, extend and improve the design(s) for robust performance over a variety of terrain and target types. Quantitative performance measures will be developed and applied for comparison to current/conventional techniques over diverse sets of government supplied SAR data.

PHASE III: Transition algorithms and techniques into ongoing projects, both military (e.g., ONR, ARPA, NAVAIR, etc.) and nonmilitary (e.g., environmental and/or commercial).

COMMERCIAL POTENTIAL: The utility of low frequency SAR is only now emerging as an important remote sensing tool for environmental as well as disaster response applications. The ability to penetrate foliage, and to some extent the ground, could have profound impact in some areas such as forest wetlands management, geological/resource exploration, and law enforcement (in terms of counter drug surveillance in remote regions). Robust imaging techniques will be required in order to extract optimal information from this data.

REFERENCES: "Proceedings of SPIE AeroSense Conference, Algorithms for Synthetic Aperture Radar Imagery II," Spie Proceedings Vol. 2487, 19-21 April 1995, Orlando, Fla.

N96-052TITLE: Helicopter Onboard Sensor Training

OBJECTIVE: Develop an embedded advanced helicopter onboard sensor training system.

DESCRIPTION: Currently, US Navy aircrews of multi-mission aircraft receive ground based training in the operation of helicopter onboard sensor systems. As sensor systems become more complex, the volume and complexity of the ground training must increase and proficiency becomes increasingly perishable. By embedding intelligent training software into the onboard sensor systems, it is possible to develop a comprehensive interactive learning aid for advanced training and regular refresher training while deployed. The Navy desires to develop such a supplemental training system embedded into helicopter sensor display systems. The benefits of this effort will be an increase in aircrew situational awareness, overall system knowledge, and mission effectiveness.

PHASE I: Provide a feasibility study which develops an intelligent training system embedded in onboard sensor systems for helicopter aircrew. The system shall be designed to stimulate tactical displays with simulated tactical information as an overlay to real world data. The study shall investigate systems requirements for intelligent, multimedia, embedded training systems, investigate alternative system architectures, and include a preliminary design of the embedded training system.

PHASE II: Develop a prototype of the intelligent embedded training designed under the PHASE I SBIR effort. Demonstrate stimulation of an aircraft sensor with simulated threat data overlaid onto real world environmental data for display on actual tactical gear. This should include an embedded lesson that demonstrates how operator proficiency can be improved by embedded training. The selected sensor for this demonstration should be FLIR (with laser designator), ESM, acoustics or radar.

PHASE III: Produce variants of the PHASE II embedded training system for various Navy ASW aircraft platforms.

COMMERCIAL POTENTIAL: This embedded training system architecture will be of great value to the US Navy maritime patrol and ASW communities, US Air Force surveillance communities, and commercial heavy industry. Incorporation of this technology into heavy industry would enhance on the job training achieving increased trainee performance at reduced cost.

N96-053TITLE: Interface Unit Enabling Utilization of Aircraft Tactical Tape in Aircrew Simulators

OBJECTIVE: Provide a cost effective alternative to the traditional methods used by the Navy for making software transitions from aircraft to cockpit simulators. Current methods require redundant development efforts which are costly and time consuming.

DESCRIPTION: The Navy has an interest in reducing the cost of maintaining its cockpit simulators to provide cost effective tactical man-in-the-loop simulation, mission planning and rehearsal. The problem with existing simulators stem from the lack of portability of software developed for the parent aircraft -- to aircrew simulators. It currently takes an inordinate amount of time and money to make this transition. When a software update is being implemented in the aircraft, a parallel effort is on-going for the affected simulators. This proposal will develop and prototype an interface unit which allows aircrew simulators to utilize their respective aircraft tactical tape.

PHASE I: Phase I will consist of a front end analysis to determine functional requirements and technical feasibility of the interface unit. Existing cockpit simulators will be studied to define the technical design requirements of the interface unit.

PHASE II: A prototype interface unit will be designed, built and tested for a single aircraft type.

PHASE III: The prototype that was designed and tested in phase II will be expanded and implemented in various other simulator types, possibly including a ship and a tank.

COMMERCIAL POTENTIAL: The interface unit could serve as a prototype training system for the Navy as well as for other DoD components. Since the system will be highly portable, its application will be applicable to all types of aircraft. Tremendous cost savings potential will be realized by reducing simulator software development for all types of DoD and commercial simulators including aircraft, ship, and command & control centers.

REFERENCES: Marc Robs, Cockpit Technology Forms Swift Roller-Coast Ride, National Defense Journal, vol. 78, Nov. 1993. Ray Braybrook, The Cockpit of the Future, Military Technology and Economics, vol.4, no. 17, 1990. William B. Scott, Simulator Flight Tests Validate Integrated Pictorial Cockpit Display, Aviation Week and Space Technology, vol.130, no. 2, Jan. 9, 1989.

N96-054TITLE: Portable Tele-training/Technical Assistance

OBJECTIVE: Develop the means to conduct tele-training and technical assistance for ships at sea and other mobile users.

DESCRIPTION: The Navy relies extensively on the costly and time consuming use of technical representatives and on-site support to provide technical assistance in maintaining critical ship systems and training/technical support when introducing new or modified systems. Equipment failures that cannot be repaired by onboard personnel results in lost operational capability until technical assistance can be obtained. Training for personnel on deployed ships is limited to onboard assets or to generic training broadcasts. Training needs to be tailored to the ship's operational requirements and the specific needs of the crew. Advances in video tele-conferencing and information technology provide some of the tools that could enable real-time (or near real-time) training and technical assistance to deployed ships and other mobile users. However, the limiting factor is connectivity. Limited satellite availability, coverage, and bandwidth pose serious constraints. Some initial attempts at providing a satellite pipeline to a ship at sea have also highlighted reliability problems. This effort will provide a reliable and affordable means of providing two-way video, voice, and data connectivity with ships at sea and other mobile users.

PHASE I: Provide a feasibility study which develops a method (or methods) of providing reliable and affordable video, voice, and data connectivity with ships at sea and other mobile users to enable portable tele-training and technical assistance. The method(s) must be compatible with existing ship's communications and data architectures and should allow coverage for most potential deployments using existing and planned satellite systems.

PHASE II: Develop, test and operationally demonstrate the method(s) formulated under the Phase I SBIR effort.

PHASE III: Produce the tele-training and technical assistance method(s) demonstrated in the Phase II effort. This will be the transition into the Navy's distance learning and logistics programs.

COMMERCIAL POTENTIAL: Many corporations are now geographically dispersed and employ a world wide network of field service providers. New video, voice, and data connectivity methods will link them with their organizations for training, technical assistance, and data exchange. Current landline and cellular systems lack the bandwidth and coverage to provide adequate coverage, particularly when video is required. This same technology can be used to provide connectivity to emergency medical service personnel in the field, particularly in remote areas, to provide assistance with diagnosis and treatment (tele-medicine).

N96-055TITLE: Software Package for Speaker Independent or Dependent Continuous Speech Recognition

OBJECTIVE: Adapt or develop a software application to replace existing air traffic control (ATC) trainer hardware for speaker dependent continuous speech recognition.

DESCRIPTION: Air traffic control is critical to carrier battle group and amphibious war fighting operations. The Navy trains approximately 1600 air traffic controllers per year. Due to the volume and critical nature of this training, it is very important to use innovative technology to improve training and lower costs. Currently, a combination of software and high performance hardware is use to provide speaker dependent continuous speech recognition in ATC trainers. Speaker independent continuous speech recognition is desired. However, a portable all software implementation of speaker dependent continuous speech recognition would be a significant improvement over the current hardware/software implementation.

PHASE I: Perform a feasibility study to determine if a software implementation of speaker independent or dependent continuous speech recognition is feasible for air traffic control training with performance characteristics that exceed the technology that is currently use in ATC trainers.

PHASE II: Develop, test and operationally demonstrate the software application formulated under the Phase I SBIR.

PHASE III: Integrate the software application demonstrated in the Phase II effort into existing ATC trainers.

COMMERCIAL POTENTIAL: Commercial applications include civilian air traffic control training, law enforcement training, entertainment, and others.

REFERENCES: Phraseology for Navy Air Traffic Control, Documents relating to current voice recognition systems

N96-056TITLE: Virtual Vertical Aircraft Signal Trainer (VVAST)

OBJECTIVE: Creation of a virtual environment which represents helicopter aircraft in taxi, takeoff, and landing phases of operations and which respond to hand gestures and/or spoken signals of the signal trainee directing the system.

DESCRIPTION: The Navy currently uses live helicopter operations to train Landing Signal Enlisted personnel in the signaling of vertical aircraft during taxi, takeoff, and landing phases of operations. Recently, cuts in the numbers of hours to be flown by pilots have put significant constraints on opportunities to train LSE personnel. In addition, the cost of training LSE personnel last year was $ 468,000.00 in flight time alone. Although the cost of developing a facility like that used to train Landing Signal Officers would be prohibitively expensive, it might be possible to develop a virtual system for a fraction of that cost. The system would have the advantage of reconfigurability inherent in virtual systems, such that various helicopters, vertical jump-jets, and other aircraft in taxi mode could be added as needed.

PHASE I: Provide a feasibility study which develops a method to represent a generic helicopter during operations, and which would respond to the hand signals and speech inputs of the trainee. The visual system should minimize the problems of depth perception and distance estimation that can occur in simulated displays. The development of a hand (or wand) tracker would be required, and the system should allow the user to move about an open area of about ten square feet as necessary - yet still be able to track their signals and respond appropriately. Additionally, the proposed method should be of a modular, open architecture design to facilitate upgrades and integration into the Navy's VETT Lab architecture.

PHASE II: Develop, test and operationally demonstrate the VVAST system formulated under the Phase I SBIR effort.

PHASE III: Produce the VVAST system demonstrated in the Phase II effort.

COMMERCIAL POTENTIAL: Training a variety of signal-persons in commercial settings, marketing of arm/hand trackers for other non-DoD applications.

REFERENCES: Naval Warfare Publication Nos. NWP-42 and NWP-19.

N96-057TITLE: A Hybrid Immersive/Non-Immersive Virtual Environment Workstation

OBJECTIVE: Develop digital hardware and software technology to produce a hybrid virtual environment workstation which supports highly interactive immersive interfaces concurrently and in coordination with conventional high-resolution, flat-screen displays.

DESCRIPTION: In contrast to the traditional view of virtual environments which places the system operator in an immersive head-mounted display with spatial trackers for head and body motion, many relevant applications would benefit greatly from a hybrid system which supports both immersive and non-immersive interfaces concurrently. An example of this is in shipboard command and control where it is impractical to require an operator to remain immersed in a computer generated virtual environment for extended periods of time. While a virtual environment will enhance performance on specific spatial dominant tasks, conventional wide-screen displays will continue to be most effective for many Top-down or flat (two-dimensional or projected three-dimensional) views of data. The operator must be able to seamlessly switch from one display to the other making the essential and time-critical data available at all times. Furthermore, the users conceptual model of the system must be that of one unified system rather than two connected systems. Such a hybrid system must be able to operate in a confined area allowing it to be safely used in small spaces. It must allow the operator to navigate large virtual spaces efficiently but with fine control. The system must integrate spatial input with the displays. The spatial tracking system must be immune to external interference such as that from magnetic fields and noise. The display must be full color, high-resolution and wide field-of-view.

PHASE I: Provide a thorough investigation of potential solutions and develop a design which addresses the needs and requirements listed above. A report describing the proposed solution, its technical advantages over alternative solutions, and its expected performance specifications will be required.

PHASE II: Develop, test, and demonstrate the solution described under the Phase I effort.

PHASE III: Produce the system developed under the Phase II effort for general purpose applications.

COMMERCIAL POTENTIAL: Current technology constraints require system designers to choose between immersive environments and flat-screen through-the-window environments. A hybrid system combining the strengths of both allow designers to make use of immersive interface technology for visualization and interactions which most benefit from the spatial characteristics of virtual worlds while preserving the utility of flat-screen technology for non-spatial tasks. Such a system will serve to bring virtual environment technology to a wider range of applicable problem domains.

N96-058TITLE: Weapons Impact Assessment Technology

OBJECTIVE: Decrease the time and cost required for strike commanders to obtain post-strike imagery of a target area.

DESCRIPTION: When assessing effectiveness of air strikes, a strike commander's ability to quickly determine weapon impact location in relation to the intended target is vitally important. Current Bomb Impact Assessment (BIA) methods depend on aircrew visual reports, aircraft forward-looking infrared tapes, visual and infrared photography from reconnaissance aircraft, unmanned aerial vehicles with sensors, and information gathered from national assets such as satellites. These methods are limited, imprecise, time consuming, and strongly dependent upon weather in the target locale. Near-future combat operations will be conducted with little regard for target area weather conditions. This situation will rapidly outstrip existing assessment system capabilities. Analysts will be unable to meet the requirements for timely and accurate restrike assessments and recommendations. A requirement exists for a non-intrusive, low-cost sensor/transmitter/receiver that can be adapted to existing and future weapons and weapons systems, which will transmit an image of the weapon impact site to the launch aircraft for recording and subsequent review within one hour after aircraft recovery. This effort will provide technology leading to a formal engineering development program to resolve the tactical limitations of today's theater-based BIA techniques.

PHASE I: Provide a study addressing the tradeoffs between costs and requirements for: (1) night time and adverse weather imaging; (2) data link range and robustness; (3) aircraft integration complexity; and (4) data marking for post-strike mission analysis. The analysis should address the infrastructure needed to support and use the weapons impact assessment concepts as well as the acquisition costs. Technology risk areas shall be identified and appropriate demonstrations for resolving risk areas shall be proposed as products of the study.

PHASE II: Develop the sensor/transmitter and receiver prototype devices for the preferred concept identified in the Phase I effort. Conduct component tests and analyze data to resolve key technological risks.

PHASE III: Fabricate prototypes with updated designs based on data gathered in the Phase II effort. Perform flight tests to demonstrate the feasibility and utility of the weapon impact assessment concept in a realistic operational environment. This technology will transition into the Joint Direct Attack Munitions program.

COMMERCIAL POTENTIAL: Low cost imaging sensor/transmitter technology can be used by news media, crisis response teams or other security or safety applications where visibility and hazards prevent normal video coverage.

REFERENCES:
(1) "Systems Acquisitions for Precision Air Strikes, " FY 1994-1999 Defense Planning Guidance
(2) USAF Surveillance and Reconnaissance Mission Area Plan
(3) Navy Strike and Antisurface Warfare Master Plan
(4) Draft Mission Need Statement for Bomb Impact Assessment (BIA) Capability.

N96-059TITLE: Fuel Combustion Inhibitor (FCI) as a Non-Lethal Cruise Missile Payload

OBJECTIVE: Development of a cruise missile payload which can effectively inhibit combustion engine operation of an adversary’s motorized military equipment (either on land or at sea) without adversely affecting personnel or the environment.

DESCRIPTION: The vast majority of weapons in the US Navy inventory are designed to deliver ordnance payloads which have destructive and/or lethal effects. Predicting the degree and extent of these destructive effects is often difficult, particularly when targets are near civilian population centers. Accordingly, there is an emerging requirement for weapon payloads which can degrade an adversary’s military capability while at the same time minimizing or eliminating the destructive effect on civilian populations. Since any effective military capability depends heavily on motorized equipment, a weapon payload which inhibits the operation of combustion engines would be highly effective. At the same time, such a Fuel Combustion Inhibitor (FCI) payload would have little or no destructive effect on civilian populations or property. The goal of this effort is the identification/development of a non-lethal FCI which can disable motorized equipment with little or no effect on personnel or the environment and that is deliverable as a cruise missile payload.

PHASE I: Analyze and describe the chemical characteristics and synthesis requirements for FCI compounds. Based on these postulated characteristics, estimate the quantity of FCI required for effective utilization

and the feasibility of using cruise missiles as a delivery system. Perform an associated analysis to determine what countermeasures are possible to neutralize the FCI and what potential personnel safety and environmental impacts would be associated with the FCI. Perform a feasibility study for synthesizing small quantities of FCIs for test purposes.

PHASE II: Based upon the analysis and results of Phase I, synthesize samples of FCI compounds and conduct testing to determine their effectiveness, toxicity, and environmental impact. Prepare and test anti-FCI compounds to demonstrate that friendly forces can be protected from their effect. Based upon the results of FCI testing, propose a design concept for a FCI cruise missile payload.

PHASE III: Transition FCI weapon payload into land-attack/anti-ship cruise missile programs.

COMMERCIAL POTENTIAL: New methodology can be used by Law Enforcement and/or Customs Officials to preclude or halt the flight of criminal suspects using motorized vehicles or boats.

N96-060TITLE: High-Temperature-Superconductor (HAS) Antenna Cooling

OBJECTIVE: Develop compact cooling apparatus for high-temperature-superconducting antennas that will not degrade antenna performance.

DESCRIPTION: The Navy is investigating several air-launched missile applications involving HAS materials operating below their superconducting transition temperature (~90-100 Kelvin). Designs are sought to actively cool antenna structures from ambient temperatures to well below transition temperature in short duration (on the order of 10 seconds), and maintain sub-transition temperatures for moderate times (on the order of 1-5 minutes). The structures are envisioned to consist of .020" LaA103 substrate material with dimension either (1) 6" diameter, or (2) .80" by .64". Multiple cooled rectangular antenna structures may be required per missile (possibly 36).

PHASE I: Develop hardware design to cool HAS antennas. Demonstrate through studies best cooling approach. Solutions must meet the functional needs of the HAS antenna system as well as requirements for affordability and producibility. Component testing to insure design capability is encouraged.

PHASE II: Pending the successful outcome of Phase I efforts, demonstrate operability of cooling apparatus in conjunction with sample HAS antenna system.

PHASE III: Produce cooling apparatuses for advanced development/testing efforts in preparation for transition to Navy ARM seeker/AIM seeker/data link applications.

COMMERCIAL POTENTIAL: The apparatus may be applicable to commercial HAS or electronics applications.

REFERENCES: MTSS 39(9), 1499-507

N96-061TITLE: Development of CL-20 Based Explosive For Exploding Foil Initiators (EFI)

OBJECTIVE: Investigate CL-20 based explosive formulations in pellet form for use with EFI's which have a lower voltage threshold than current materials

DESCRIPTION: The production of exploding foil initiators (EFI's), which are the heart of Electronic Safety and Arming Devices (ESAD's) currently depends on the use of the explosive HNS-IV. There is a significant interest from all DOD services in finding a good replacement for HNS-IV. The output of HNS-IV is low, having a detonation pressure that is only 54% of the detonation pressure of PBXN-5. Because of this, EFI's must be made larger than desired, or an explosive with better output characteristics must be added to the output side of the detonator. HNS-IV is expensive, costing approximately $4000 per pound, with procurement lead times of up to one year. HNS-IV is being produced by only one manufacturer (a DOE Facility), and that facility cannot manufacture material to meet the DOD specification. In addition, HNS-IV is recrystallized from HNS II, which is no longer manufactured in the United States.

PHASE I: Investigate the formulation of high surface area CL-20 powders and fabrication techniques for low cost pellets.

PHASE II: The second phase formulations using various binders with the best CL-20 power from Phase I a variety of EFI bridges will be investigated to determine the voltage threshold which EFIs will fire and producibility. Goal is to have a voltage threshold in the range of 600-700 volts.

PHASE III: In Phase III the explosive with binder and the bridge variant providing the most robust design will be qualified.

COMMERCIAL POTENTIAL: EFI's detonators are used in the commercial market for explosive operations. Applications for this technology include; use in adverse environments with high temperatures and potentially high electromagnetic fields that are capable of initiating hot wire detonations. The use of CL-20 in place of HNS-IV is attractive because of the reduced amount of hazardous waste produced - approximately 1/20 as much as HNS-IV.

N96-062TITLE: Advanced IR Augmentation

OBJECTIVE: Develop innovative concepts in infrared (IR) augmentation technology to improve target IR presentations.

DESCRIPTION There have been a number of missile program updates to include and upgrade IR sensors. Evaluation of these systems has been deficient as there is no adequate IR augmentation source, usable on targets, that can fully exercise these sensors in the micron band in which they are designed to operate, at an intensity required to correctly exercise missile sensors. The newest seekers use imaging IR, therefore, there is a need to provide distributed IR sources that can exercise the discriminatory power of various image tracking methods.

PHASE I: Develop the concept for advanced IR augmentation in sufficient detail for a feasibility determination to be made, perform an analytical evaluation of the concept, and perform a simplified simulation analysis of the concept. This will include researching the characteristics of seekers now in use and those designs likely to appear in the near future.

PHASE II: Develop a prototype of the concept for advanced IR augmentation. Perform detailed analyses of its overall performance and of its performance with respect to the weapon system sensor. This analysis should be consistent with analyses of IR models used in all-digital and hardware-in-the-loop simulations.

PHASE III: Integrate onto selected target system identified in Phase II and test.

COMMERCIAL POTENTIAL: Infrared augmentation has potential applications within the heating industry. New IR augmentation has the potential to significantly reduce fuel cost.

N96-063TITLE: Multi-Dimensional Solid Propellant Rocket Stability Prediction (MSSP)

OBJECTIVE: Improve current solid rocket motor stability prediction codes to include three dimensional acoustic flow fields, three dimensional grain design and ballistics and have the capability to predict the acoustic stability of both longitudinal and tangential acoustic modes.

DESCRIPTION: The Navy, Air Force, Army, and to some extent NASA, currently depend upon the Air Force funded Solid Propellant Rocket Motor Performance Computer Program (SPP) to evaluate the acoustic stability of solid rocket motors. Although the model has been updated in recent years to include improved grain design, ballistic performance prediction and nozzle design, the stability portions of the code are over 10 years old. Currently the stability prediction is limited to one-dimensional acoustics (longitudinal modes only) and is only coupled to the axi-symmetric and 2-D grain design. Recently numerous development rocket motors have experienced stability concerns which are outside the predictive capability of the current stability codes. It is proposed to increase the capability of the prediction code to include multi-dimensional acoustics coupled to axi-symmetric, 2-D and 3-D grain design and ballistics and to provide for both longitudinal and tangential stability prediction. In addition, current government funded efforts are underway in the university community to improve physical understanding and develop methodologies to better predict motor stability. These improvements will require the above stability code improvements in order to be incorporated into the next generation of stability prediction codes.

PHASE I: Perform a feasibility study for development of a standalone 3-D acoustic solid rocket motor cavity algorithm which will be driven by the existing axi-symmetric, 2D and 3-D grain design and ballistic modules in the current SPP code. Couple the existing 3-D grain design and ballistics with the current longitudinal stability prediction module in the SPP program.

PHASE II: Implement the 3-D acoustic module into framework of existing multi-dimensional grain design and ballistics. Incorporate recent improvements to stability prediction such as distributed combustion, flow field effects and propellant response into the improved stability code.

PHASE III: Refine the code for commercial use including operational manuals, test cases, graphical interfaces and provide a variety of versions for different computer platforms.

COMMERCIAL POTENTIAL: The program will have wide spread use throughout the solid rocket motor community for both research and development and will be used in industry, government and university environments.

REFERENCES: "The Solid Propellant Rocket Motor Performance Prediction Computer Program (SPP), Version 6.0", G. R. Nickerson, D. E. Coates, A. L. Dang, S. S. Dunn, D. R. Berker, R. L. Hermsen and J. T. Lamberty, Air Force Astronautics Laboratory, AFAL-TR-87-078, December 1987.

N96-064TITLE: Low Cost, Hot Gas Turbine Powered Hydraulic Power Supply

OBJECTIVE: Develop a hot gas turbine powered hydraulic power supply system

DESCRIPTION: Investigate and demonstrate the feasibility of using commercially available components such as automotive turbochargers and hydraulic pumps to produce a low cost, hot gas powered turbine driven hydraulic power supply and fuel pumping unit for tactical missiles.

PHASE I: Design a low cost, hot gas turbine powered hydraulic power supply and fuel pumping unit utilizing commercially available components such as automotive turbochargers, planetary gear trains, chain drives, and hydraulic pumps. The unit shall be capable of producing one (1) hp of hydraulic power and pump 0.5 Ibm/sec of jet fuel against a back pressure of 100 psia with a turbine air inlet temperature and pressure of 1200 ^{0}F and 20 psia, respectively, and an exit pressure of one (1) psia. The unit shall also be capable of supplying 5 hp of hydraulic power and pump 10 Ibm/sec of jet fuel against a back pressure of 500 psia with an air inlet pressure of 100 psia and an exit pressure of 14.7 psia. The unit shall be capable of sustaining the above operation for one hour. The contractor will also perform a production cost analysis of the unit.

PHASE II: The contractor will manufacture two complete units and test them to the specified conditions.

PHASE III: These power supply units will be used on an advanced supersonic missile system. The contractor will manufacture several of these units for flight demonstration tests.

COMMERCIAL POTENTIAL: These units could be used as hydraulic power supply systems on heavy equipment or as aircraft emergency hydraulic power supply systems.

N96-065TITLE: Mini-Metrology System to Provide TROPO Inputs for GPS Error Reduction.

OBJECTIVE: Provide for the near-real time collection and application of atmospheric conditions to reduce the combined troposphere effects on location accuracy derived from GPS signal processing.

DESCRIPTION: Refraction of the GPS Carrier frequencies in a neutral atmosphere is independent of the particular application frequencies. The troposphere is non-dispersive with the refraction consisting of dry and wet components. The dry component contribution to range error at zenith is approximately 2.3 meters, based on an average atmospheric pressure. The zenith range error may be estimated from local surface pressure. The wet component contribution to error is dependent on the total signal path conditions. Model parameters effecting error resolution include: water vapor; temperature; altitude of players; and signal path elevation angle(s). For differential

observation error correction application, the atmospheric conditions at the base-line ends, must be taken into account. The accuracy to which the water vapor can be determined along the line-of-sight will directly effect the ability to achieve centimeter level accuracy. The models to accept parameters which define atmospheric conditions and determine probable errors are available to refinement for variable signal path conditions. An on site (differential receiver) miniature meteorological station could provide current conditions for the computation of the dry and wet components. This would provide near-real time error correction.

PHASE I: Perform a feasibility study and develop a reasonable cost approach for providing the required atmospheric condition data to the model that is determining refraction error corrections.

PHASE II: Will result in the development, fabrication, and testing of an engineering development laboratory model, of the atmospheric conditions data collection and in-line computational processing, for the determination of error corrections and their application.

PHASE III: Build and document five prototype operational field units based on the results of the previous phase demonstration(s) and tests.

COMMERCIAL POTENTIAL: The system can be used for more precise location of FAA in-route air traffic and commercial airport final approach vectoring.

REFERENCE: Wells, Guide to GPS Positioning, Tropospheric Effects, Canadian GPS Associates, December 1986, May 1987.

N96-066TITLE: Computer Code for Predicting Warhead Booster Performance

OBJECTIVE: Develop a computer code that can predict the performance of modern flyer plate boosters against insensitive main charge explosives.

DESCRIPTION: A convention warhead booster is a relatively shock sensitive small charge of explosive, easily detonated by the warhead firing train. The design of conventional boosters can be accomplished using modern reactive flow hydrocodes. To meet Insensitive Munitions requirements, modern explosives are often very shock insensitive. A promising concept for initiating shock insensitive main charge explosives uses an insensitive booster explosive to drive a flyer plate into the booster/main charge interface. This results in a very high pressure shock of short duration which produces a detonation in the main charge in a very short run distance. Analysis of the flyer plate booster with a conventional Eulerian reactive flow hydrocode. Shockwave Multimaterial Eulerian Reactive Flow (SMERF), shows that the detonation, once formed in the main charge, may then fail due to corner turning effects. These corner turning effects highlight the weaknesses of our current codes. Results obtained from these analyses were shown to be dependent on the computational mesh size, since the reaction zone of the detonation wave is very thin and it could not be resolved. The product of this SBIR would be a computer program that could be used for design and analysis of both conventional and flyer plate boosters. It would, therefore, be capable of simulating both the run up to detonation and detonation failure behavior of explosives.

PHASE I: Develop an approach for a computer code to design flyer plate boosters and validate the utility of that approach. A reactive flow hydrocode based on either CTH or SMERF, which the Navy currently uses, is preferable. Other codes will be considered, if significant advantages to the user community are demonstrated. If the approach, requires a burn model for the explosive, it must be calibrated from the results of small scale experiments. The calibration method for the burn model must be demonstrated. The overall goal is a code for use by the booster design engineer, that can be used to determine the properties of a good booster explosive.

PHASE II: Implement the approach developed in PHASE I. This includes writing or modifying the computer code, benchmarking the result against standard problems and verifying the performance of the computer code by experiments performed with insensitive explosives. The deliverables include the computer code and its technical and user documentation.

PHASE III: Transition of the developed computer code into existing analysis tools which will reduce and cost and development time of future ordnance systems.

COMMERCIAL POTENTIAL: A computer code of this nature has application in several commercial industries (i.e. petrolium, transportation, risk assessment, mining, and space). The ability to accurately predict potentially

hazardous conditions and design systems in such a way to mitigate catastrographic failures, directly translates into savings in life, property, costs, and time.

REFERENCES:
(1) A Survey of Barrier MATERIALS for Mitigating Sympathetic Detonation, by E. Lundstrom, C. Carlton, and A. Thompson, published in the Proceedings of the 1993 JANNAF Propulsion Systems Hazards Subcommittee Meeting, Fort Lewis, WA, 10-14 May 1993.
(2) Naval Air Warfare Center Weapons Division. The SMERF Code-Multimaterial Eulerian Reactive Flow, by Larry Libersky, New Mexico Institute of Mining and Technology, Socorro, NM, and Eric Lundstrom, Naval Air Warfare Center Weapons Division, China Lake, CA., China Lake, CA., NAWCWPNS, September 1994. (NAWCWPNS TP 8206 publication UNCLASSIFIED)
(3) A Numerical Study of Fragment Impact on Bare Explosive", by Eric Lundstrum, Prodceedings of 24th ICT Conference, Karlsruhe, Germany, July 1993.

N96-067TITLE: Separable Platform Glint/ Cross Polarization Target Signature Modeled RF Augmenter

OBJECTIVE: Provide realistic target signature features in an active wide bandwidth augmenter in a configuration that can move the aim point off the target platform.

DESCRIPTION: Target signature characteristics shall include glint, depolarization, fading, scintillation, phase reversals and jet engine/propeller modulation spectra. It is to be programmable and able to model the threat spectrum of airborne vehicles. The model will be accurate for a specified sector of the threat vehicle at the modeled aspect angle and for a region of test vehicle aspect angles for test purposes. The augmentation loop gain and amplification shall be able to simulate radar cross sections of 0.2 to 1000 square meters and remain stable when illumination power saturates the microwave chain. The JEM/PM, glint and cross-polarization modulations shall be undisturbed by saturation. The delays through the amplifier chain, cables, and modulators will be coincident with the geometric positions being modeled. Towed active sources will be used and "tuned" in time/frequency so the apparent position of the guidance target and the phase coincide. A towed web configuration shall be included. The augmenter shall be installable in the bulk of the tri-service targets. The augmenter will include a receive antenna, two to three transmit antennas, two modulation chains for glint and cross polarization, phase and amplitude modulation components, computer, memory and reeled tow antennas. The unit will augment over 2 to 18 GHz. It shall have preprogrammed -autonomous and grounded controlled target glint, depolarization, fade, scintillation and engine modulation.

PHASE I: Review existing SBIR programs for glint/cross polarization augmenters such as the multi-point augmenter, and the fading target generator for immediate use in the design. Review new technologies such as miniature towed modules and improved microwave/millimeter components. Design for installation in the BQM-74C and AQM-37C targets. Design to satisfy the stated objectives which have all been satisfied separately in other projects.

PHASE II: Design an augmenter with all the features specified under objectives for target installation in a BQM-74C with a two to three output horn installation. Design the installation to fit in the AQM-37C endure its worthy for its temperature and vibration environment. Build the augmenter and test it in the SPARROW or SM-2 hardware simulation to prove out the threat vehicle modeling and effect. Design the augmenter modulation control to be autonomous, uplink controlled based on ground track data or by use of miniature global positioning units. The augmenter program shall be entered by memory loader verifier (MLV) or equivalent, or selected by ground control. Install the augmenter in the BQM-74C or other missile target and flight test it. Develop and complete a threat vehicle signature data base for use in setting the augmenter characteristics.

PHASE III: Adapt the developed design to operate in at least 3 separate target models. Complete development and manufacture 6 units for first article testing in NAWCWPNS threat simulation targets. Perform simulation, captive and air launch evaluation of the augmenters. Perform operational use tests and provide operating manuals, programmer manuals and BIT description documents. Design an "end-to-end" microwave tester to prove out the glint and cross polarization modes.

COMMERCIAL POTENTIAL: Commercial air liner self protection against radar missile threats. Complex multi-directive radio beacon, control element in X- or K-band automatic landing system, complex electronic countermeasures, deployable/portable micro-wave repeater, repeater for surface obstructions in flyways, and repeater for race car telemetrics. Mineatureization and multiple modulation modes provides basis for desk top satelite communications, true PDA with satcom capability, wireless internet communications. Wireless PC for use at in stock exchanges as front end of client servers as Codic wireless protocal.

N96-068TITLE: High Speed Scene Signal Processor Accurate Fuzzy Logic/Neural Network/Data Compressor High Speed Scene Signal Processor

OBJECTIVE: Apply Fuzzy logic, neural networks, and data compression technology to high speed (frame rate) precision scene processing for highly accurate target recognition and identification.

DESCRIPTION: The Navy currently uses high speed digital signal processors to process missile sensor and guided missile seeker scene information. Performance demands are increasing frame rates, pixel counts and constricting transmission bandwidth. Fuzzy logic and neural networks modeled to process IR or visual scene data rapidly and efficiently can be designed. Fuzzy logic and neural networks will be combined to provide scene noise filter, target detect, and target shape identification functions. These functions will be fully programmable so the scene signal processor can be employed with several types of detection schemes. Target characteristics action/guidance and response repertoire will be programmed in the fuzzy logic for alarm, response and guidance functions. The processor may be used for:

a. Identification Friend For at Beyond Visual Range
b. Replace current IR Visual Seeker Processing.
c. Combat Surveillance and Drug Enforcement and Interdiction:

PHASE I: Provide a survey and solution study to employ existing fuzzy logic and neural network knowledge using existing sensor technology. Design logic/ network for use with three types of detector arrangements (Rotating, Scanning and Staring focal plane array) and for stable and rotating field of view applications. Resulting processor shall reduce scene noise, detect targets in low Signal to noise conditions, identify targets and formulate alarm, responses and guidance signals. Frame rates from 60 to 1000 FPS and pixel arrays from 1 by up to 200 in line, 256 by 256 up to 1024 by 1024 arrays and 8 to 16 bit digitization will be accommodated. Programmable target feature and identification will be designed in to the processor. The processor must use low power and be reduced to fit with in aircraft and guided missiles. The design should be modular, open architecture to facilitate incorporation into a wide variety of sensors and platforms

PHASE II: Develop, test and operationally demonstrate the Fuzzy logic Neural Network, compressed data processor using existing seekers, or aircraft sensors. Demonstrate as well with at least 200 FPS and 256 by 256 pixel array with at least one commercial camera.

PHASE III: Produce the resulting compressed microelectronic processor or HMA package for use in a wide variety of commercial and military sensors as well as in existing guided missile and weapon control systems.

COMMERCIAL POTENTIAL: The new technology can be used in vehicle traffic monitoring, safety, and evidence recording. It may be used for security and surveillance for human and physical threat detection, evidence, alarm, and action/response.

REFERENCES: Neural Networks for Signal Processing, by Bart Kosko Prentice Hall pub. Neural Networks and Fuzzy Systems, by Bart Kosko, Prentice Hall pub.

NAVAL SEA SYSTEMS COMMAND

N96-069TITLE: 3D Model Simplification for Simulation

OBJECTIVE: To develop software to automatically simplify CAD produced three dimensional models to a level of detail suitable for visualization and simulation.

DESCRIPTION: Computer Aided Design (CAD) systems are used to design complex machinery, such as ship systems. It would be advantageous to transfer the information available in the CAD system directly to a visualization and simulation computer system. However, the detail available in the CAD system is often much higher than the usable level of detail for visualization and simulation. The level of detail to be retained may also differ within a single model. For example, details of the inside of a model may be eliminated while many exterior details may be retained for realism. Software that would intelligently automate the process of reducing the level of detail with user control would accelerate the transfer process.

PHASE I: Develop the basic software for automatically simplifying CAD produced three dimensional models to models suitable for simulation and visualization. The basic code would be demonstrated on individual pieces of equipment such as pumps and control panels.

PHASE II: Develop, test, demonstrate, document and deliver operational software for larger CAD models such as entire ship/submarine compartments. This software would incorporate additional user control and would allow different levels of detail to be specified for different parts of the model.

PHASE III: Transition the operational software into an on-line documented production package. The software would be used for creating models to visualize and simulate systems aboard naval vessels and in other applications.

COMMERCIAL POTENTIAL: Many industries, such as the automotive and building industries, are using visualization and simulation. The software would have significant commercial potential by simplifying the process of transferring CAD models to visualization and simulation computer systems.

N96-070TITLE: Integration of Specifications Information into a Product Model

OBJECTIVE: Develop the database structure and related software necessary to integrate specification information into the NAVSEA product model.

DESCRIPTION: Naval ship specifications have traditionally been produced as text documents. The complexity of the specification documents demanded that a designer have a working knowledge of its organization in order to find relevant information. Ship specifications are living documents that continually change and expand as the design progresses. With the advent of computers, it became possible to move and maintain specification documents within the computer. Text search techniques improve accessibility, but a knowledge of the documents organization is still necessary to obtain information. The computer holds the text of the specification, but the specification is still fundamentally a text document. The organizational capabilities of the computer have not been exploited. Naval ship design at NAVSEA is moving into a computer-based product model environment. The product model utilizes a relational database to organize design data in ways that make it easier for the designer to access and update the data. With the advent of the product model, it has become practical to include the specification information in the database with the other design data. The specification information can be connected to the parts of the design that it affects in a manner that was never possible in the past. The details of the relationships between the specifications and the remaining design information is complex. Accessing and updating the specification information held in the product model demands new techniques that are different than traditional commercially available text retrieval methods.

PHASE I: Develop the basic software for accessing product model-based specification information. This will include the definition and implementation of extensions to the product model relational database structure. The basic software will access the extended product model to obtain specification information in a manner that indicates the feasibility of the technique to properly link information.

PHASE II: Develop, test, demonstrate and document operational software for accessing, updating and locally tailoring (ie. without destroying the master) specifications contained in a product model. This software will include the production user interface. Tests will be conducted to ensure that the software is suitable for use with the large volume of data present in a ship design and is capable of self linking to related areas of the product model in a dynamic manner.

PHASE III: Transition the operational software into a self documenting production package. The software would be used for accessing, updating and locally tailoring the specifications to assist with the ship design.

COMMERCIAL POTENTIAL: Many industries, such as the building industries, use specifications. The product model concept is increasing in popularity as a means of organizing engineering data. This unique software would have wide commercial potential by easing access to and providing control of specification information concurrently during design.

REFERENCES: Product Model Information is available from Computer Aided Engineering on the NAVSEA Headquarter's Internet server. The NAVSEA Internet home page address is http://www.navsea.navy.mil.

N96-071TITLE: Object Oriented Data Base for Combat System Ship Design

OBJECTIVE: Develop an object-oriented database for Combat System Ship Design that integrates the Functions, Parameter, and Characteristics List (FPAC), Combat System Specification (CSS), Combat Compartment Location Arrangement Model (C/CLAM), Fiber-Optic Topology Design Tool (FOTDT), Combat System Catalog of Parameters for Equipments (C/SCAPE), Electromagnetic Assessment Workstation (EMA/WS), Ship Specification, and the CAD 2 Combat System Equipment Macro Libraries.

DESCRIPTION: The Navy currently uses many disjoined databases for Combat System Ship Design. The databases are at various security levels which has blocked previous attempts to integrate the information in them. The time and cost of developing Combat System Ship Designs for new construction and major overhauls are decreasing so that improved integration is required to meet Ship Design schedules and design budgets.

PHASE I: Develop the basic schema and design for an object oriented database that integrates the Functions, Parameter, and Characteristics List (FPAC), Combat System Specification (CSS), Combat Compartment Location Arrangement Model (C/CLAM), Fiber-Optic Topology Design Tool (FOTDT), Combat System Catalog of Parameters for Equipments (C/SCAPE), Electromagnetic Assessment Workstation (EMA/WS), Ship Specification, and the CAD 2 Combat System Equipment Macro Libraries. The design must be supported by NAVSEA CAD 2 equipment and software and the concept must be shown to be extensible to many other databases.

PHASE II: Develop, test, operationally demonstrate and document the design that was formulated under the Phase 1 SBIR effort. The design shall produce all the database related documentation that will support a Combat System Ship Design. The demonstration shall include a multi-level security system to permit classified and proprietary data to be stored in an approved inscription format with a security control access system to permit all classes of users only the access to the data that they have authority to access.

PHASE III: Produce a CAD 2 software product that implements the design demonstrated in the Phase 2 effort.

COMMERCIAL POTENTIAL: The new object-oriented database design could be used by commercial ship builders to support detail design of Navy and commercial ships. The commercial ship builders can input the need information for contractor furnished information for the contractor furnished equipment in a integrated data environment to provide for an integrated data produce. This integrated data produce will then support computer logistic, computer aided detail ship design, and computer aided manufacturing.

N96-072TITLE: Automated Human Systems Integration Tools for Reduced Ship Manning

OBJECTIVE: Develop and demonstrate automated tools to achieve effective, economical, and safe ship manning reductions.

DESCRIPTION: There is a strong impetus in Navy and commercial ship design to reduce the manning levels associated with the operation and maintenance of surface ships. This thrust is primarily motivated by a requirement to reduce operating costs. Costs associated with the human crew typically comprise 40 to 50% of a ship's operational and support costs. The constraints on reducing ship's manning include the potential impacts on: mission effectiveness, crew safety, crewman workload, and human performance capability. Historically, the most frequently applied method to reduce ship manning has been to automate tasks previously performed by a human, thereby reducing workload and manning requirements. This approach is not always effective due to an inadequate

allocation of functions to human performance and automation, and to a failure to consider the most effective integration of the human in automated system operation. Human systems integration (HSI) application in early system design and development specifically addresses the allocation of functions issue, as well as the required roles of the human and automation, and the design of workstations, human-machine interfaces, jobs, procedures, and training systems to reduce human error, accidents, workloads, task complexity, and required skills for human performance in a reduced manning environment. The potential for reducing manning beyond the use of automation, through HSI techniques such as improved task simplification, decision aiding, and improved design for operability and maintainability, has been well demonstrated. The Naval Research Advisory Council, in a review of the status of man-machine technology in the Navy, estimated that the application of human-centered design methods in system design will result in a 20% reduction in required manning levels. What is needed now is to automate HSI methods and data which will result in effective and safe ship manning reductions. HSI methods and data include allocation of function techniques, design to reduce complexity and error/accident potential, modeling and simulation to assess workloads, support decision-making, and evaluate what-if conceptualizations of reduced manning impacts, and models of the affordability and risk associated with specific ship manning reduction approaches.

PHASE I: Develop a conceptual model of the activities accomplished by ship system design personnel in developing and implementing ship system and total ship design concepts for a reduced manning level. Define a ship reduced manning process which is integrated with each phase of the ship design process. Develop prototype tools to support the specific activities of the ship reduced manning process. Prepare technology development specifications for tools and models not currently available. Validate tools with ship scenarios, such as those associated with a reduced manning bridge.

PHASE II: Based on the technology development specifications developed in Phase I, further develop the methods, models, and simulation tools to meet the ship reduced manning tool requirements. Tools will be of three general types associated with the relevant phases of the ship reduced manning process. These tool types are: 1) analysis tools (allocation of function, comparability analysis, task analysis, tradeoff analysis); 2) simulation and prototyping tools (for workload assessment, manning estimation, and workstation design and arrangement); and 3) assessment tools for evaluation of the affordability and risk associated with a ship reduced manning concept.

PHASE III: Transition fully developed tools to assist in reduced manning efforts on future ship designs such as SC 21 and CVX.

COMMERCIAL POTENTIAL: The results of this effort will be applicable to any commercial application where there is a requirement to reduce manning levels, simulate the effects of these reductions on safety and performance effectiveness, and assess the impact of reduced manning concepts on affordability and risk. Examples of industrial applications include: commercial ships, process control systems, and transportation control systems (intelligent vehicle-highway systems, rail control systems, port control systems).

N96-073TITLE: Robust Distributed Broadband Network Control System Development

OBJECTIVE: Develop a robust distributed broadband Asynchronous Transfer Mode (ATM) network system control, capable of supporting emerging broadband and wireless services in a robust, fault tolerant, and extensible manner.

DESCRIPTION: Network control provides for the effective functioning of network system transport. It is of central importance to the continued tactical effectiveness of an integrated ATM network, as well as to its cost effective deployment, to evaluate and build this capability around existing and emerging industry broadband standards, capable of providing high bandwidth voice, data, and video services, for current and future military network applications. ATM is a connection oriented and packetized broadband network technology that allows users to transmit voice, video, data, and imagery over the same circuit. In addition to bandwidth requirements, it is necessary to establish a control architecture built upon robust networking systems providing for the automatic restoration, intelligent provisioning, and gathering of network traffic information. The objective of this research is to establish a distributed software package and associated network protocols capable of supporting current and future network control requirements. The proposed approach should pay special attention to ensuring the robust, verifiable, efficient, coordinated and real-time performance of network control software. The resulting system should be capable of easily being transitioned from a simulation domain into an operational domain with minimal

re-coding effort. The system software modules should be easily maintainable, and extensible as additional system requirements emerge. System behavior should also be easily monitored, and capable of being operated in both an automated, and supervised man-in-the-loop mode.

PHASE I: Investigation of proposed concept. Develop a preliminary simulation of proposed solution, demonstrating feasibility of the network system service control layer. Include in the development features such as service control, Operation & Maintenance (O&M), and traffic management.

PHASE II: Demonstration of the proposed concept with a small scale lab based ATM prototype system. Prototype effectiveness will be evaluated, and scaling issues will be discussed.

PHASE III: Scaling of lab based system into a larger scale naval ship based application, such as the LPD-17's Shipwide Area Network (SWAN), or the CVN-76's Integrated Communications and Advanced Networks (ICAN).

COMMERCIAL POTENTIAL: This technology will have an impact in digital communication in the areas of network restoration, fault isolation, congestion control, and traffic monitoring, as well as in the development of distributed network control nodes.

REFERENCES:

1. ATM User-Network Interface Specification, Version 3.1, The ATM Forum, September 1994.
2. ATM Forum 94-0471R9, Private Network-Network Interface (PNNI) Draft Specification, Phase 1, June 16, 1995.
3. CVN-76 Presentation, Integrated Communications and Advanced Networks (ICAN), W. Page Glennie, CVN-76 Ship Design Manager
4. LPD-17 Draft Specification Section 409, Shipwide Area Network (SWAN).

N96-074TITLE: High Power Multi-Layer Frequency Selective Filters

OBJECTIVE: Develop technologies and techniques for designing high-power, multi-layer frequency selective filters for the purpose of reducing the in-band and out-of-band radar cross section (RCS) of large shipboard antennas to aid EW effectiveness.

DESCRIPTION: Ship RCS must be reduced to make detection more difficult and to enhance the effectiveness of ECM and decoys. Areas other than vehicle top side structures contribute to the RF signature of ships, the main one being high-gain antenna systems. Reducing antenna RCS will make the on-board EW systems more effective.

PHASE I: (Concept Definition): Through the use of computer codes, develop passive band-pass and band-reject low loss multi-layer frequency selective surface (FSS) filters suitable for high power applications. Conduct high power analysis of multi-layer filters. Conduct a trade-off study to investigate filter power handling requirements and effectiveness in reducing RCS as a function of filter placement.

PHASE II: (Concept Demonstration): Develop candidate filters. Continue analysis into multi-layer FSS filters for high power applications. Perform high power tests on candidate filters.

PHASE III: (Concept Implementation): Transition a FSS to a government owned full scale antenna for further test and evaluation.

COMMERCIAL POTENTIAL: This technology has applicability in the private sector in the area of high power materials. In addition, other commercial benefits can be derived by utilizing this technology to reduce EMI crosstalk between nearby antennas.

N96-075TITLE: Tools to Develop, Deliver and Exchange Electronic Technical Information in Support of New Research and Development (R&D) Projects

OBJECTIVE: Apply innovative tools and techniques to electronically develop, deliver and exchange design, engineering, program management, product data and life cycle support information between Navy activities and the

development contractor. This will reduce the cycle time and cost of preparing and distributing conventional products during the R&D phase and throughout the entire life cycle of the system.

DESCRIPTION: A broad range of expensive technical products related to R&D projects are currently developed and delivered to the fleet and shore support activities in paper and electronic forms. The products are typically developed and updated by assembling design, engineering and logistic information in stand-alone products such as technical manuals, parts lists, maintenance procedures and drawings; and distributing them to the requiring organizations. Tools and techniques developed under this topic should enable the raw technical information to be exchanged and delivered electronically using an integrated data environment without the cost and extended cycle time associated with repackaging in conventional products.

PHASE I: Design and implement prototype tools and techniques to enable electronic development and exchange of technical information for new R&D programs during system design, fleet introduction and life cycle support.

PHASE II: Determine requirements for implementation. Demonstrate using tailored commercially available tools and new techniques in a pilot project for an Advance Surface Machinery (ASM) R&D program. Document data requirements and data flows and technical package for use in all other R&D programs.

PHASE III: Extend and implement the tools and techniques on remaining ASM Programs in an integrated modular system that dynamically links between all the R&D projects as well as to other more administratively and production oriented systems. Create standard data requirements, tool sets, and data flows in order to extend the application to other Government R&D projects.

COMMERCIAL POTENTIAL: The tools and techniques can be used to develop, maintain and deliver up-to-date technical information to any complex commercial system such as power plants, manufacturing facilities, and chemical refineries.

REFERENCES: Navy/Marine Corps Manager's Desktop Guide for CALS Implementation

N96-076TITLE: Facility for Radiative Susceptibility and Emission Testing

OBJECTIVE: Characterize the radiated susceptibility and emissions testing performance of an optimized hybrid transverse electromagnetic cell/reverberation chamber facility design

DESCRIPTION: Several hybrid facilities combining the features of transverse electromagnetic (TEM) cells and reverberation chambers (RC) have been constructed to demonstrate the feasibility of broad band frequency coverage in a single test facility isolated from the external electromagnetic environment. The performance of these proof-of-concept facilities has been positive. However, the available data is insufficient to characterize the overall facility performance for susceptibility and emissions testing versus design parameters including, for example, the linkage between uncertainty bounds in test results and test cost. These issues must be resolved before the concept can be employed as an accepted radiated susceptibility/emissions test facility.

PHASE I: Define the critical design parameters of a hybrid TEM/RC which impact field uniformity, frequency coverage, pulse response, test time, confidence in test results, and size scaleability. Develop theoretical models to address these issues and define experiments necessary to provide data on the performance tradeoffs as the critical design parameters are varied. Define the theoretical and experimental approach to correlating the test results from a hybrid TEM/RC facility to the results from existing facilities including but not limited to open area ground planes and MIL-STD-462 test procedures. Define the size scaleability of a hybrid TEM/RC facility.

PHASE II: Using a scale model or an existing facility, characterize the electromagnetic test environment over the required frequency regime as a function of the critical design parameters.

PHASE III: Develop a prototype hybrid TEM/RC facility with a validated software package for demonstrating facility performance and for conducting automated susceptibility and emissions testing.

COMMERCIAL POTENTIAL: All commercial electronic systems sold in the European Community will, effective in 2006, be required to pass stringent immunity tests in addition to the emissions test required in the US. It is likely that in response to the EC initiative, the FCC will extend its traditional emissions standards to include immunity

standards as well. This will generate a demand for inexpensive facilities which provide low cost, high confidence, repeatable immunity and emissions testing and which can be correlated with currently specified regulatory test procedures. An optimized, single test facility such as a hybrid TEM/RC facility which meets the increasing commercial test requirements will have a significant impact on the cost effectiveness and time-to-market of the multi-billion dollar US electronics industry.

REFERENCES:
1) Crawford, M.L., Ma, M.T., Ladbury, J.M., and Riddle, B.F., Measurement and Evaluation of a TEM/Reverberating Chamber, NIST Technical Note 1342, Jul 1990.
2) MIL-STD-462

N96-077TITLE: Shock Resistant Single-Mode Fiber Optic Connector

OBJECTIVE: Develop a shock-resistant single-mode fiber-optic connector/adapter that is compatible with the commercial ST type fiber-optic connector/adapter.

DESCRIPTION: The ST connector is the standard Navy single fiber connector (MIL-C-83522/16 and /17). Current Navy ST connectors/adapters configured with multimode fiber show transient losses less than 0.5 Db for a duration less than 50 microseconds during shock tests performed in accordance with the Navy standard shock test procedure, MIL-S-901. These same connectors/adapters show transient losses over 2 Db for a duration of up to 100 milliseconds during the same shock test when used with single-mode fibers. An improved ST connector/adapter is needed that will show transient losses less than 0.5 Db for a duration less than 50 microseconds during the Navy shock test. The improved ST connector/adapter must still be intermateable with standard ST connectors and adapters as defined in Electronics Industry Association/Telecommunication Industry Association 604-2.

PHASE I: Develop a design or designs for an improved single-mode ST connector/adapter that will show transient losses less than 0.5 Db for a duration less than 50 microseconds during standard Navy shock testing.

PHASE II: Build prototype connectors/adapters and perform standard Navy shock tests on the prototype connectors. Upon successful completion of prototype connector testing, develop full manufacturing capability and produce manufacturing representative connector/adapter samples. Test the manufacturing representative samples for compliance with the Navy fiber optic connector specifications.

PHASE III: Production and Sale of the connector/adapter to the U.S. Navy and commercial aircraft manufacturers.

COMMERCIAL POTENTIAL: The greatest potential for the improved ST connector/adapter is the commercial aircraft market. Aircraft vendors have not used typical commercial ST connectors because of concerns about the connector shock and vibration performance which this project will solve.

REFERENCES:
(1) EIA/TIA-604-2
(2) MIL-C-83522
(3) MIL-S-901.

N96-078TITLE: Solid State Tritium Monitor

OBJECTIVE: Develop a reliable, portable, continuous processing, solid state detector which measures tritium levels in air to 1 microCurie per cubic meter (0.1 microCurie per cubic meter desired). The portable unit must be able to operate from standard 120 VAC power and weigh no more than 25 pounds.

DESCRIPTION: Develop a solid state tritium detector for shore and shipboard use. Present systems are bulky and measure only to about 5 microCuries per cubic meter and use ion chambers that require sensitive electronics which are susceptible to noise. A solid state detector will result in smaller monitors with higher sensitivity.

The new system should measure to 1.0 microCurie per cubic meter. (However, 0.1 microCurie per cubic meter is desired.) The system would be hardened against noise from power line and external gamma (Cobalt 60) fields up to 0.5 milliRoentgen/hr.. In addition, the unit must be compact and light enough (under 25 pounds) to be carried with one hand. Unit must be able to run continuously 24 hours per day with an average reliability rate greater than 2000 hours mean time between failures.

PHASE I: Design a reliable, streamlined, continuous processing tritium monitoring system. Provide experimental evidence that proposed design will meet sensitivity requirement. Provide report including experimental data. Demonstrate feasibility using laboratory setup.

PHASE II: Construct and provide prototype monitors for field test and evaluation. Conduct field testing with Navy potential users (to be determined). Provide report showing results of field tests, proposed design changes, and evaluation of technical difficulties.

PHASE III: Develop production model for Navy use. Conduct final field test and evaluation. This will be the transition to production phase.

COMMERCIAL POTENTIAL: This device will be useful to manufacturers of tritium devices (airport signs, tritium displays, watches) and commercial fusion power plants. The increased reliability will save wasted manpower in reacting to false alarms. The increased sensitivity will allow monitoring closer to environmental levels.

REFERENCES: Operational Requirement (OR) for Tritium Monitors (OR #182-04-89), [all performance-related excerpts to be provided to DTIC]

N96-079TITLE: RF Voltage Measurement System

OBJECTIVE: A voltage measuring system is required which will be capable of measuring voltage from DC to 100 Mhz, from millivolt levels to 1,000 volts, at 10 ppm uncertainty or better.

DESCRIPTION: RF voltage measurements have traditionally been made using thermal converter techniques with standards such as the 1394/1395, TDO series, or the 540B. Thermal converter techniques are time consuming, subject to operator errors, and are not accurate enough to support new workload items while maintaining a four to one accuracy ratio. The new measurement system should be simple to operate, minimize interconnections, and provide an indication when it is being operated outside of its specifications. This device should be capable of serving as the Navy's highest accuracy RF voltage measuring standard for its maintenance level calibration facilities.

PHASE I: This phase will be utilized to develop a prototype RF Voltage Measurement System and to resolve any high-risk issues associated with the proposed approach.

PHASE II: This phase will be utilized to develop a prototype RF Voltage Measurement System and associated user's manual. Prototype system and user's manual should be suitable for utilization by Navy maintenance level calibration facilities.

PHASE III: This phase will be utilized to develop a commercial version of the RF Voltage Measurement System which would be purchased by System Command acquisition activities for use by maintenance level calibration facilities.

COMMERCIAL POTENTIAL: RF voltage measurement is a basic requirement of the electronics industry. A higher accuracy voltage measurement system which is easier and cheaper to use will be welcomed by the commercial market as well as by the military.

N96-080TITLE: Computerized, Interactive, Generic Sub Systems vs. Total Ship System Design Program

OBJECTIVE: The objective of this topic is to develop a computerized, multi-platform, networkable, generic mechanical design program based on parametric modeling techniques using CAD and optimization software. The

proposed initial use of this software is for Naval gun sub system designs with subsequent linking to total ship design modules.

DESCRIPTION: With recent developments in three dimensional Computer Aided Design (CAD) software, especially with the advent of parametric modeling and generalized optimization techniques, the opportunity has arisen to automate a significant portion of the current labor-intensive, costly, and time consuming efforts in mechanical design and integration of Naval Gun Sub systems. A short term goal of such a system development would be creation of an analysis tool that would allow systems engineers to develop a very quick system configuration for a proposed gun system to mount aboard a specific ship class. The long term goal would be to achieve a system with sufficient flexibility and accuracy to allow development of a complete gun design and subsequently other combat weapon sub systems through the use of a series of interlinked automated design modules.

Such a system should be developed around a high level desktop computer system such as the Power PC or Pentium machines. The software should be icon driven with pull down menus. User friendliness is a must due to the wide range of personnel who would have use for such a system. The software should be developed in an open architecture, associative format (such as NAVSEA's SHIP Design Optimization Code (SHIPDOC), see references) to allow use on various machine types with easy access by follow-on modules as they are developed. Special emphasis shall be placed on integration of existing government sub system models and analysis tools into the system either directly or as peripheral modules. Output format should support dynamic simulation models that may be developed to evaluate gun weapon systems performance aboard ship.

This system would also allow commercial vendors of components and sub-components to develop interfaceable models of their components in somewhat of an electronic catalog/database of parts. The gun designer could readily incorporate these models directly into the overall system with a minimum of effort. These models could be modifiable so that if an external feature of the component needed a change to interface with the system, the modified models could be directly fed back to the vendor for quote and/or procurement. This should be an advantage, not only to the Navy , but to the commercial suppliers also.

PHASE I: Explore the design methodology, input requirements, modeling and analysis techniques, and define the total scope of an effort to develop a parametric generic gun and weapon sub system design program.

PHASE II: Using the chosen design from Phase I develop, demonstrate and document a basic central processing model for a generic gun and weapon sub system design optimization both by itself and interacting optimally together with the shell of a total ship system design module.

PHASE III: Integrate this design into a self documenting production package with specific input models and specific parameter data to create the complete top level generic gun and weapon sub system design program. Develop interfaces to current Navy modeling programs for interior ballistic characterization, ship design, etc.

COMMERCIAL POTENTIAL: Development of such a program would open a large window of opportunity for many more interactive design programs with uses throughout commercial industries. Any type of design could be parametrically modeled with the correct input modules to produce the final item with a minimum of input data. These three dimensional models could be used in all areas of mechanical design and packaging throughout the military and commercial industries. This system would be the beginnings of a nationwide system of interlinking industries through networking which could eliminate many of the costly and time consuming mistakes and misunderstandings inherent in the long used two dimensional paper drawing system of communication. This system would be designed to be used with, but not totally eliminate the use of paper drawings and documentation. Such a generic system would have major impact on the automotive, aircraft, chemical, nuclear, oil and other industries. Since the system is based on CAD parametric modeling, it could be tailored to nearly any type of mechanical system.

REFERENCES:

(1) Ship Design Optimization Code (SHIPDOC), ASNE Proceedings 1983.
(2) SHIPDOC Status Overview of 19 Mar 1993.
(3) SHIPDOC Source Code (GFI).

N96-081TITLE: Reclamation/Reuse of Pyrotechnic Ingredients

OBJECTIVE: Develop technology to reclaim valuable constituents contained in Navy pyrotechnic flares and smokes and develop/establish military and commercial markets for the reclaimed material. This project is for pyrotechnics materials - those designed to produce smoke and brilliant colors. These materials contain metals (e.g. magnesium, aluminum); metallic salts of copper, strontium, barium; oxidizer (e.g.sodium nitrate, potassium perchlorate); binders such as viton and dyes which have reclaimed value.

DESCRIPTION: The Navy has numerous pyrotechnic munitions which currently have no demilitarization capability. Many of these contain valuable resources which could be used in commercial applications. Previous work was limited to remediation and reclaim of energetic materials such as explosives and propellants (RDX, HMX, nitrocellulose, etc.) and is not applicable to pyrotechnic materials.

PHASE I: Conduct innovative research to develop technology(s) for recovering/reclaiming valuable ingredients (e.g. metals, oxidizers, binders) from Navy pyrotechnic flares and smoke munitions in an environmentally acceptable manner. Perform initial laboratory feasibility studies of most promising technologies.

PHASE II: Based on the Phase I most promising technology, develop the reclamation capability and document its capability by performing laboratory, bench, and pilot scale testing for reclamation and reuse of pyrotechnic ingredients from specific Navy munitions. Perform evaluations to validate recovered ingredients can meet specification requirements/performance criteria for reuse for either military or commercial applications. Demonstrate that the reclaimed pyro ingredients produced from the pilot scale plant provides the desired results under actual field conditions and that a market exists for the product. Perform complete systems safety and environmental evaluation to confirm no problem exists in the recovery and reuse of the various pyro ingredients.

PHASE III: Develop and test a prototype commercial facility for reclamation and use of pyrotechnic ingredients with the ultimate goal for contractor to establish a cost effective production facility.

COMMERCIAL POTENTIAL: Reclaimed pyro ingredients have commercial value and process has commercialization potential for pyro manufacturers.

REFERENCES:
NAVSEA/SW050-AC-ORD-010/NAVAIR 11-15-8 Publication "Ordnance Data for Toxic Hazards Associated with Pyrotechnic Items"

N96-082TITLE: Low Cost Seeker (LCS) for Naval Surface Fire Support

OBJECTIVE: Develop a Low Cost Seeker for Naval Surface Fire Support Projectiles.

DESCRIPTION: This SBIR topic seeks to develop a LCS which will provide a terminal homing capability to the NAVY's long range munitions. While the primary mission of the LCS is naval surface fire support (NSFS), it is desirable that the LCS have residual capability in short range anti - air and short range anti - surface missions. Examples of these threats include low flying, high speed, maneuvering cruise missiles and small, agile surface craft. The LCS may function in any or all of the three operational modes: active, passive, or semi-active, however, all semi-active systems must be compatible with designator already in service with the US armed forces. Dual mode and/or multi-spectral systems arc of interest as well. If a dual mode system is proposed, it is desirable that at least one mode of operation be autonomous and as "all-weather" as possible.
The LCS shall be utilized on an airframe which will be inertially guided via a global positioning system (GPS) receiver and an internal measurement unit (IMU). The monition will autonomously guide itself onto the target area based on initial data loaded into the round either prior to launch or via uplink communications. The navigation and attitude control computer (NAC), on board the projectile, will activate the LCS and gather and process information from the projectile's IMU and LCS to implement terminal guidance toward the target. A two-way data path between the NAC and LCS should be assumed. It is highly desirable that the LCS be "strapped-down" to minimize complexity, cost and packaging volume and to maximize structural integrity. For design and analysis purposes. It may be assumed that the forward section of the projectile containing the LCS yaw, pitch and roll stabilized and that flight states and target positions are known by the NAC and may be used to stabilize seeker outputs and estimate range and time-to-go to target impact. All performance enhancing pre-processing of the guidance signal should be

performed within the LCS itself. The terminal guidance algorithm (software) implemented by LCS shall be considered part of this development. Implementation of the terminal guidance algorithm shall be performed by the NAC.
The LCS shall include low-drag, optical elements and/or wave guides, signal processing electronics and software, exclusive of power source. The optical elements of the LCS shall fit within the external loci of a 3 caliber 80% secant ogive body of revolution thus minimizing the additional drag associated with the collecting aperture. As a minimum, The LCS shall be capable of providing the NAC with a measurement of the angle between a body off reference and the largest (error angle) at least every 0.2 seconds to an accuracy of 2.0 milliradians (or better) over the last kilometer before intercept. The LCS shall have a field of view of at least 10 degrees. It is highly desirable that the LCS output electronic signals proportional to the error angle over the entire field of view of the seeker. The field of view of the LCS may be biased at a fixed angle if necessary to enhanced performance. For design and analysis purposes, it may be assumed that the airframe is descending into the target area on a 20 degree glide slope at 300 m/s and can produce 1 G of lateral acceleration for every 5 degrees of airframe angle of attack.
The LCS shall occupy no more than the first 6.5 of the projectile nose length of a 3 caliber 80% secant ogive. In its tactical configuration, the LCS shall be capable of operating within specification for at least 30 seconds after activation by the NAC and after the application of at least 20,000 G's of set back acceleration in line with the be 3,000 and 10,000 G's, respectively. The unit production cost goal in quantities of 2,500 is $5,000.

PHASE I: Research and develop a preliminary design of an LCS, and report the theory of operation, estimated performance, technical risks.

PHASE II: The PHASE II program shall contain system design, hardware demonstrations, specified shock tests and technical reports which estimate, verify and document risk reducing demonstrations of the LCS and its components and will include hardware and software tests at 12,500 G of setback acceleration or higher,. It is highly desirable that this phase of development produce at least one deliverable unit of flight worthy hardware. The minimum hardware deliverable is a form, fit and function optics system with "brass board" electronics which can be "hardware-in-the-loop" tested by the Navy.

PHASE III: (A transition to a 3 year, engineering, manufacturing development (EMD) phase is anticipated which will be funded directly by the NSFS program office (PM 429). The EMD phase of the LCS development will be one element of a planned seeker/warhead Product Improvement Program (PIP) option to the ERGM. If PIP option is exercised, the LCS development shall be required to demonstrate form, fit and function hardware which shall perform as predicted and specified in the PHASE I/II studies. The seeker/warhead PIP test program shall include operational tests of the ERGM with LCS through the entire tactical gun launch environment, including the ammo handling system, as well as accuracy tests against a variety of target types.

COMMERCIAL POTENTIAL: The commercial application of this technology will be best suited for areas of development which require high resolution, low cost imaging,. Some examples of such applications are aircraft, marine and land vehicle collision avoidance, robotics vision, automatic landing/recovery systems for high value research vehicles, all weather search and rescue and possibly industrial safety and security systems.

N96-083TITLE: Modular Guidance Control Unit for Spin-Stabilized Projectiles

OBJECTIVE: Produce small electro-mechanical system (motors and generators) in a compact, highly integrated design. Apply this approach to a guidance control unit sub system for spin-stabilized projectiles fired from the 5"/54 MK 45 Naval Fire Support System.

DESCRIPTION: Current Computer Integrated Manufacturing techniques have great promise to produce highly integrated assemblies of motors, actuators, and generator, to replace the older design of individual machines assembled onto a heavy and bulky frame. The specific military application of this approach is to provide a control section for a guided projectile, which places the guidance and control elements (fins, actuators, electronics, antennas, and inertial components) in an aerodynamically despun section, using the despinning reaction to power the projectile. This approach permits the projectile to fly with a low-drag finless configuration at its initial high velocity, and allows a common component (a generator) to provide both electrical power and one axis of control. It also enhances the reliability of the projectile by allowing greater test-ability by eliminating one-shot devices, and by eliminating chemical batteries, which are reliability and demilitarization problems. This topic seeks a design for a

such a guidance control unit. The guidance unit shall contain the fins, actuators, and motive power, to despin the guidance section and control the projectile's flight. Bank-to-turn (two-axis, pitch and roll) control is acceptable. Space and power allocations shall be made for guidance and navigation electronics, Global Positioning System receiver and antennas, uplink and downlink antennas, and terminal seeker. (The government will provide size, mass, form, and power needs). The design's actuators shall be powerful enough to drive fins that can produce a 3-G turning force at subsonic speeds (for long range, surface fire support) and 30 G's at Mach 3 for close-in defense against missiles.

PHASE I: Prepare a design and appropriate simulation models to establish its structural, mechanical and dynamic performance.

PHASE II: Construct a gun-launchable prototype of the PHASE I design.

PHASE III: The design would transition to the Naval Surface Fire Support program in production of a guided projectile.

COMMERCIAL POTENTIAL: In the specific design form needed for a guided projectile guidance unit, this device would also be suitable for a windmill generator producing 500 watts. In this size there is an immediate market for recreational sailboats, to provide power without running a gasoline generator. The design also scales up to larger generator outputs, suitable for specialized applications such as isolated electronic equipment such as microwave relay towers and cell telephone master sites, and for general power generation. Similar designs, incorporating multi-axis actuators in a compact hub, would be useful in ventilation blowers, variable-flow pumps for industrial plant equipment, and low-head hydroelectric generation.

N96-084TITLE: Operational Training for FFG-7 Anti Air Warfare (AAW) Combat System

OBJECTIVE: To develop a shipboard operational trainer for the FFG-7 AAW combat system.

DESCRIPTION: Provide a means for training the FFG-7 AAW combat team to operate their equipment in condition 1 watch stations. The extent of training shall include the following equipments and/or functions: Fire Control System MK 92, air search radar AN/SPS 49, surface search radar AN/SPS 55, integrated sensor signal processor SYS 2, Tactical Action Officer, Air Detector Tracker controller, Weapons Control Officer, and Weapon Control Console operator. The training shall cover the entire combat process, from target detection to standard missile or gun engagement. The training is to be realistic and be based on a simplified tailored version of the philosophy being utilized for the AEGIS system Embedded Training Advanced Technology Demonstration program.

PHASE I: The contractor shall demonstrate the capability to develop an inexpensive FFG-7 operational trainer. The contractor shall provide cost estimates for the non-recurring engineering (less than $500,000) and the recurring cost for any Ordnance Alterations and/or Ship Alterations that may be required (unit cost less than $200,000). The cost for PHASE I shall not exceed $100,000. The contract will be firm fixed price.

PHASE II: The contractor shall build a prototype and demonstrate its capability through testing. During this phase the Government shall down select to 1 - 3 contractors. Costs for PHASE II shall not exceed $500,000. The contract will be firm fixed price.

PHASE III: The contractor shall produce the first production unit, verify performance through application testing, and start production of up to fifty units. The contract will be firm fixed price.

COMMERCIAL POTENTIAL: The experience and technology gained from the development of a complex embedded trainer can be applied to the development of emmbedded trainers for complex industrial equipment such as very large scale chemical processing plant equipment or nuclear reactor plants.

REFERENCES: Embedded Training FY 96 ATD NAPD

N96-085TITLE: Microwave Removal/Conversion of High Explosives from Loaded Munitions

OBJECTIVE: Develop microwave technology to remove/convert the high explosives from loaded munitions into a commercially usable product and establish a market for the materials.

DESCRIPTION: The Navy has numerous projectiles/munitions loaded with explosives such as Explosive D (ammonium picrate) which presents problems with demilitarization. Reclamation and separation/chemical conversion could provide materials which would have commercial value.

PHASE I: Determine which markets exist for the end use of the reclaimed material. Investigate microwave technologies to remove/convert the explosive in an environmentally acceptable manner. Perform initial laboratory feasibility studies of the most promising microwave technologies.

PHASE II: Perform laboratory, bench, and pilot scale testing of the microwave technology for removal/conversion of the explosive from loaded projectiles. Perform evaluations to validate removed/converted materials can meet specification requirements/performance criteria for reuse for commercial applications. Demonstrate that the reclaimed materials produced from the pilot scale plant provides the desired result under actual field conditions and that a market exists for the products. Perform complete system safety and environmental evaluations to confirm no problem exists in the removal/conversion of explosive and reuse of all materials.

PHASE III: Develop and test prototype commercial facility for reclamation and use of reclaimed materials with the ultimate goal for contractor to establish production facility.

COMMERCIAL POTENTIAL: Reclaimed materials have commercial value and process has commercialization potential.

REFERENCES: SW050-AG-ORD-010

N96-086TITLE: Miniature Eye-Safe Laser Designator and Receiver

OBJECTIVE: Develop a small laser designator and matched receiver. The designator must operate at an eye-safe wavelength, and should be suitable for a small UAV or expendable aircraft. The receiver should be suitable for a five-inch, high g launched projectile. A more powerful version, suitable for mast mounting on a ship, is also desired.

DESCRIPTION: Military and commercial uses for laser range-finders and designators are limited by the need for an eye-safe wavelength. Current practice is to begin with a non-eye-safe Nd:YAG laser at 1.06 ìm, and shift it with non-linear optics to an eye-safe wavelength, an approach that significantly limits the useful range. New materials, such as Erbium, are now making direct generation of eye-safe wavelengths possible. To provide naval gunfire against hard, mobile targets in areas where no forward observers are available, we need a small laser designator, suitable for use in an expendable air vehicle that is only 30 inches long. For the weapon (a five-inch guided projectile) we need a matching receiver. The receiver should be able to function in a spinning or non-spinning projectile. Both the air vehicle and the guided projectile must withstand gun launch forces, so mechanical designs that have no moving parts or very simple, robust mechanisms with reduced moving mass on are needed. Range needed is 3 km from designator to target and 2 km from target to projectile. Ability of the designator to operate as a range-finder is desirable. The illuminator should operate in the eye-safe wavelength such as 1.55 ìm. The designator and receiver must support coding of the designation signal, to permit multiple designators to operate in the same area. Additional installation of the illuminator is possible onboard ship, where a range of 19 km designator to target and 2 km target to projectile is desired.

PHASE I: Develop a system design, and demonstrate a bench version of the source, optics, and receiver.

PHASE II: Produce a hardened, form and fit prototype for flight test and document design.

PHASE III: Production transition will be to the expendable air vehicle and guided projectile described above. Additional transition opportunities to larger UAVs are possible for a designator with a longer range.

COMMERCIAL POTENTIAL: The most direct commercial application is in range-finding for surveying and cartography. The added range available from a directly-generated eye-safe laser will permit measurements from aircraft or remote sites without the need to place retroreflectors on the surveyed points. Other laser tracker, laser range-finder, and laser illumination applications, such as laser radars used for aircraft flight research and laser inspection systems for road surface and elevated roadway inspection, would also benefit. Applications are also

possible in point-to-point data links to moving vehicles, in metrology, and industrial process control using Raman spectroscopy. This topic itself leverages the commercial developments in erbium-doped fiber amplifiers developed for the telecommunications industry.

N96-087TITLE: Composite 5"/70 Barrel Component for MK-45 Gun Upgrade

OBJECTIVE: The objective of this topic is to advance the state-of-the-art in composite materials in the areas high amplitude cyclic pressure fluctuations, and resistance to high temperatures (800 F) for use in development of a stretched 5"/70 caliber barrel for the MK45 gun that has basically the same moment and moment-of-inertia as the current 5"/54 caliber barrels.

DESCRIPTION: With the ongoing Naval Surface Fire Support (NSFS) Program, the need for an extended length barrel has become apparent. This comes from the goal of developing an upgrade to the 5" Mk45 gun that will produce muzzle energies in the 18-22MJ range. Increasing muzzle energy of the gun requires enhanced propulsion charges. This means more energetic propellant in larger volumes. A longer barrel is required to allow sufficient in-bore volume for complete combustion of the propellant and expansion of propellant gases to keep muzzle exit pressure within the allowable shipboard limit. The longer barrel also allows the pressure to act on the projectile for a longer time, thus producing a higher muzzle velocity (higher muzzle energy) even with the existing propulsion charges. The purpose of this SBIR is to investigate the use of high strength graphite composite material as an overwrap on a significant portion of a reduced thickness barrel near the muzzle will allow a 70 caliber barrel to be fabricated with similar weight, moment and moment-of-inertia characteristics to the current 54 caliber barrels. Such a barrel would eliminate the need for major modifications to the train and elevation drives of the Mk 45 gun system that would be necessary with a similar steel barrel. Thus, making the barrels interchangeable. Current commercial applications for pressure vessels deal largely with steady-state pressure systems which undergo only small pressure fluctuations, thus not bringing about the fatigue problems commonly present in gun barrels. These vessels are used for low temperature operation only, due to degradation of the epoxy binder at high temperatures. The goal of this effort is to develop composite materials, fabrication methods and design methodology that produce a pressure vessel that can withstand both the fatigue loading and the high temperatures present in gun barrel applications.

PHASE I: Explore the design methodology, materials requirements, manufacturing requirements, and required verification test series necessary for development of a 70 caliber composite overwrapped barrel for use with the Mk 45 system. The barrel must withstand the proposed muzzle energy upgrades, and yet be compatible with the current ammunition and firing rates. Special attention must be given to the thermal loading resulting from sustained firing through a single barrel. The results of this phase should be a barrel design with a corresponding development test program.

PHASE II: Using the chosen design from PHASE I a barrel will be developed.

PHASE III: Complete engineering development of the barrel, producing a commercially manufacturable unit that has been integrated into an upgraded MK 45 gun system.

COMMERCIAL POTENTIAL: The largest commercial potential for this technology would exist in the chemical, nuclear, automotive, and aircraft industries. Commercial uses of this technology would exist in high temperature fluid flow and collection apparatus, especially portable systems that require light weight components. With both high temperature capabilities and high resistance to fatigue, these materials could play a major role in development in lighter, more efficient automotive and aircraft engine components. Suspension and drive train components would also be prime candidates for this technology.

N96-088TITLE: Inertially Guided Micro-machined Navigating Device with Application to Submunitions

OBJECTIVE: Capitalize on the coming large-scale availability of micro-machined accelerometers to develop inertially-navigating devices that can increase their accuracy by calibrating themselves against the Global Positioning System or other more accurate sources. The specific military application will be an inertially-guided

submunition that can be carried in a larger, GPS/inertial guided airframe. The submunition will align its own low-quality INS to the carrier's GPS/INS, so that when released, it will guide itself to its aimpoint.

DESCRIPTION: Micro-machined inertial components (accelerometers and gyroscopes) are projected to be available in large quantities at very low cost, due to the demand from the automotive industry. Detroit will be using these sensors primarily as rate sensors: for example, to measure deceleration for air bag deployment or turn rate for active skid control. But these sensors can also be used in a military-style inertial navigator, provided they can be accurately calibrated and initialized. Such navigators can then be used for military and commercial navigation applications, and would be particularly useful where other more accurate navigation is sporadically available. In the military application, this situation occurs when a GPS guided projectile encounters jamming, or when a submuntion is released from a carrier vehicle. In the commercial sector, GPS becomes unreliable in cities, in the canyons between tall buildings, because of multipath, and under heavy tree cover.
The Naval Surface Fire Support (NSFS) program is developing gun projectiles and missiles that will use the Global Positioning System (GPS) and inertial navigation for its guidance. If a submunition were equipped with a low cost inertial navigator based on automotive-grade micro-machined inertial technology, and a comparably low cost control system, it could align its navigator the high quality GPS/INS of the carrier vehicle, and when released, fly for a limited time with enough accuracy to hit 80 percent of the targets in the NSFS target set. Such an Inertially Guided Submunition must operate to meet the following specifications: Submunitions must survive a 30,000 G gun launch from a 5"/54 gun to 63 nautical miles. The submunition will be released up to one minute before target impact. On release it will be able to divert 2 kilometers from its ballistic impact point, and have sufficient additional control authority to compensate for environmental effects such as wind. Required accuracy is 3–15 meters (taking the carrier's GPS/INS as truth). Submunitions will be dispensed at Mach 0.8 or below, either individually or in clusters, with each submunition individually and separately targeted. Payload is not to exceed 0.5 kilogram. The primary objective is to produce a low cost submunition design with a simple control mechanism.

PHASE I: Develop a design approach and concept which best meets the goals of performance and cost. Demonstrate in a simulation the resulting accuracy.

PHASE II: Fabricate a brass-board Inertially Guided Micro-machined Navigating Device submunition and document its design. Perform ground and flight tests to verify its performance. Demonstrate gun-launch survivability in an air gun.

PHASE III: Convert the Inertially Guided Micro-machined Navigating Device submunitions brass-board design to a producible form. Transition would be to the Naval Surface Fire Support program, with additional possibilities in strike warfare.

COMMERCIAL POTENTIAL: Low cost miniature inertial sensors, the primary sensor to be developed under this activity, have extensive potential commercial application in measuring and controlling manufacturing processes, general aviation, robotics, industrial automation, medical electronics, sport fitness equipment, personal computer mice, virtual reality, and toys. Integration of commercial inertial measuring components with military-derived navigation methods will provide navigation and position-recording capabilities for automobiles, surveyors, hikers, outdoor workers, and equipment, even when GPS and other external navigation sources are not continuously available. One specific application illustrates this demand: Hikers and other outdoor workers are currently buying GPS navigators in large numbers, but still must carry magnetic compasses because GPS does not have a gyroscope or compass capability. However, the GPS position history can be used to calibrate an inertial navigator that would provide compass, horizon, and vertical measurements, with the added benefit that these measurements would not be affected by the deviation and variation errors of a magnetic compass. The low-cost inertially-guided submunition itself would be applicable to commercial low-velocity projectiles, such as line-throwing guns for sea rescue, tear gas canisters, and non-lethal law-enforcement equipment. (Because of their low velocity, these devices are currently very inaccurate.) Note that the navigation capability is itself dual-use (both military and commercial applications for the navigator), and combines spin-on (use of commercial-grade micro-machined devices from the automobile industry and the underlying commercial silicon production base) with spin-off (use of inertial sensors for navigation, plus the ARPA investment in micro-machining technology).

REFERENCES:
1. Elwell, John, "Micromechanical Inertial Instruments for Commercial and Military Application", 50th Annual Meeting, Institute of Navigation, June 1994

2. Elwell, John; Publicover Joseph, "Silicon Instrument Technology-Strategic Applications" (Secret), AIAA Missile Sciences Conference, Nov 1994

N96-089TITLE: Oscillator Stabilization In Shock And Vibration Environments

OBJECTIVE: To design and develop a Stabile Master Oscillator (STAMO) which can perform without degradation in the adverse shipboard environment of shock and vibration.

DESCRIPTION: Several existing and proposed radar systems are limited in performance by oscillator noise side bands created by the shock & vibration environments (e.g., gunfire, engine vibration, g-forces, missile launches, road shock, etc). Improved STAMO's are needed for use in Radar and Communication equipment that will perform without degradation in severe shipboard environmental conditions.

PHASE I: Evaluate design concepts for the improved STAMO. These concepts may include unique resonator designs, special mechanical mountings and/or feedback to the oscillator circuit from environmental sensors. Shall address the critical technical issues.

PHASE II: Develop several models of the STAMO and test under various conditions of shock and vibration.

PHASE III: The STAMO design shall be matured for production.

COMMERCIAL POTENTIAL: Stable oscillators are required in many radars, communication, telemetry and measurement systems. In military systems, severe environmental conditions are expected. However, with the explosion of commercial mobile communications and more sophisticated commercial telemetry, the need for precise performance in hostile vibration environments has increased dramatically. Development of a good technique could make many new applications feasible.

REFERENCES: V. A. Rosati and R. L. Filler, Reduction of the Effects of Vibration on SC-Cut Quartz Crystal Oscillators, Proc. 35th Annual Symp. on Frequency Control, pp 117-121, 1981.

N96-090TITLE: Signal-to-Noise Ratio Meter

OBJECTIVE: Develop a signal-to-noise ratio (SNR) meter for use in microwave component development and advanced radar systems design.

DESCRIPTION: The Navy solicits proposals to facilitate the incorporation of microwave SNR measurements in the design of active radar systems. The successful applicant shall develop an economical meter which displays the total signal-to-noise ratio (SNR) of pulsed and continuous microwave signals and/or the degradation of the SNR caused by microwave components. The meter shall measure the compensated Moving Target Indicator (MTI) and pulse doppler performance of pulsed radars. The design of the meter should meet the following requirements: 1) Accuracy (±0.1 Db); 2) Resolution (±0.01 Db); 3) Measurement time (1 second (maximum)); and 4) SNR range (90 to 160 dBc/Hz minimum).

PHASE I: Shall develop and evaluate several design concepts for the proposed meter. The designs shall address the technical and operational tradeoffs, including the following requirements: 1) SNR dynamic range maximization; 2) r.f. noise bandwidth range; 3) separation of AM and PM noise; 4) correlation of AM and PM noise, 5) noise spectra (AM, PM and total); and 6) spectral aliasing. The analysis and design shall be in sufficient detail to indicate a good probability of success under PHASE II. An optimized design to be tested in PHASE II shall be fully described in a final report.

PHASE II: Should provide a high-quality versatile SNR meter for an on-going NAVSEA program. A prototype of the SNR meter shall be fabricated, tested, demonstrated and evaluated. Test results shall be compared with those obtained by existing conventional techniques for accuracy and speed of response.

PHASE III: The design shall be matured for production. Full development for commercial, military and university research applications is envisioned. Target commercial industries include communications, aerospace and remote sensing industries.

COMMERCIAL POTENTIAL: Strong commercial potential exists. The continuous monitoring of SNR in microwave components can be utilized for many applications (design, production and repair) in both military and commercial applications. The meter will enable microwave engineers to improve the quality of their designs and to produce lower noise components. The meter will also enable continuous monitoring of the stability of these microwave components and alert the operator if corrective action is required.

REFERENCES: Goldman, Stanley, "Phase Noise Analysis in Radar Systems," 1989, John Wiley & Sons.

N96-091TITLE: Nanosecond Opto-electrical Switches

OBJECTIVE: To design, demonstrate and develop reliable electrically-controlled opto-electrical switches suited for fiber optic microwave delay line applications.

DESCRIPTION: Opto-electrical switches are needed for time delay beam-steering for future wide-band active radar systems. Current photonic beam-steering applications are limited by large insertion losses and poor switch performance, either with respect to cross-talk or switching speed. Configurations to be considered include: Single Pole Single Throw (SPST), Single Pole Double Throw (SPDT), and Double Pole Double Throw (DPDT). The following technical objectives are needed in an opto-electrical switch:

(a) low insertion loss / polarization sensitivity
(b) high optical extinction (greater than 40 Db)
(c) nanosecond switching times
(d) operation at 1310 nm and 1550 nm wavelengths
(e) small size and light weight
(f) low switching voltages
(g) potential intergradation with other devices, such as electro-optic modulators and wide-band photodetectors
(h) stable characteristics over a wide temperature range
(i) stable characteristics over long operating times
(j) low cost

PHASE I: Conduct and document a comprehensive survey of the state-of-the-art technology in electrically controlled electro-optic, magneto-optic and acousto-optic switching. Based on the results of this investigation, the contractor shall provide one or several design options which address the technical objectives in an opto-electrical switch. A hardware demonstration would be desirable.

PHASE II: Selected switch(es) shall be manufactured, tested, demonstrated and delivered for a NAVSEA fiber optic delay line. Test results shall be compared with state-of-the-art technology.

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: Opto-electrical switches are widely used in analog and digital fiber optic communications and data links, sensor arrays, fiber gyroscopes and optical computing applications. In addition, there are potential markets for photonic radar beam-steering and delay-line technology in the civilian aerospace and telecommunications industries.

REFERENCES:
1) Henry Zmuda, and Edward N. Toughlian, *Photonic Aspects of Modern Radar*, (Artech House, Inc., Norwood MA 1994) chapters 13, 17; 2) John E. Midwinter, *Photonics in Switching* (Academic Press, Boston 1993); 3) Robert G. Hunsperger, *Integrated Optics: Theory and Technology* (Springer-Verlag, New York 1991).

N96-092TITLE: NTDS Archival Tool Using RAID Technology

OBJECTIVE: Develop a system using Random Array Independent Disks (RAID) hardware and software that replaces low performance/storage capacity NTDS peripherals with higher performance, flexible archive workstation systems. One archive workstation will replace between 8 and 16 NTDS peripherals , such as RD-358 or USH-26. Additionally, the archive workstation will provide access to commercial support management (HSM) software, which will migrate collected data from disk to tape based on a user-specified migration policy.

DESCRIPTION: The archival tool will allow all communications between NTDS computer systems to be captured by a high performance microcomputer workstation, such as a Pentium or SPARC based system. Interfacing hardware is currently available using off-the-shelf NTDS cards for all NTDS interface types, serial and parallel. The archive workstation will assemble the captured data in a near-line high capacity RAID disk and, via the HSM software, will migrate it to tape as needed. A simple TCP-IP network will be established to allow commercial support computers to access the collected data. The HSM will move data from tape to disk, as required by support computer requests, to make the collected data appear as one consistent virtual file system.

PHASE I: Study requirements and methods for developing a system to meet the above objective and description. This will involve analyzing system configurations and performance requirements. Performance specifications for tape and disk drives, NTDS interfaces, and the archive workstations will be identified. Data acquisition, storage and migration will be determined. NTDS communication requirements will be measured. An archive workstation prototype will be demonstrated which contains 2 NTDS interfaces, a small near-line disk, a commercial tape device and the HSM software.

PHASE II: Continue archive workstation development needed to archive data for one or two complete AEGIS elements, i.e. C&D and WCS. A sophisticated tape storage handling system, using one or more robotic changers, will be added to the PHASE I system. In addition, higher performance network connections, such as HiPPi or FDDI, will be used for communication with commercial workstations.

PHASE III: Expand into multiple AEGIS elements and additional support computers. Prepare land-based development, testing, training and integration sites for installation of complete archive workstation.

COMMERCIAL POTENTIAL: Other systems could be developed that collect data from other interfaces or networks. For example, the NTDS interfaces could be replaced with MIL-STD-1553 or ethernet interfaces. Almost any market that includes computer technology would benefit from the use of archival technology. The ability to store large amounts of data and to have that data on-line for retrieval would be a great benefit and in some case, a necessity, to systems used in these markets.

N96-093TITLE: Standard Forth Generation Language for Interface Specification and Simulation

OBJECTIVE: The objective of this topic is to develop a fourth generation language (4GL) which can describe and simulate software protocols over military and commercial communications channels. The 4GL will automate the design and specification of a software protocol including the message structure, syntax and operational sequence for both "sides" of the interface. Once a software protocol has been specified, the tool can simulate either "side" of the interface using commercial hardware interface cards. Such a tool allows more complete specification of interfaces, more thorough analysis of existing interfaces and a powerful development tool for assessing impact of baseline upgrades and modifications.

DESCRIPTION: Demands increase every day for new hardware interfaces needed to implement new data communication requirements. It is becoming increasingly cost and time prohibitive to purchase specialized simulation equipment whose sole function is to exercise one interface. Because of the growth in the data communication technology, in software and hardware areas, more powerful tools are needed to specify, design, test and simulate new software protocols as improved hardware/communication technology becomes available. This need is further justified after systems specification and development, during life-cycle maintenance and field support, where interface problems account for an increasingly large percent of installation and operational problems.

PHASE I: Determine techniques for specifying software protocol in terms of messages, message content, data validation, and sequential exchange of messages. This level of effort should provide a prototype to define the interface specification language, as well as define a standard operating procedure.

PHASE II: Using the design from PHASE I, develop a working interface using existing hardware and software interface requirements specifications for one AEGIS and one commercial interface which requires complex data simulation logic.

PHASE III: Fully implement the project into a commercially existing application and demonstrate its ease of use.

COMMERCIAL POTENTIAL: The commercial market potential for this product is unlimited, as demonstrated by the large number of emulator, testers and analyzers currently available and presently being developed. Additionally, any time a need arises to integrate two pieces of hardware with a communications channel, data will have to be formatted in order to test the hardware. High speed data collection systems gathering external source data will have the need for this interface.

N96-094TITLE: MCM Dynamic Planning Tool

OBJECTIVE: To develop a computational tool that provides near real-time estimates of a minefield's penetrability and casualty production potential. Used as a component of CSS's tactical expert system, this tool will allow the user to dynamically manage minesweeping operations.

DESCRIPTION: Minefields are a major obstacle to naval operations in littoral waters. There is great need for a capability of dynamically planning mine countermeasure operations that are designed to minimize the effect of minefields on missions such as amphibious assault, etc. A crucial component in meeting this need is a dynamic planning tool that incorporates updates in intelligence, surveillance, reconnaissance data as they become available, to produce a near real-time quantification of the effects on penetrability and casualty production of a specified set of minesweepers in operation for specified amounts of time; and the relationship among the risk of casualties, minesweeping assets committed, and time allocated for minesweeping. This tool must accommodate the operational characteristics of hostile mines, including such features as sensitivity, ship-counter, and arming-delay settings. It must be suitable for execution on a high-end desktop computer (such as a pentium-based pc).

PHASE I: Develop, describe, and illustrate the architecture of the dynamic planning tool. Documentation is to include textual/block diagrammatic descriptions of the analytical approaches taken in problem formulation and definition (formulated in cooperation with CSS) of two fully functional demonstration modules (‘limited scope" / ‘full scope’) that can serve as prototypical examples for proof of concept.

PHASE II: Develop a prototypical dynamic planning tool that implements the architecture specified in PHASE I in the form of a program that executes on the aforementioned high-end desktop computer. Within, respectively, one year/two years after PHASE II commences the ‘limited scope’/’full scope’ demonstration modules defined in PHASE I are to be fully functional. Deliverables are: (i) a technical report that updates and expands the documentation given in PHASE I by interrelating system variables and parameters; (ii) all procedures and algorithms are to be provided in a form appropriate for immediate encoding into a target language by a CSS programmer experienced in the target language; (iii) a user’s guide that includes a symbol dictionary defining all input and output variables, program constants and parameters, source listings of all programs, and sufficient test case data for verification purposes.

PHASE III: Expand the scope of the planning tool so that it can be used in the dynamic planning of sea mine clearance operations in support of an amphibious assault. The tool is to be placed in a form so that it can immediately be transitioned, as a fully functioning component, into CSS's tactical expert system analysis tool for MCM systems. Complete documentation with algorithms and procedures is to be of the same form as that described in the PHASE II.

COMMERCIAL POTENTIAL: The analytical approaches and computational procedures developed for formulating and solving the nonlinear optimization problems associated with this particular application should be applicable to a variety of other applications not limited to the software development industry.

N96-095TITLE: Real-Time Pixel Array Processing Architecture (PAPA)

OBJECTIVE: Develop and fabricate a real-time image processing architecture. The architecture must be capable of handling high-speed military applications, using sensor arrays of 512 x 512 or greater.

DESCRIPTION: Mine reconnaissance using an autonomous underwater vehicle (AUV) requires extremely powerful computing capability. Presently, much of the data gathered in the field must be processed off-line. Typically, the images obtained are of 512 x 512, or lower resolution, and many image processing algorithms operate on smaller submatrices of the image. Use of either a parallel processor architecture or an array of optimized, dedicated pixel operation units (POUs) might provide the necessary computing power to allow the required real-time processing capabilities.

PHASE I: Propose a design to meet the requirements based on available technology. An order of magnitude estimation of the computing requirement is that if the calculations were to be performed by a single processor, that processor would need to perform tens to hundreds of GFLOPS (billions of floating point operations per second).

PHASE II: Implement the design proposed in PHASE I. Fabricate, package, and test the prototype design. Upon successful completion of testing, evaluate the design for incorporation into a specified weapon with regard to the required parameters. Required specifications will be supplied by the Magic Lantern Program at NSWC/DD/CSS.

PHASE III: Fabricate and package preproduction samples suitable for field testing in both military and target applications. This product will transition into the Magic Lantern, and Mine Reconnaissance Programs.

COMMERCIAL POTENTIAL: The PAPA has application in manufacturing process control using machine vision, quality control using automated visual inspection, medical imaging, automated guidance systems, and automatic target recognition where many images must be processed and/or computation-intensive image processing algorithms must be performed in a short time.

REFERENCES: "Annual Proceedings Of The International Conference On Pattern Recognition" available through DTIC.

N96-096TITLE: Wide Dynamic Range Absolute Pressure Sensor

OBJECTIVE: A pressure sensor is sought which uses micromachining technology for oceanographic research for Naval mines. The particular effort is to develop an absolute pressure sensor to avoid the costs of a liquid backfill. The physical and electrical interfaces must match existing Navy underwater data collection systems. The sensor must be environmentally rugged.

DESCRIPTION: Measurement of small amplitude pressure changes in deep water typically requires a differential technique using a liquid backfill to counter the high static pressure. The hydraulic low pass filter subsystem of the sensor is typically bulky and expensive to produce. Additionally, silicone oil in backfilled sensors is susceptible to voids below -40 degrees F, reducing storage and delivery options. Micromachined silicon pressure transducers offer the capability to detect low frequency (0.5 to 250 millihertz), absolute pressure changes of 0.05 inches peak-to-peak in water to 600 ft depths. To measure acoustic signals (2 to 500 Hz), 120 Db dynamic range is required. Sensor and electronics fit within a cylinder of approx. 2 inches diameter and length. Power consumption is limited to 2 mW from a 5 to 7.2 VDC supply. Thermal gradient error for a water temperature ramp of 5 degrees F over 20 minutes must not exceed 0.2 inches water pressure. The sensor must survive shock, vibration and temperature environments.

PHASE I: The vendor shall prepare a report demonstrating the feasibility of a micromachined absolute pressure sensor to meet Navy needs. Micromachined transducers elements and electronic interface circuitry shall be fabricated to demonstrate the proposed concept by pressure tests in the laboratory.

PHASE II: The vendor shall design and fabricate twelve (12) absolute pressure sensors suitable in form, fit, and function for response and environmental testing in the lab and at sea. The sensors are for evaluation in NAVSEA- and ONR-sponsored R&D programs.

PHASE III: The sensor, upon meeting Navy requirements, will be transitioned into the NAVSEA-sponsored mine improvement program. The final design shall be produced in quantity for full evaluation for production and use in Naval mine programs.

COMMERCIAL POTENTIAL: High quality, mass producible absolute pressure sensors can be used in numerous industrial applications: e.g., oil tank seepage detectors, tank fill depth sensors, barometers, altimeters, tsunami detectors, tide gauges. This sensor may make possible many other academic and industrial applications.

REFERENCES:

1) Bryzek, J., K. Peterson, and W. McCulley, "Micromachines on the March," IEEE Spectrum, May 1994, pp. 20-31.

2) Gabrielson, T., "Mechanical-Thermal Noise in Micromachined Acoustic-Vibration Sensors," IEEE Transactions on Electronic Devices, Vol. 40, No. 5, May 1993, pp. 903-909.

N96-097TITLE: VMEbus Supportability/Test Software Tools

OBJECTIVE: The objective of this project is to research and develop innovative methods that are independent of specific users and vendors to address life cycle support issues associated with VME architectures. The intent of this objective is to potentially develop universal VMEbus test software tools to assist DoD users with VME Bus testability Life Cycle support problem.

DESCRIPTION: The use of VMEbus circuit cards integrated into VMEbus based architecture systems is now widespread throughout DoD. As the utilization of VMEbus based systems becomes more widespread, there exists the potential for proliferation and duplication of on-line/off-line test software to provide VMEbus supportability. Although most test and diagnostic software requirements for VMEbus systems are strictly application specific for each user and vendor, VMEbus interface logic and open system architecture are well defined with common standards. The solution presented in this project is to research and determine standard VMEbus interface logic and commonality that are independent of specific users and vendors. If sufficient standards and commonality are identified and quantified, the intent is to develop VMEbus test software tools that can be used universally regardless of unique system application. By developing universal VMEbus test software tools and making them generic enough to cross system boundaries, potential duplication of VMEbus test software within DoD can be avoided.

PHASE I: Explore VMEbus architecture and interface logic standards to identify, define and quantify common parameters that are independent of specific users and vendors, and determine the feasibility to develop VMEbus-test software tools to test VMEbus circuit cards in a VME chassis in multi-user multiple configurations. Study DoD utilization of VMEbus architecture systems to determine most commonly used VME circuit card technologies (e.g. DSP, Serial I/O, Memory). Recommend tests for each specific VME circuit card technology which are independent of specific vendors. Provide analysis of VMEbus supportability benefits that may result from development of universal VMEbus-test software tools. Provide analysis of application of universal VMEbus-test software within DoD to determine if potential duplication of effort can be minimized. PHASE II: Develop VMEbus-test software tools that specifically address the common and standard VMEbus parameters defined in PHASE I. Procure a VME chassis to use as VME test bed and identify, for Government selection, specific VMEbus circuit card technologies that are the best and the worst candidates to be tested. Design and develop user-tailorable (to meet application specific requirements) VMEbus-test software tools, for the Government-selected candidates, to support VMEbus circuit card technologies in multi-user defined VME chassis configurations. Apply and demonstrate VMEbus-test software tools for the selected VMEbus prime system. Provide an Economic Analysis (EA) in the use of universal VMEbus-test software tools in conjunction with application specific test software development versus traditional VMEbus test software development. Report shall be submitted 6 months after award.

PHASE III: Utilizing the VMEbus-test software tools developed under PHASE II, build and integrate VMEbus software into on-line/off-line software diagnostics of designated VMEbus Navy systems. Incorporate

VMEbus test software as part of the prime systems Performance Monitoring/Fault Localization (PMFL) and self-test capability. Manufacture a VMEbus chassis test bed to support testing of VMEbus circuit cards. Build VMEbus chassis test bed software utilizing the tools developed under PHASE II. Construct VMEbus chassis test bed and software to support multiple user and multiple VMEbus system configurations. Establish a Navy-wide VMEbus supportability program. Setup infrastructure to provide test software support for VMEbus based systems. Disseminate VMEbus test software and VMEbus supportability information to firms with potential commercial applications of Navy VMEbus-test software tools. Establish Navy nomenclature to Navy wide VMEbus-test software tools. Provide life cycle support and maintenance of such software. Provide VMEbus-test software tool to all Navy Programs acquiring VMEbus systems. Provide VMEbus chassis test beds and software to meet end-user requirements.

COMMERCIAL POTENTIAL: VMEbus architecture is an industry standard and is used throughout commercial industry. Potential applications include widespread use and potential further development by private industry.

N96-098TITLE: Enhanced Air Quality Management

OBJECTIVE: Ozone based air cleaning for removal of chemical and biological contamination.

DESCRIPTION: Current technology in ozone/air and ozone/water based cleaning and decontamination of air streams can be applied in Naval applications for controlled atmospheres to protect personnel and mission capabilities in theaters subject to threat of chemical and biological (C&B) warfare. Additionally, this technology has medical applications in the treatment of forces returning to the ship after exposure to viral or bacterial agents that must be isolated from ships general population.

PHASE I: Establish the feasibility of applying ozone based cleaning for air quality management (AQM) for human health and mission sustaining requirements. The study will result in identification of user environmental requirements. Define an AQM system which utilizes ozone as a means to react with chemical and biological agents in the air stream that could degrade mission capability by adversely affecting human resources.

PHASE II: Develop a preliminary design capable of processing ships airflow to result in adequate cleanliness with reference to C&B agents. Develop a demonstration plan for the adaptation of ozone treatment for AQM.

PHASE III: Fabricate, test, and validate an AQM system for submarine and shipboard use which utilizes ozone based treatment based upon the preliminary design completed in PHASE II.

COMMERCIAL POTENTIAL: Potential commercial applications include medical and hospital industries. These facilities are typically large buildings with controlled air which is partially recycled, requiring treatment to prevent spread of chemical or biological contamination. Medical facilities in general, will house a population with high sensitivity to airborne viruses.

N96-099TITLE: Reverse Osmosis (RO) Systems Applications

OBJECTIVE: Develop innovative RO System component designs.

DESCRIPTION: The existing submarine RO design utilizes two positive displacement pumps. The first pump is used to pump 18.0 gpm seawater up to 900 psig. The second pass pump pumps 5.0 gpm freshwater up to the same pressure. Each pump measures 23 inches long and 18 inches high. The current pumps are plunger-type, positive displacement and require multiple desurgers to dampen the pulsations down to the point where the RO unit will meet the structure-borne and fluid-borne noise requirements for NSSN. Essential to the operation of the RO unit is the need to maintain a fixed flow (within plus or minus 3%) at the RO brine outlet. The existing submarine RO unit design accommodates this by dumping the brine to a tank (0 psig backpressure), from where it is then pumped overboard using a separate system. To reduce the dependency on other systems, and to reduce the volume and weight occupied by the RO unit and its associated systems, a Quiet Brine Throttle Valve (QBTV) is highly desired.

PHASE I: Based on identified technology, define the component designs and required system interfaces to meet desired performance. Develop technical, cost and schedule estimates and associated risks.

PHASE II: Perform detailed design of innovative RO components. Fabricate and demonstrate components to adapt to current submarine(s) system hardware.

PHASE III: Fully integrate the successfully demonstrated RO component technologies. Liaison with SBIR POC for land-based verification and validation and eventual at-sea testing.

COMMERCIAL POTENTIAL: Application to the design and development of new marine vehicle fresh water production system for oceanography research, cruise ship tour industry, and the merchant ship industry.

N96-100TITLE: Database driven 3D Compartment Arrangements

OBJECTIVE: Provide an automated 3D CAD arrangement tool for submarine compartmentation.

DESCRIPTION: The system will automate the manual compartment arrangement process embedding intelligence (historical data, design standards, and constraints) in the 3D CAD modeler. Current technology mainly involves CAD systems as modelers only; the design process involving data and constraints is done off-line. The system and process would be geared toward a networked multi-user environment.

PHASE I: Establish the feasibility of developing an automated 3D CAD arrangement tool for application to submarine compartmentation design. The study will result in identification of CAD and database technologies, 3D CAD performance parameters and functional requirement at a minimum.

PHASE II: Develop a preliminary 3D CAD submarine compartmentation arrangement tool design and demonstration and validation plan. Develop a prototype system using the technologies identified in PHASE I and test to the approved demonstration and validation plan.

PHASE III: Integrate the successfully demonstrated arrangement tool with other design tool technologies at a designated government facility. Incorporate historical data and existing standards requirements and demonstrate as a complete system.

COMMERCIAL POTENTIAL: Creating an intelligent CAD arrangement system would be widely applicable, e.g. building construction, commercial shipbuilding, and vehicle design. The target of this task is compartment modeling for submarines, but it would apply to any process involving automated compartment arrangements.

REFERENCES: NAVSEA 3D Product Modeling Guidelines

N96-101TITLE: Fuel Cell for Replacement of Submarine/ Battery Diesel Generator Emergency Power

OBJECTIVE: The objective of this topic is to replace the current submarine battery/diesel generator emergency power with fuel cells capable of increased energy density, low noise, and reduced recharging time.

DESCRIPTION: There are 126 nominal 2-volt cell lead-acid batteries currently used for emergency power in submarines. The current optimum lead-acid battery design delivers 1,500 kw for a one hour rate. The batteries have a 10 year life for 400 cycles. The volume occupied is roughly 1,000 ft^3, with a weight of about 100 tons. The lead-acid batteries possess high weight and volume characteristics that limit submarines with respect to size and maneuvering capabilities. Fuel cells have shown dramatic improvement in storage capacity over current batteries. Fuel cell stacks may be assembled to provide the desired dc bus voltage required to operate the submarine emergency power. Fuel cells are advantageous in terms of size, weight, performance, reliability, maintainability, efficiency and noise.

PHASE I: Develop a optimized fuel cell stack design (operable from Navy logistic-system fuel) and a proposed prototype fuel cell stack configuration based on available fuel cell technology.

PHASE II: Using the proposed design, fabricate and develop a prototype fuel cell configuration and perform validation testing at a recognized testing laboratory for fuel cells.

PHASE III: Transition the technology to the acquisition sponsor upon the successful completion of PHASE II.

COMMERCIAL POTENTIAL: Many commercial applications are suitable for fuel cells, ranging from mobile electrically powered vehicles to any stationary power generation application.

N96-102TITLE: Active Vibration and Acoustic Control

OBJECTIVE: Identify active systems for the control of the vibration of a geometrically-complex surface and to define, document and demonstrate design practices for an integrated surface material/transducer.

DESCRIPTION: Traditionally, the control of noise and vibration has been achieved by a combination of hydrodynamic design (to minimize the forcing function) and the use of passive vibration control. The passive control includes tailoring of material damping, geometric shaping, and the addition of mass. Further gains using passive techniques may need to be supplemented with other methods to meet the future requirements of marine vehicles. Active vibration control is such a method that has been demonstrated in selected cases to have the potential for significant improvement in surface vibration control. It is desired to generalize the application of active vibration control. The objective of this effort is to demonstrate the design of a submerged system capable of creating at least a single order of magnitude increase in surface normal displacement over a 50-2000 Hz band width. This will require the development and demonstration of high power density actuators, sensing devices and a control approach. It will also require the development of fabrication procedures to permit the incorporation of the components into a surface structure. It is important that the transducer installation not compromise the structural integrity of the surface. The design practice used to define the system must be clearly documented to permit the design of other surface, material, and transducer arrangements.

PHASE I: Based on identified technology define a practice to design, fabricate and evaluate the actuators and sensors required to provide the desired performance. Also define the hardware and software required to control the method.

PHASE II: Demonstrate and document the design practice necessary for the definition and fabrication of a transducer/surface arrangement. Design and fabricate a system for evaluation in a controlled flow environment. Validate the design practice and demonstrate the performance of the control system, and its limits of performance.

PHASE III: Integrate the successfully demonstrated component technology with other vehicle performance technologies by designing and demonstrating a noise and vibration control system.

COMMERCIAL POTENTIAL: Application to the vibration control of marine vehicles for oceanography research and commercial shipping, aircraft and land-based vehicle cabin noise control, and industrial machinery vibration control.

N96-103TITLE: Materials Research In Sliding Electric Contacts

OBJECTIVE: Improve the performance and decrease the material constraints, complexity and cost posed by the present state of the art metal fiber brushes.

DESCRIPTION: The sub-component that generally limits the power and torque density of direct current motors and generators is the sliding electric contact usually called a brush. These brushes are required to transport the armature current over a range of speed and current densities while providing minimum power loss and maximum wear life. Unfortunately, techniques and parameter adjustments which tend to minimize power losses, also tend to increase wear and vice versa. In conventional direct current machines the brushes must switch current across commutator bars. This current switching can lead to arcing which causes increased wear and general degradation of brush and machine performance.

Great strides have been made in developing metal fiber brushes for non-switching slip ring technology. The research effort described herein will explore and develop innovative materials and fabrication techniques which can be used to satisfy the requirements of a commutating metal fiber brush.

PHASE I: Develop innovative materials and fabrication techniques for fiber brushes in direct current machines. A report will indicate applied pressures, types of innovative materials, potential mechanical loads, frictional losses, brush wear and potential slip ring applications at high speed and high current densities.

PHASE II: Demonstrate the technologies identified in PHASE I. Define and document the fabrication techniques required to produce the brush technologies. Demonstrate the brush technologies and establish their potential operational capabilities.

PHASE III: Integrate the successfully demonstrated brush technology and fabrication techniques, fabricate an operational system and verify the performance

COMMERCIAL POTENTIAL: High performance brushes are an enabling technology for any advanced direct current electric machine. Principle applications include machinery which require high torque and loads which require high current. High torque electric motors are used in shredding machines, paper mills and punch press drive systems. Potential transportation systems include conventional electric trains, electric cars and magnetically levitated trains. Compact, high performance DC generators will have applications in the electroplating industry and pulsed electric welding sources such as used in offshore drilling industry. High current, low voltage dc electric machines will provide the most efficient, reliable method of utilizing environmentally attractive alternate low voltage energy sources such as derived from solar, thermoelectric or fuel cell technology. Low power applications also exist such as high quality instrumentation slip rings used for strain gauge or temperature measurement on rotating equipment.

REFERENCES:
D. Kuhlmann-Wilsdorf and D. Alley, "Commutation with Metal Fiber Brushes", in Electrical Contacts 1988, see also IEEE Trans. CHMT Vol. 12, pp. 246-253, 1989.

N96-104TITLE: Dynamic Control of Undersea Vehicles

OBJECTIVE: To develop a computational approach that describes the effects of advanced propulsor and appendages to control the motion of an undersea vehicles. To demonstrate the use of this approach in the design of a propulsor-appendage arrangement to provide a specified vehicle motion.

DESCRIPTION: Scale model experiments are performed to address a wide variety of problems related to the design of the appendages and propulsor that influence the control of the dynamic motion of undersea vehicles. The results of Captive Model (CM) and Radio Control Model (RCM) experiments are conducted to obtain data that are used in computer simulations to develop the submerged operating envelope (SOE), recommend ship control recovery procedures for selected casualties, and define ship control trainers. The consideration of advanced propulsor concepts (multiple propellers, pumpjets, etc.) and advanced control forces producers (multiple lifting surfaces, thrust vectoring, thrusters, force augmentation, etc.) indicate a significant, and as-yet, highly unpredictable effect on the vehicle motion. The ability to predict the non-propulsive forces generated by different propulsor and control force producing arrangements, including the effects on the ship in four-quadrant operation, is needed. There is also a need to be able to define new means for providing vehicle control forces.

PHASE I: Establish the feasibility of developing an analytical physics-based approach to predicting the effects of advanced propulsor concepts and control force producing arrangements on the stability, maneuverability and control of submerged platforms. This will result in the identification of realistic technical, cost and schedule factors associated with military and commercial applications; determining an approach using empirical, then semi-empirical and finally analytically based prediction capabilities to be pursued; and the identification of scale model experiments, predictive model development and validation/certification of predictive efforts.

PHASE II: Develop an analysis practice and demonstrate the component technologies identified in PHASE I and judged to provide a practical solution. Define and document the integrated design/analysis practice required to apply the component technologies.

PHASE III: Integrate the successfully demonstrated component technologies, fabricate an operational system, and verify the integrated performance.

COMMERCIAL POTENTIAL: Application to the design and development of new marine vehicles for oceanography research, commercial shipping and recreation boating.

N96-105TITLE: Depth Keeping Digital Algorithm for Control of Undersea Vehicles in Shallow Water

OBJECTIVE: To develop an innovative design digital "hovering" algorithm to integrate with existing undersea vehicle equipment and components to permit depth keeping in an littoral environment.

DESCRIPTION: The U.S. Navy Submarine Force has greatly increased their operations in littoral environments [1]. Currently, Navy submersibles including submarines and experimental platforms are being backfitted with a modified hovering control system using antiquated SSBN 640 Class analog components. There is an urgent need to upgrade these assets with state-of-the-art digital control which exhibits the following characteristics:
1. Capable of being used on various appendage hullforms.
2. Capable of accurate digital modelling of secondary wave equations and directional wave probabilities in a `brown water' environment. Perform necessary wave studies to verify and validate controller performance.
3. Capable of accepting various weights to be added to the various hullform(s).
4. Capable of adapting to current hullform system hardware configurations with minimal alterations.
5. Capable of applying artificial intelligence to improve system performance.

PHASE I: Review existing digital controllers and algorithms. Propose new design approaches for digital algorithms to meet required performance characteristics for depth control. Develop technical, cost and schedule estimates with associated risks.

PHASE II: Develop digital code which correctly models the shallow water secondary wave equations and predicts directional wave probabilities. Fabricate or procure and modify a digital controller to adapt to current submersible(s) system hardware and incorporate and execute the digital hovering algorithm. Demonstrate controller and algorithm.

PHASE III: Fully integrate the successfully demonstrated controller technologies. Liaison with SBIR POC for land-based verification and validation. Conduct Full scale at-sea testing.

COMMERCIAL POTENTIAL: Application to the design and development of new marine vehicle control systems for oceanography research.

REFERENCES: "From the Sea"

N96-106TITLE: Submarine Electrical Hull Penetrators/Connectors

OBJECTIVE: Develop electrical hull penetrators/connectors that will provide reliable transfer of electrical power through the pressure hull of submarines to externally mounted electrical devices.

DESCRIPTION: Increased use of electrical power on submarines requires the ability to locate electrical components such as actuators, propulsion motors, and auxiliary units outside the pressure hull. This requires the development of a range of electrical hull penetrators/connectors to transfer electrical power through the pressure hull. Requirements are for both 3 phase ac as well as dc power. Voltages to 5,000 volts and currents to 100,000 amps are being considered. Power requirements will range from actuator levels to main propulsion levels.

PHASE I: Review existing penetrator designs. Propose new design approaches for both high current low voltage and for low current high voltage applications. Document the work in a report to be delivered at the end of phase I.

PHASE II: Select candidate approaches based on phase I work. Design and fabricate prototype penetrators/connectors. Test the prototypes in a pressurized sea water environment at full rated current and voltage. Develop design approaches for full scale applications. Provide a preliminary design for the prototypes at the end of the design phase. At the end of PHASE II deliver the prototypes, a test and evaluation report, and the preliminary designs for the full scale penetrators to be developed in phase III.

PHASE III: Based on the results of the phase I and II work, design and fabricate full scale penetrators/connectors. Test the penetrators/connectors in a pressurized sea water environment at full rated current and voltage. Provide a detailed design report and drawings for the penetrators/connectors at the end of the design phase. At the end of phase III deliver the final penetrators/connectors and a test and evaluation report, and produce penetrators/connectors to meet Navy installation requirements to be identified.

COMMERCIAL POTENTIAL: Electrical penetrators/connectors are applied to deep submersibles and undersea oil exploration and production. They are also applicable to underseas power generation, and pressure vessels.

N96-107TITLE: Micro Electro-Mechanical Systems (MEMS) for Shock Physics

OBJECTIVE: Improve the capability to measure the response of submerged and partially submerged structures to underwater shock.

DESCRIPTION: Underwater explosions have long been characterized only in terms of their shock waves for purposes of assessing damage to structures in the water. Although the great damage potential of the "bubble" of gaseous explosive products has long been recognized as a source of significant target damage, lower frequency bubble effects were "designed away" by using stiff structures that tended not to respond to the relatively low frequency excitations imposed by the bubble.
Recent developments in computer technology have resulted in development of highly efficient numerical procedures which permit accurate theoretical predictions of the motion of the water surrounding an underwater explosion; give approximate descriptions of the interaction between the responding structure and the water, and describe the response of the structure. The mathematical models developed using these modern computerized numerical procedures are difficult to create and always require experimental validation prior to use in ship design. Recent ship designs have relied heavily on mathematical models which have identified vulnerabilities to low frequency bubble loadings and bulk cavitation closure loadings. Experimental validation is essential.
Instrumentation currently used in underwater explosion response experiments was originally designed fifty years ago for of producing high frequency data associated with the shock wave of an underwater explosion. Recent innovative modifications to accommodate late time, low frequency responses of both the free field and the structure continue to fall short in some category, e.g a gage that moves with the fluid.

PHASE I: Establish the feasibility of using Micro Electro-Mechanical Sensors (MEMS) for data acquisition of underwater shock events. The report should identify realistic technical, cost and schedule factors associated with military and commercial applications, determining test instrumentation capabilities, identifying upgrades to test instrumentation for validation of physics-based codes and recommendations for further studies.

PHASE II: Develop a preliminary design of and demonstration plan for a MEMS. Perform demonstration/proof of principle subsystem tests to establish sensor sensitivity with respect to measurement capability and resistance against shock and accelerations, power consumption and type of source and frequency response and duration of response.

PHASE III: Integrate the successfully demonstrated MEMS subsystem technology, fabricate a full scale operational system and verify its performance.

COMMERCIAL POTENTIAL: There are many possible uses for the technology developed under this SBIR Topic. Some potential applications include: (1) diving & salvage, (2) rescue teams (i.e. fire fighters, divers, Search And Rescue, etc.), and (3) seismic event data acquisition. In addition, there are benefits in transferring this technology to ecological and recreational sources.

N96-108TITLE: Permanent Magnet Motor Systems

OBJECTIVE: Design and construct affordable Permanent Magnetic variable speed (PMVSD) motors/drives for auxiliary applications in US Navy submarines.

DESCRIPTION: Permanent Magnet (PM) variable speed drive (VSD) motors promise favorable ship impact if they can be substituted for hydraulic systems and actuators in US Navy ships. Other uses include Heating, Ventilation and Air Conditioning (HVAC) and a whole range of small motor applications. Although PM motors are currently more expensive than induction motors of the same horsepower, they may offer improved efficiency, especially in applications which require large motor air gaps (e.g. flooded motors). This effort will investigate solutions to the affordability problem and construct several PM VSD systems to verify the results.

PHASE I: Estimate and report the impact of PM VSD systems in auxiliary applications in US Navy submarines. The following should be considered in the study: (1) level of current and future technology in the area of PM materials and power conditioners, (2) impact of standardization of equipment and systems simplification, (3) reduction of piece part count, (4) impact on fuel efficiency of the ship, (5) impact on maintenance and operational flexibility, (6) impact on military effectiveness metrics such as quieting and survivability, (7) impact on component, module and ship size/weight, (8) impact on ship producibility, and (9) impact on US industrial base. Design to cost targets, a desirable range of applications and preliminary design detail should be established and reported.

PHASE II: Design several PM VSDs, having an expected favorable impact on auxiliary systems, from the results of the PHASE I study.

PHASE III: Construct prototype PM VSD for submarine qualification.

COMMERCIAL POTENTIAL: While phase I will quantify the effect on the US industrial base, PM VSD systems will be used in commercial applications such as HVAC systems in large buildings.

N96-109TITLE: Fire-Fighting Alternatives

OBJECTIVE: To develop effective, cost efficient, and non-toxic alternatives to existing fire-fighting systems on U.S. Navy surface ships and submarines

DESCRIPTION: U.S. Navy submarines and surface ships currently deploy a variety of fire-fighting alternatives, such as halon, seawater, and foam systems. New and improved alternatives are being explored for reasons such as:

- enhanced fire-fighting effectiveness,
- environmental concerns (e.g., CFC dispersion),
- reduced installation and maintenance costs,
- reliability,
- ease and safety of application, and
- volume requirements

Certain techniques, non-toxic gas systems, may take advantage of existing dispersion systems, thus reducing installation costs on existing vehicles. Candidate fire-fighting alternatives must demonstrate improvement over existing fire-fighting systems with respect to fire-fighting capability and other criteria as listed above. New nozzle and dispersion systems may overcome certain limitations of existing systems. Dispersion of non-toxic, ozone-safe gases (such as Lyumer-E) is an alternative, with potential benefits in terms of effectiveness, environmental concerns, system maintenance, and safety. Systems may involve either new development or technology transfer from existing applications in the United States or abroad.

PHASE I: Evaluate, quantify and develop candidate technologies for application in surface and subsurface vehicle fire-fighting systems. Document expected improvements over existing systems in terms of fire-fighting capability, safety, toxicity, anticipated installation and maintenance costs, system reliability, and compatibility with existing dispersion systems. Identify further test and analysis requirements. Conduct additional testing to verify the effectiveness of the proposed methods.

PHASE II: Create and demonstrate test prototype system for shipboard applications. Obtain Environmental Protection Agency (EPA) certification incident to transferring the technology to the United States. Develop and test prototype non-toxic gas and/or water-mist fire-fighting systems for shipboard applications.

PHASE III: Fabricate, validate and test candidate fire-fighting systems for submarines and surface ships, which utilize the results of the previous phases of this SBIR. Obtain any Environmental Protection Agency (EPA) certification necessary for sales for commercial ship, aircraft, and industrial applications.

COMMERCIAL POTENTIAL: Any military or commercial fire-fighting application. Potential customers include commercial ships (e.g., cruise ships, cargo ships, ferries), chemical and petroleum industries, airlines, and firefighting stations.

N96-110TITLE: Flow Noise Reduction Techniques to Enhance Underwater Sonar Performance

OBJECTIVE: Demonstrate techniques which reduce the effect of flow noise on the performance of sonar on underwater vehicles and weapons, and which permit effective operation at higher speeds.

DESCRIPTION: Sonar performance on undersea vehicles and weapons can be significantly degraded by turbulent pressure and shear fluctuations generated on the surface during underwater motion. Such fluctuations may be interpreted by the sonar as acoustic noise which masks actual acoustic signatures. This problem generally intensifies at higher vehicle speeds, with implications for both submarine stealth and vulnerability and also for underwater weapon maximum speed. It is desired to identify and exploit practical new techniques which will reduce the impact of pressure and shear fluctuations on sonar effectiveness, particularly for high-speed motion. It is desired to have the potential to actively tune the method applied for different operating conditions, according to optimization criteria which shall be developed as part of this effort. Techniques which may be considered include, but are not limited to, artificial cavitation, polymer ejection, and liquid jets. Some of these technologies may also be applied to enhance the performance of non-acoustic sensors.

PHASE I: Develop techniques which may be used to reduce the influence of flow noise on sonar performance. Provide recommendations regarding the most promising options. Describe mechanism of operation for most recommended technique, with estimates of effective increase of sonar performance with respect to a simple baseline (flat plate or axisymmetric body) based upon theory or preliminary experimentation. Identify potential concerns or limitations for practical implementation and report findings.

PHASE II: Experimentally demonstrate flow noise reduction concept in turbulent flow for at least one configuration and over a range of speeds. Validate optimization criteria developed in PHASE I. Based on concept success, develop design for application on full-scale underwater weapon or vehicle.

PHASE III: Fully integrate demonstrated technique into Navy underwater vehicle or weapon for full-scale testing.

COMMERCIAL POTENTIAL: Applications for enhanced performance of commercial sonar used for oceanographic research, treasure location, or search and rescue.

N96-111TITLE: Simulation Based Concurrent Planning and Development System

OBJECTIVE: Identify new and innovative techniques using state of the art hardware and tailored software for developing a system level modeling and simulation capability. develop a pilot implementation of this technology in a modular extensionable fashion capable of simulating Theater Area Defense Combat scenarios to be used by integrated product development teams of contractors and government personnel simultaneously.

DESCRIPTION: New innovative techniques such as embedded virtual reality, fuzzy logic and generalized optimization theories are needed for planning and developing these complex simulation systems. These systems need to address the current technological needs of current Theater Area Defense Combat scenarios while allowing the flexibility and growth needed for the future. They should also encourage, through their design a tighter coupling between top level designer, developer, and war fighters while allowing the implementing modelers, analysts (both contractors and government) to come together to concurrently develop requirements perform trade offs and design future complex systems.

PHASE I: Conduct an analytic feasibility study that proposes a system design, implementation approach and a demonstration plan.

PHASE II: Accomplish system design, develop the prototype technology and demonstrate the proposed technology as part of the PEO Theater Area Defense Combat SIMULATIONs.

PHASE III: Transition to ongoing and planned DOD and commercial distributed simulations.

COMMERCIAL POTENTIAL: Technology gained through this is directly transferable to high order commercial modeling systems especially those that involve complex multi-disciplined subsystems such as automotive, manufacturing, and chemical processing.

N96-112TITLE: Integration of Operational Simulation with Functional/Behavioral Simulations

OBJECTIVE: Develop a technology which will allow an operational simulation (comprised of interacting models) to stimulate a model of the system under development to disclose function and performance requirements and other system design parameters.

DESCRIPTION: Operational simulations are those which are used to exercise models of engagement for the purpose of determining survivability and probability of kill for a given platform in a given situation. Quite often, these simulations use other models to represent subsystems or environmental conditions. This is facilitated by protocols such as those defined by the IEEE for distributed simulations. The results obtained from such simulations are survivability and probability of kill. Functional/behavioral (F/B) models of systems represent the tasks that a system must perform in order to meet its requirements, and the absolute and relative timing, of those functions. Such a model can be exercised to determine whether indeed the design can meet the need. This creates a need to generate test scenarios which may or may not represent a real life situation, such scenarios are often geared toward worst case. This is problematic, since because the only question being asked is "what may cause a catastrophic failure", when the interesting question may be "how will the system react in a moderately loaded situation when the scenario changes in this way". To help answer this latter question, it is desirable to integrate an operational simulation of a combatant with the F/B model of a subsystem in such a fashion that the scenario of the first will load the second in a real life manner. In addition, this integration should be real-time and two-way; that is, a perturbation in the operational simulation should immediately change the load on the F/B model, and a change to the model (perhaps in response to an overload in the first case) should have an effect on the combatant in its simulated environment.

PHASE I: A PHASE I effort would produce a study of current tool and technologies which are appropriate for such integration; would propose a set of tools to integrate, along with an approach for the integration.

PHASE II: A PHASE II effort would produce either 1) a tool set which, when used in conjunction with various existing tools, allow the desired simulation capability; or 2) a set of tools which embed the desired technology. In either case, the approach and implementation would be documented to assist further work in this area. The effort would also produce a demonstration of the tools on an example to be determined.

PHASE III: A PHASE III effort would produce a commercial quality toolset or technology that can be applied to various domains and toolsets.

COMMERCIAL POTENTIAL: This effort will have potential in commercial procedural systems, such as factory production lines, and to commercial subsystems which support the procedural ones, such as robotics. It would allow for communication between operational engineers and electrical or mechanical engineers that will produce a system with known behavior in real situations.

N96-113TITLE: Methods for the Networking and Control of Military Data

OBJECTIVE: Develop a methodology and toolset for managing data in military applications sharing an intelligent high performance computing network.

DESCRIPTION: The Gulf War showed the need for a system for managing large amounts of surveillance and targeting data together with the assets which gather data. Data is supplied by satellites, Defense Mapping Agency maps, intelligence sources and local information from commanders and pilots, etc. A world-wide network for receiving and transmitting data and accessing complex networks of data bases is needed to manage data needed at a point of military action (Command and Control Center). A method for managing data which focuses in extensive real-time parallel computing and geographic distribution is sought, i.e., a way of combining high performance computing and a very high speed communications network. The exploitation of the potential of such an environment will require a new paradigm, supported by computer-aided tools, for transfer of real-time military applications from the present environment to the network. A key aspect of the paradigm is that it is used throughout the application life cycle. Simulation and optimization will be used for intermediate redesign for parallelism, as well as for selecting optimal allocation of resources at run time. The supporting toolset should be integrated to existing systems analysis and development tools (such as Computer Aided Software Engineering (CASE) and/or simulation and should complement existing technology.

PHASE I: Develop methods and demonstrate application in a Laboratory Network (Sun SparcStation Network).

PHASE II: Develop an automated prototype system, including software tools. Demonstrate the system using Navy Communication Data network such as Link 4a, Link 9, Link 11, Link 16, etc.

PHASE III: Improve prototype system and install on a Navy ship Command and Control Center for trials.

COMMERCIAL POTENTIAL: Applicable to large computer systems which need to share resources. Examples are communication (telephone) manufacturing and air traffic control.

REFERENCES:

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(2) Bowen, B.A., Brown, W.R., System Design: Volume II of System Design for Digital Signal Processing, Prentice-Hall, Inc., 1985

(3) Choi, D., Youngblood, J., Hwang, P., "Modeling Technology for Dynamic Systems", Proc. 1991 Systems Evaluation and Assessment Workshop, Aug 1991.

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N96-114TITLE: Methodology to Predict Ballistic Penetration and Damage of Composite Laminated Structures

OBJECTIVE: Develop and deliver a methodology to predict penetrator and target terminal ballistic responses for projectiles and warhead fragments impacting composite laminated structures. The methodology will also be applicable to Theater Ballistic Missile type targets.

DESCRIPTION: Current utilization of composite materials in air and surface weapons systems and structures is extensive, and the use of these materials is expected to increase in the future. Weapons effectiveness assessments and the design of protective structures require methodologies to predict the terminal ballistic interactions between projectiles and fragments penetrating composite laminated target structures at speeds up to 5 km/sec. Penetration and response models for isotropic, metallic and nonmetallic material are well developed. A similar methodology for application to orthotopic, laminated structures of fiber reinforced materials is needed. The methodology will be incorporated in a stand-alone computer program, and the Government shall be granted full license to employ and operate this computer software in multiple sites.

PHASE I: Identify principal penetrator and target response mechanisms, provide a limited demonstration of key concepts, establish an analytical basis for methodology development, and provide a detailed plan for methodology development. Report the methodology development plan and include full details on testing, computations, and other work required for PHASE II.

PHASE II: Develop objective prediction methodology for selected materials. The prediction methodology will be incorporated into a stand-alone computer program. Full documentation of the use of the code will be provided through a technical report.

PHASE III: Extend methodology to new materials and structures. Install methodology in commercial and government computer codes.

COMMERCIAL POTENTIAL: Commercial uses include predicting hazards and damage from terrorist actions against commercial aircraft and helping develop designs to minimize damage. The technology will be applicable to analyzing damage from flying pieces of failed jet turbine or other debris striking composite air frame and crew structures. The methodology also applies to evaluation of composites for use as light weight shielding to protect against inadvertent industrial explosions and rotating machinery (engines, flywheels, armatures, etc.) failures.

REFERENCES: Penetration Equations Handbook for Kinetic-Energy Penetrators (u) 61JTCG/ME-77-16, Rev. 1 - JTCG/ME, 15 October 1985

N96-115TITLE: Low-Cost, Lightweight Rocket Nozzle Materials for Tactical Missiles

OBJECTIVE: Develop a low-cost fabrication technique for continuous-fiber-reinforced ceramic matrix composite tactical rocket nozzles.

DESCRIPTION: Current tactical rocket motors utilize multi-segment nozzles with tungsten or graphite throats. Although both materials have provided satisfactory performance, significantly improved design flexibility, reduced cost, and reduced nozzle complexity (with attendant improved reliability) is believed possible with ceramic matrix composite (CMC) materials. The use of a low density CMC to replace tungsten would provide improved missile design flexibility from a weight/CG perspective. The replacement of graphite with a structural, oxidation-resistant CMC would also provide improved missile design flexibility from, a performance (range, velocity, etc.) perspective. With a low-cost fabrication technique, a one-piece CMC nozzle shell could reduce overall motor cost and improve system reliability. In addition, a flexible fabrication process for a broad range of matrix materials (carbides, borides) would provide for future nozzle needs by enabling the relatively simple optimization of nozzle composition. Thus, the nozzle material development cost could be kept low for future needs such as for advanced propellants (high-performance and/or environmentally benign) and advanced concepts (pulse motors, hybrid solid/liquid).

PHASE I: Identify a low-cost fabrication/processing approach for continuous-fiber-reinforced CMC nozzle shell geometries. Fabricate simple geometry components, such as rings or plates, and subject these components to critical mechanical testing to verify viable properties over the desired use temperature range. The PHASE I effort shall also show how the fabrication approach provides wide tailorability of the matrix composition.

PHASE II: Technologies required to demonstrate the fabrication/processing approach shall be developed and representative nozzle components shall be produced. A component demonstration plan shall be prepared which identifies a suitable demonstrator motor, identifies critical material properties, fabricates and characterizes sufficient material to confirm the material capability for the test. A representative motor demonstration test shall be performed.

PHASE III: The selected material shall be qualified for the selected motor application.

COMMERCIAL POTENTIAL: The developed material fabrication approach would have broad application to the manufacturing of low-cost, high-temperature structural materials. The technology could be applicable to advanced commercial gas turbine engines for aircraft or for power generation. In addition, the materials technology could significantly reduce the cost of advanced composites for satellite propulsion and earth-to-orbit vehicle applications.

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2. Baskin, Y., et al., "Failure Mechanisms of Solid Propellant Rocket Nozzles," Ceramic Bulletin, Vol. 39, no. 1, (1960), pp. 14-17.
3. Campbell, J.G., "Refractory Chamber Materials for N204/Amine Propellants," AFRPL-TR-73-31 (May 1973). (DTIC AD-762531)

N96-116TITLE: Photonic Controlled True-Time-Delay Wide-Band-Radar

OBJECTIVE: To develop photonic controlled true-time-delay components for an active, wide-band, phased array radar system.

DESCRIPTION: Due to the recent advance in Monolithic Microwave Integrated Circuit (MMIC) technology, the next generation Navy radar system may feature an active solid state phased array radar. The future need to consolidate Navy radar functions to reduce the number of antennas aboard a ship demands some form of the Shared Aperture Concept. The complexity associated with controlling the many thousand arrays elements, while handling the broad bandwidth of the shared aperture configuration, makes the marriage of photonics and microwave radar attractive. In particular, the envisioned photonic system will provide a True Time Delay Beam Forming Network, as well as phase and/or amplitude control of each individual element. An innovative photonic scheme to deliver the True Time Delay components is solicited. The emphasis is on compactness and control simplicity within the system.

PHASE I: Survey and compare the possible photonic sub-systems, and provide an optimal scheme with rational justifications for a complete system utilizing the sub-components. Provide a prototype system design.

PHASE II: Develop, fabricate and test the prototype system. Submit design disclosure drawings and test methods and procedures for Government approval, conduct the testing in a laboratory environment, and report test results to the Government.

PHASE III: Transition to Advanced Electronic Counter Measures Transmitter or other advanced radar programs.

COMMERCIAL POTENTIAL: Highly directive satellite communications of broad bandwidth is an anticipated commercial usage of this research.

N96-117TITLE: Target Discrimination Techniques for Infrared Search and Track

OBJECTIVE: The development of innovative algorithms to improve the separation of real from false targets in planned Infrared Search and Track (IRST) systems.

DESCRIPTION: Automatic infrared surveillance systems are plagued by the difficulty of separating the infrared emission from real intruders from those of an active environment because they react to increases in the radiant

intensity of all sources. This problem is compounded in a scanning shipboard IRST system which generates several million samples of data per second for spatial filtering and signal processing. These data typically result in many threshold exceedances which may be due to target (e.g. aircraft or missiles) but are mostly due to clutter (e.g. clouds or sea reflectance). The exceedances produced by the signal processor must be further processed by target versus clutter discrimination algorithms to automatically select and track the targets. Innovative approaches to exploit advanced tracking techniques, such as estimation theory or hypothesis testing, are needed in new discrimination algorithms. The end result should be a tracking and discrimination routine which increases the probability of target declaration while decreasing the probability of false alarm.

PHASE I: Develop an advanced IRST track discrimination algorithm and demonstrate feasibility in laboratory testing.

PHASE II: Develop, fabricate and test a proto-type capable of being applied to a scanning shipboard IRST system. Submit design disclosure drawings and test methods and procedures for Government approval, conduct preliminary testing in a laboratory environment, report results of preliminary testing to the Government, and participate in Navy testing of the IRST track discriminator installed in a system.

PHASE III: Implement hardware and software for IRST track discrimination into an operational Navy IRST.

COMMERCIAL POTENTIAL: Algorithms can be applied to automatic surveillance and alarm systems. Commercial ship IRST for navigation or station keeping. Aircraft IRST for Navigation and collision avoidance.

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(1) S. S. Blackman, "Multiple-Target Tracking with RADAR Application," Artech House, 1986.
(2) Y. Bar-Shalom, T.E. Fortmann, "Tracking and Data Association," Academic Press, 1988.

N96-118TITLE: Miniature Two Color Infrared Detector

OBJECTIVE: The development of a low cost, miniature, two infrared wave bands (colors) detector. The detector will be integrated with two color signal processing under development to provide a proximity fuse for Navy 5"/54 projectiles.

DESCRIPTION: The Navy is interested in advanced infrared projectile fuzing for use against air targets. Current single wave band (color) fuzes will be incapable of engaging both powered and unpowered targets with reduced (stealth) infrared signatures. An effort is underway to develop a two color infrared proximity fuse for Navy 5" artillery rounds. This fuse will perform target discrimination through use of two colors in the mid infrared wave band (3.0-5.0 um) or alternatively 1 color in the mid with one in the long infrared wave band (7.8-12.0 um). A low cost miniature two color uncooled detector array is needed for use in the proposed fuse. Detector elements should be procured and miniaturized or constructed based on current technology. The goal is to integrate the detector array and signal processing chips under development to fit 5"/54 artillery round fuzing.

PHASE I: Propose a 2 color detector system for use in a proximity fuse in Navy 5"/54 artillery rounds. Detectors should fit current 5"/54 fuse designs which employ 4 detectors mounted so that their instantaneous fields of view are 90^0 with respect to the circumference of the shell (single wave band) detector systems should cost less than $100. per round and be suitable for close proximity (100 feet or less) detection/discrimination. Deliver a feasibility study on a detector system which best meets all fuse requirements.

PHASE II: Build and test prototype detector arrays and integrate them with a signal processor currently under development for 2 color detection/discrimination. Provide static testing of the integrated device versus ground sources. Participate in possible Navy flight tests to verify fuse performance.

PHASE III: Optimize the detector system for performance, a miniaturize and engineer for low cost. Detector system will be included in a proposed planned product improvement or in the development of a new infrared fuse for Navy 5"/54 gun fired projectiles.

COMMERCIAL POTENTIAL: Two color infrared detectors with discrimination signal processor can be used in aircraft collision avoidance warning systems. Other uses include false target discrimination for detection in

security/surveillance systems and in robotics/machine vision devices. A novel use for the infrared detection/discrimination technology would be in an automotive warning device against road hazards caused by solar glare, oil, water buildup or obstacles.

REFERENCES:
(1) Low-Cost Signal Processor for Passive, Multi-Band IR Fuse, SBIR Topic No. N91-345.
(2) Infrared Sky Clutter Suppression Using Uncooled Two-Color Sensors; H.R. Riedel, A.C. Bouley, T.K. Chu, R.J. Goetz; October 1883; NSWC TN83-368.
(3) Metal-Semiconductor Mesh Technology: A New Basis for Infrared Detector Array Structures; T.K. Chu; October 1983; NSWC TN83-446.

N96-119TITLE: Transmit/Receive (T/R) Module Cost Reduction Through The Use Of Taguchi Design Of Experiments

OBJECTIVE: The objective of this work is to lower the cost of T/R modules by applying Taguchi design of experiments to T/R module manufacturing techniques and T/R module subcontractor (housing and substrate) manufacturing techniques.

DESCRIPTION: Taguchi design of experiments can be used to identify, control, and tolerance process/manufacturing variables efficiently to ensure high yields (low cost). A large percentage of T/R module cost is associated with assembly labor and packaging materials. This effort would utilize Taguchi methods in the manufacturing T/R module assembly costs and the cost of manufacturing T/R module packaging materials (e.g. housing and substrate).

PHASE I: Identify and report the T/R module packaging and substrate cost drivers and explore ways to develop lower cost and lighter weight T/R module packaging and substrate materials. Analysis is to be conducted to investigate potential lower cost or lighter weight systems or concepts. Functional characteristics subject to Taguchi DOE improvements will be reported. Identify controllable and noise factors for potential systems/concepts. Provide system models with associated plans to implement Taguchi Design of Experiment philosophy in each potential system/concept process or product. Report on most favorable approaches and likelihood for each approach to achieve lower cost and or lower weight products.

PHASE II: Conduct experiments for the most promising system or concept reported in PHASE I. Formal Taguchi DOE to be conducted for most promising system/concept, subject to Government concurrence in the selection. Process/product factors affecting functional characteristics of the selected system/concept will be identified and classified as controllable or noise. Assessment of impact and interactions will be conducted for these factors and Taguchi arrays developed to maximize orthogonalities and improve signal to noise ratios. Additional analysis will be performed on the next selected alternative if the results of the first selected system/concept do not optimize T/R module packaging or substrate supply cost. Results of the Taguchi analysis will be reported with recommendations of designs/process parameters which will assist in lowering cost and/or lowering the weight. Expected cost/weight improvements will be determined. Weight reduction will be a goal, but will nor compromise experiment results.

PHASE III: Process/product parameters will be transitioned into commercial designs for T/R packaging and substrate, on the basis of cost reduction (Primarily) and weight reduction (Secondarily). .

COMMERCIAL POTENTIAL: Many Wireless products receive and transmit signals at microwave frequencies (cellular Phones) and rely on the same technologies at military T/R module vendors. This project will make suppliers of these technologies more efficient and will lower manufacturing costs for both commercial and military vendors.

REFERENCES: " Quality Engineering and Production Systems", Genichi Taguchi, 1989

N96-120TITLE: Continuous Wave Mid-Infrared Laser Sources

OBJECTIVE: Develop technology in 3-5 micron, continuous wave, medium power lasers and monolinear optics.

DESCRIPTION: Solid state and gas mid-infrared lasers are generally operated in the pulse mode to provide sufficient peak power for efficient conversion in optical parametric oscillators and harmonic generators, respectively. The cw or pulsed chemical DF laser has size/weight and potential safety constraints for certain operational platforms. Innovative proposals are sought to explore the potential of new solid state and/or gas laser sources to generate cw (or pulse repetition frequency 50-100 Khz if pulsed) output powers of 10 watt or greater on laser lines that operate in the 3-5 um atmospheric transmission windows and with mode quality that does not exceed 2 times diffraction limited.

PHASE I: Explore concepts from an analytical and/or experimental perspective to determine the feasibility of a cw/high prf MIR laser meeting the average power, wavelength and beam quality requirements. The study shall address the design and performance of a system to be fabricated in Phase II as well as power scaling issues in achieving>10w output power.

PHASE II: Design,fabricate,test,and deliver a fieldable prototype, compact, cw/high prf,10w, MIR laser system. The laser shall also meet wavelength and beam quality requirements.

PHASE III: The technology will be transitioned to a test facility such as the Navy's Chesapeake Bay Detachment for integration and characterization with the Multi-Band Anti-Ship Cruise Missile Tactical Electronics Warfare System (MATES) and other DoD related systems requiring directed IRCM.

COMMERCIAL POTENTIAL: Other possible applications include the use of such a laser source for nuclear proliferation monitoring, process control, medical surgical systems, and pollution sensing of hydrocarbon molecules.

REFERENCES: S. N. Tskhai, et al, Appl. Phys. Lett., vol. 66, no.7, 1995. (2) Private communications.

N96-121TITLE: Electrorheological Fluids

OBJECTIVE: Develop electrorheological fluid(s) that will provide shock dampening for ship mounted equipment and adjustable recoil performance for navy gun weapons.

DESCRIPTION: An electrorheological (ER) fluid is one which is transformed from a liquid into a viscoelastic solid upon application of a strong electric field. The three main aspects of the ER technology are: (1) the ER device, (2) the ER fluid, and (3) the power/control circuitry. This technology has broad Navy application for shock isolators on shipboard equipment, as well as for providing adjustable recoil systems for Navy gun weapon systems. This task will focus on shock dampening initially as a less demanding research effort.

PHASE I: Develop an ER fluid that will provide optimum shock dampening for Navy equipment assuming acceleration in the vicinity of 10 g's.

PHASE II: Develop the ER device and control circuitry that will support the effort.

PHASE III: Conduct barge and shock table tests to verify performance.

COMMERCIAL POTENTIAL: Shipping industry, transportation industry, electrical power industry

REFERENCES: "Electrorheological (ER) Fluids, A research Needs Assessment Final Report", US DOE Office of Program Analysis, contract DE-AC02-91ER30172

N96-122TITLE: Broadband Acoustic Processing Technologies

OBJECTIVE: Develop algorithms for tactical passive or active broadband processing in the mid-frequency range.

DESCRIPTION: Innovative signal processing algorithms in the mid-frequency range are required in response to changing operational requirements, especially in the shallow waters of coastal environments. Current acoustic signal processing is based on narrowband assumptions. To date, proposed broadband algorithms are evolutionary

extrapolations from existing narrowband work rather than revolutionary. Consequently, highly innovative algorithm development is sought to handle either the passive processing or the active processing problem. Proposals should focus on one problem or the other. The following elements are common to both: beamforming; clutter reduction; and improved detection, classification, and localization.
Additional elements of particular interest to the passive broadband area include, but are not limited to: trackers; full spectrum processing; data fusion; acoustic contact correlation. Algorithms may address one or several elements of the passive processing problem. In the active area broadband area, algorithm development should focus on improved detection of coherent signals from bottomed submarines and mines and enhanced reverberation suppression from bottom, volume, and boundary layer phenomena.

PHASE I: Develop, describe and implement the new algorithm.

PHASE II: Provide non real-time demonstration of the algorithm using Navy provided data for the passive case and a Navy provided wideband acoustic source to generate signals for the active case. Provide source code.

PHASE III: Demonstrate real-time performance enhancements of new algorithm with respect to current algorithms, on commercial processing hardware.

COMMERCIAL POTENTIAL: Commercial potential for algorithms developed under this SBIR are dependent on specific problem addressed but include: offshore petroleum exploration; underwater inspection services including environmental assessment; medical imaging technology; and enhanced underwater acoustic communication, for example among divers.

N96-123TITLE: Multisource/Multireceiver Tactical Decision Aid

OBJECTIVE: To develop a tactical decision aid (TDA) that assesses the various environmental, tactical, and system factors associated with multisource/multireceiver active sonar scenarios and develops effective ASW Commander and shipboard sonar employment recommendations.

DESCRIPTION: The U.S. Navy has in various stages of development several active sonar systems that are designed for or are suitable to bistatic/multistatic applications. These systems include air and surface sonar sources and air, surface, subsurface, and fixed sonar receivers. Properly employed, these sonar systems can dramatically improve ASW performance in a wide range of operating environments. There is a requirement for an integrated decision aid tool that can assess the complex matrix of bistatic/multistatic employment and make optimum source and receiver positioning, sonar system setup, and transmission characteristic recommendations. Innovative solutions are sought that will develop such a tactical decision aid for existing sonar systems.

PHASE I: Design a multi-static TDA that meets the above stated tactical requirement. The deliverables from Phase I will include as a minimum: 1) an operations concept document identifying the intended use of the system; 2) design of input and output screens; 3) algorithm design document for the proposed TDA; and 4) report on the availability of data required to support the designed algorithm.

PHASE II: Develop a computerized tactical decision aid that was designed in Phase I. This tacit should be suitable for employment on board Navy vessels for an evaluation of the system in an at-sea setting. The deliverables for Phase II will include as a minimum: 1) source code of all software developed in support of this SBIR; 2) report on the sea test which includes quantification of the value added by employing the system. The demonstration system should consider leveraging existing acoustic tactical decision libraries, allowing the SBIR effort to focus on developing an innovative tacit. To this end, use of the Joint Maritime Command Information System (JMCIS) should be considered as it is the Navy C41 system for platform location and movement information. Additionally, a Sensor Performance Prediction (SPP) library should be considered for leveraging. One SPP library is the surface ship Sonar In-situ Mode Assessment System (SIMAS). This library contains acoustic models and databases and combat system interfaces which may provide relevant data (e.g. reverberation and ambient noise data).

PHASE III: Produce and market the product for ASW purposes.

COMMERCIAL POTENTIAL: Expected commercialization includes seismic research and oceanographic applications such as active tomography.

REFERENCES:
1) Joint Maritime Command Information System (JMCIS) Common Operating Environment Revision 1.3 of 14 February 1994.
2) Sensor Performance Prediction (SPP) Program Architecture Plan Version 3.0 of February 1994.
3) Surface/SIMAS II Advanced Development Model (ADM) Software User's Guide Version 3.2 of September 1994.

N96-124TITLE: High Pressure Gear Pumps for Improved Wear Resistance

OBJECTIVE: The improvement of pump performance and service life enhancement of small high-pressure gear pumps is sought through material development and component design and testing. Prototypes of pumps and pump components resulting from material development and testing and/or design refinements will be analyzed.

DESCRIPTION: The gears and sealing surfaces in high performance high pressure gear pumps experience demanding loads applied from high pressure abrasive fluids. The pump components need to be comprised of durable materials maintained at tight tolerances to withstand loading and associated wear during operation. The current components often lend themselves to problems with wear, which reduce flow, pressure, and self-cooling during repetitive operation. Deionized water, being the working fluid, provides primary lubrication and cooling for the pump components. New materials and technologies exist that may prevent unnecessary wear and prolong pump life. The effort should include investigations into new gear materials, removable or replaceable liners for gear sealing surfaces, and improved bearings. Along with material selection, novel designs and design enhancements should be considered. The developed technology would greatly enhance high pressure gear pump performance and extend asset operational life.

PHASE I: Categorize prospective materials for pump gears and develop design concepts for gear sealing surfaces. This effort includes examining gear and bearing design for improved wear resistance while maintaining desired performance characteristics. Small scale bench testing is to be performed on candidate materials to determine wear characteristics. Recommendations on candidate materials and designs are to be provided in a detailed report.

PHASE II: Develop full-scale prototypes based on testing results from Phase I research. These tests are to be developed and conducted to reproduce Navy System operating conditions. They shall include pressure, flow, and endurance evaluations to characterize pump performance, as well as, gear and bearing operating life. Phase II shall culminate in the development full prototype assemblies for incorporation into the Navy application for evaluation. A data package describing in detail the design and testing of the pump assemblies is to be developed and delivered.

PHASE III: The Phase III program would develop level 3 drawings of a final pump configuration to be incorporated into the Technical Data Package for the MK 50 program. This documentation can also be incorporated into other related Navy systems utilizing small, high pressure gear pumps. Phase III would then lead into production of pump assemblies and use in the various Navy vehicle systems and applications.

COMMERCIAL POTENTIAL: Improvements to high pressure gear pumps would have wide applicability in both the Defense and civilian sectors. A number of Navy systems employ gear pumps that must endure repeated and extended operation in critical roles. These systems may be upgraded through this research to further enhance their performance and operational life. Many commercial and industrial applications would benefit from pumps that are able to transmit abrasive and elevated temperature fluids and endure prolonged operation.

N96-125TITLE: Peacetime Use of the Adaptable High Speed Undersea Munition (AHSUM)

OBJECTIVE: To adapt munition and the launcher for military and civilian applications. To test the concept for the selected applications.

DESCRIPTION: AHSUM is an undersea munition that travels at speeds exceeding 600 m/s and possibly as high as 2000 m/s. It is normally gun-launched, and may be provided with a rocket propulsor. Long term development

potential includes smart variants. The high speeds of the munition make it capable of kinetic penetration of a variety of undersea targets. AHSUM is under consideration for a variety of peacetime applications, mostly in the offshore industry. Such concepts as an inexpensive bottom penetrator system, a tension leg platform mooring system, and a new type of acoustic source for coastal geotechnical work have been proposed. Assistance is required in identifying and downselecting practical applications of importance, adapting the munition and the launcher, and testing the concept for selected applications.

PHASE I: Develop a set of operational requirements for the munition for each application. Using existing performance data and military operational goals (to be Government furnished), assess the prospects of success of each application. Identify commercial uses of AHSUM not listed below.

PHASE II: Demonstrate the effectiveness of specific AHSUM variants for selected military and peacetime applications in cooperation with the United States Navy.

PHASE III: The military development of AHSUM would transition to the fleet via any of several weapon system development programs, including PE#101226N Submarine Defensive Warfare System, PE#0603506 Surface Ship Torpedo Defense, PE#0604558N New Attack Submarine, and PE#0603502 Mine Countermeasures.

COMMERCIAL POTENTIAL: The low cost of AHSUM, (especially if commercial markets are developed) makes it an ideal candidate for any offshore application requiring effective inexpensive rapid safe kinetic penetration capability. Proposed applications in the offshore industry include inexpensive bottom penetration, tension leg mooring of offshore platforms, and littoral geo-technical and oceanographic applications such as cavitation-based broadband acoustic source, bottom penetrating detonation sources capable of reaching the upper strata for geo-physical mapping and exploration and rapidly moving sensors for mapping time-dependent phenomena. Interest in pursuing such applications has been expressed by experts in the offshore industry. Other applications include uses in sport diving, marine biology, undersea construction, and safe undersea storage of spent radioactive fuel.

REFERENCES:

1. Kirschner, I.N., and L.M. Dean (1995) "Mid-Range Land-Based Tests of the Adaptable High Speed Undersea Munition (AHSUM)," NUWC-NPT Technical Report (in progress), Naval Undersea Warfare Center Division, Newport, RI

2. Kirschner, I.N., A.N. Varghese, and J.Q. Rice (1994) "Supercavitation Drag Reduction in High-Mach-Number Liquid Flows," NUWC-NPT Technical Memorandum 942043, Naval Undersea Warfare Center Division, Newport, RI

3. Stace, J.J., L.M. Dean, and I.N. Kirschner (1994) "Face Seal Technique for the Exclusion of Water From Underwater Gun Barrels," NUWC-NPT Invention Disclosure, Navy Case Number 76643, Naval Undersea Warfare Center Division, Newport, RI

4. Kirschner, I.N., L.M. Dean, and R.B. Philips (1995) "Spooled Metal Tape Seal for Underwater Gun Operation," NUWC-NPT Invention Disclosure, Navy Case Number 76837, Naval Undersea Warfare Center Division, Newport, RI

N96-126TITLE: Low Cost Underwater Mateable Fiber Optic Connector

OBJECTIVE: To develop a low cost underwater mateable multi-mode fiber optic connector to support submarine hull mounted array short haul communications.

DESCRIPTION: Placing electronics outboard of a submarine pressure hull in support of hull mounted arrays has many advantages. In order to support high speed telemetry and ground isolation for the outboard electronics, a fiber optic communication link is desirable. To perform array/sub-array replacement without drydocking it is necessary to develop an underwater mateable connector. The connector should be mateable by a diver. A single fiber and/or a duplex fiber design should be considered. The receptacle end of the connector shall mount on a stainless steel plate that is part of the pressure housing for the electronics. The receptacle should protrude into the pressure vessel less than a half (1/2) inch. The connector housing should not corrode in the presence of Titanium or 316 CRES. The plug end should mate to underwater cables such as Rochester Steelite, Mil-C-0085045E, or similar. The plug, including cable strain relief, should not extend more that six (6) inches from the face of the steel plate that the receptacle is mounted on. Optically the connector should use 62.5/125 um multi-mode fiber and should exhibit loss

of less than three (3) Db at 1300 nm over a minimum of 50 mating cycles. This performance should be maintained for pressures from ambient to 1000 psig in a seawater environment for up to 20 years.

PHASE I: The effort will result in a study of different connector concepts, predicted performance, and expected construction costs. Breadboard and test most promising concepts.

PHASE II: Develop and test the most promising connector concepts. Produce test report. Deliver several first article units for Navy testing.

PHASE III: The Navy would recommend a successful connector to various Navy hull array programs where fiber optic telemetry is desired and low cost is important.

COMMERCIAL POTENTIAL: This connector technology has direct applications in the commercial sector. Potential users include those involved in underwater telephony, private fiber networks, CATV, and harsh environment local area network environments such as found in many industrial plants.

N96-127TITLE: Advanced Laser Source for Fiber Optics

OBJECTIVE: To increase the frequency stability, the coherence length, and the optical power of optical fiber–coupled lasers supplying light in the 1310 to 1340 nanometer wavelength range. Overall performance will be increased with the resultant lower noise bandwidth.

DESCRIPTION: The frequency stability, coherence length, and power of a laser source have a direct impact on the noise in a fiber optic system. Fiber–coupled, single–frequency, Nd:YAG (neodymium:yttrium argon) lasers in the 1319 to 1330 nm wavelength range have shown dramatic improvements in amplitude and frequency stability, coherence length, and fiber–launched (effective) optical power. But these improvements have typically been limited by frequency drifts of more than 40 Mhz per hour, coherence lengths of less than 5 km, and fiber–launched optical power of less than 200 milliwatts. Laser performance will be increased in three phases:

PHASE I: Develop ways to stabilize the laser frequency and amplitude, to lower the laser noise to obtain increased coherence length, and to raise the fiber–coupled optical power. Three goals are: (1) obtain a frequency drift of less than 1 Hz per millisecond, 1 Mhz per hour, and 10 Mhz per day as demonstrated by a beat frequency test between two independent prototype lasers; (2) minimize noise bandwidth to provide a coherence length exceeding 30 km; and (3) optimize optical power to exceed 500 Mw into polarization–preserving fiber.

PHASE II: Technology developed under Phase I will be used to fabricate three amplitude and frequency stabilized, 500 Mw, polarization–preserving, fiber–pigtailed, single–frequency lasers in the 1310 to 1340 nm wavelength band. The identical lasers will be portable, and sized to fit into a 19–inch equipment rack.

PHASE III: The three fiber–coupled lasers will be incorporated into an experimental Navy fiber optic sensor system. The Navy will evaluate the improvements in sensor system performance. The laser technology will transition directly into Navy exploratory and advanced development of fiber optic hull–mounted, deployed, and towed acoustic arrays as well as fiber optic gyros.

COMMERCIAL POTENTIAL: The largest non–military applications for this technology are coherent, long–haul, gigabit–per–second telecommunications networks and fiber optic cable television distribution systems requiring hundreds of analog channels. These are rapidly expanding, multi-billion dollar industries.

REFERENCES:

1. "Sub–Hertz Relative Frequency Stabilization of Two–Diode Laser–Pumped Nd:YAG Lasers Locked to a Fabry Perot Interferometer," Timothy Day, Eric Gustafson, and Robert Byer, IEEE Journal of Quantum Electronics, Vol. 28, No. 4, April 1992, p 1106

2. "193–Mhz Beat Linewidth of Frequency–Stabilized Laser–Diode–Pumped Nd:YAG Ring Lasers," Noboru Uehara and Kenichi Uedo, Optics Letters, Vol. 18, No. 7, April 1993, p 505

N96-128TITLE: Independent Verification And Validation (IV&V) Tool To Monitor The Effects On Navy Enlisted Skills And Knowledge Resulting From Ongoing Changes In Training Technology

OBJECTIVE: Develop an Independent Verification and Validation (IV&V) tool to identify the impact of the move towards increased shipboard training and reduced shore-based training on the skill and knowledge base of Navy personnel. Specifically, provide data that documents the efficiency (in terms of cost) and effectiveness of various shore-based and shipboard approaches to training basic and advanced knowledge and skill. Develop a decision aid (IV&V) tool, based on the nature of skill and knowledge requirements of selected tasks, that helps training designers to determine the optimal setting (and instructional strategy) for training a particular class of knowledge and/or skill.

DESCRIPTION: Recent and ongoing training technology changes have resulted in movement of training traditionally performed in shore based schoolhouses to on board training (OBT) environments. An impact analysis to quantify the trend is needed. A specific area to investigate is the interplay of skills and knowledge acquired in the initial shore based training phases and the subsequent shipboard phases. The analysis should document and describe any interplay, and based on the research, appropriate conclusions and recommendations shall be provided.

PHASE I: Contractor shall develop a conceptual framework to guide research into how best to accomplish training for various knowledge and skills that underlie selected Navy tasks. This framework shall, at a minimum, draw on existing taxonomies of human performance and training, and provide a basis to generate hypothesized associations between required classes of knowledge/skill and available training strategies (both shore-based and shipboard). In addition, Contractor shall examine the relationship between current shore-based and shipboard training in order to 1) determine redundancy in training objectives, 2) identify training gaps or shortfalls, 3) establish cost/benefit tradeoffs for various training strategies, and 4) generate propositions that suggest the optimal training strategy for various categories of knowledge and skill.

PHASE II: Critically assess and test hypotheses generated by the framework developed in Phase I. Specifically, examine the knowledge/skill requirements of existing Navy courses (provided by the government) to determine the optimal training setting and strategy. Select a subset of hypotheses that can be tested empirically using available test facilities. Contractors shall develop a pilot decision aid (IV&V) tool based on work in Phases I. Based on analytical and empirical effort utilizing the pilot (IV&V), make recommendations for which classes of knowledge and skill are best trained in shore-based facilities and which are best trained on board ship. Extend this analysis to include refresher as well as initial skill training. Document the (IV&V) design and all verification test results.

PHASE III: Contractors shall develop a decision aid (IV&V) tool based on work in Phases I and II. Specifically, this decision aid shall allow training designers (and others) to make sound decisions for how to approach training (in terms of the training setting, strategy, etc.) for
various types of knowledge and skill. The decision aid shall be user-friendly, and applicable to a wide variety of knowledge and skill (as defined in Phases I and II). Its value will be in guiding training systems designers, course managers, and even instructors in making crucial training design decisions. This will help to ensure optimal use of precious training resources, while maximizing training effectiveness and readiness.

COMMERCIAL POTENTIAL: The results are applicable to industries and professions and trades that undergo changing skills, skill levels and introduction of new techniques through technological advancement or other presidents. This includes the legal and health professions, and the transportation, building and utilities.

REFERENCES:
1. Military Training Programs MILSTD 1379D
2. Catalogue of Navy Training Courses (CANTRAC) CANTRAC Course Descriptions and Convening Dates NAVTRA 10500 Volume II
3. Navy Integrated Training Resources and Administration System (NITRAS)
4. Military Handbook (on) Interactive Courseware (ICW) MIL-HDBK-284-1
5. Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards Volumes I and II NAVPERS 18068

N96-129TITLE: Massively Parallel Processing for Ship Self Defense

OBJECTIVE: Identify new and innovative applications where Massively Parallel Processing (MPP) technology can improve littoral warfare capability while reducing warfighting costs.

DESCRIPTION: The technology for Massively Parallel Processing (arrays of over 1000 matrixed processors) has existed for some time, with most military applications limited to the shore-based "computer center" environment. These systems involved exotic equipment designs, significant data input requirements, complex programming techniques and large power consumption. These attributes have restricted this technology from reaching the battlefield and have kept the enormous potential of MPP away from the hands of the warfighter. Recent breakthroughs in deployable massively parallel processing (MPP) include the down-sizing of processors to 6U VME technology, new software techniques and advanced image processing algorithms that take advantage of the MPP architecture. There have been concomitant reductions in space and weight requirements -- with the current ability to place a 4000 processor array in a tactical environment in less space than most current PCs. These advances occur with concert with marked increases in processor and memory storage capability. These breakthroughs in MPP hardware and software enable simultaneous onboard processing and fusion of multi-sensor data in real-time. MPP

technology is ideally suited to the task of turning multi-sensor data into useable information. MPP could be a very powerful capability and force multiplier in the post cold war environment as the Navy prepares to implement advanced ship self defense combat systems supporting littoral warfare. Embedded data-parallel super-computing technology offers the ability to employ advanced programming techniques in real-time to successfully fuse multi-source data and enhance the Commanders ability to extend, visualize, manage and control his Battlespace. New and innovative MPP technologies and applications are needed for Green and Brown water operations which will increase combat systems capabilities, aid in Battlespace Management, reduce human exposure and risk, show an overall system cost reduction and conform to the Next Generation Computing Resources open systems architectures philosophy.

PHASE I: Identify existing, and define new, fleet systems that would benefit from the application of MPP technology. Outline each system's architecture, identify software development requirements utilizing advanced image processing techniques, and identify any required modifications/enhancements to existing systems. Demonstrate and select specific methods of video data compression and processing using deployable massively parallel processing super-computers. Identify the expected system performance improvements in multi-sensor processing, data fusion, and the potential bandwidth for a suite of sensors in an on-board application.

PHASE II: Confirm the feasibility of applying MPP technology and custom software to a selected system through a cost-effective demonstration, such as a partially simulated environment. Demonstrate the improved security and data compression techniques for advanced sensor imagery propagation through prototyping and in-fleet. Prepare a transition plan to fully demonstrate the implementation in an operational scenario.

PHASE III: Procure systems based on proven Phase II demonstration, utilizing deployable MPP technology for use in selected existing and planned sensor and reconnaissance systems.

COMMERCIAL POTENTIAL: Developing a system capability which brings more digital processing power to the end user, especially in an open systems environment, has many applications in a commercial environment. Many combat systems/functions apply to the high-tech/high-risk environment.; such as: commercial aerospace or law enforcement sectors of the economy. Increased digital processing will also benefit, the air traffic control sector, and any industry with remote sensing or multi-source data fusion requirements.

STRATEGIC SYSTEMS PROGRAM OFFICE

N96-130TITLE: Thermal Enhanced Electronic Component Bond

OBJECTIVE: To develop a high thermal conductivity bond for electronic components which can be debonded easily and without high temperature.

DESCRIPTION: Previous thermal enhanced bonds have used high conductivity bond materials or have added high thermal conducting materials in particle or whisker form to the bonding material. The bonds which are high conductivity materials usually are formed at high temperatures and can not be easily debonded without high temperatures, if at all. High temperatures damage sensitive electronic components. This type of bond includes brazing, welding, graphatizing and carbonizing, etc. The other type of bond which has high thermal conductivity materials added still has low relative thermal conductivity because the epoxy or thermoplastic bond matrix has a very low thermal conductivity to begin with. The added materials include silver, gold, iron, aluminum, copper, etc. The low composite thermal conductivity of these materials is a function primarily of the relative amount of matrix compared to the amount of particles that heat must traverse to get from one bonded material to the other.

PHASE I: Provide design for high thermal conductivity bonds between doublers and electronic components using carbon-carbon fabrics. Compare the design bonds performance with the performance of bonds containing high thermal conductivity particles and whiskers. The designs should include different material doublers, such as carbon-carbon and aluminum.

PHASE II: Using the designs determined in Phase I to bond and test materials and determine the thermal conductivity across the bonds. Based on these tests and additional analysis, determine optimum bond designs(s) and materials or material systems.

COMMERCIAL POTENTIAL: The produced thermal conductivity enhanced bond design has commercial potential to effect almost all electronics, as well as, any other application where high conductivity and easy bond disassembly is desired.

N96-131TITLE: Global Positioning Satellite (GPS) Simulator for Re-entry Body Application

OBJECTIVE: Develop a multi-channel dynamic GPS simulator to provide error-corrupted navigation solutions to a re-entry body trajectory computer simulation.

DESCRIPTION: Existing commercial multi-channel GPS signal simulators are capable of providing 5 to 10 channels of navigation data modified to account for simulated vehicle motion. However, the embedded motion modules in these simulators are not capable of generating realistic reentry body dynamic conditions. The innovation requested here is the development of a GPS signal simulator which can be used in conjunction with a GPS receiver as hardware in the loop elements of a re-entry body computer trajectory model. The trajectory model will provide body position and angular coordinates as inputs to the GPS signal simulator through an interface. The simulator will then provide the appropriate signals to a GPS receiver, which will furnish positional coordinates back to the computer trajectory model via an interface such as an IEEE 488. The innovation is limited to the GPS signal simulator and the required interface hardware and software.

PHASE I: Perform a preliminary design of the GPS signal simulator and interfaces, and demonstrate feasibility, using a generic GPS receiver, including how body position, velocity, acceleration, antenna-obscuration, antenna pattern rotation with the vehicle, etc. alter the simulated GPS RF signal.

PHASE II: Develop a prototype of the GPS simulation which will input vehicle dynamic descriptors (e.g. vehicle angular velocity and acceleration) and which will include a Navy specified GPS receiver to provide a stream of navigation coordinates via a standard interface. The contractor must document all work performed under this program.

PHASE III: Improvement and sale of simulation and support services to interested government facilities.

COMMERCIAL POTENTIAL: The most obvious commercial or non-DOD use is in the testing of proposed receivers/navigation algorithms intended to operate in high dynamic environments.

REFERENCES: Boulton, Peter, “Study of Error Sources Relating to Test and Development of GPS Receivers for Attitude Sensors in Low Earth Orbit", Institute of Navigation GPS Proceedings, Sept., 1994.

N96-132TITLE: Inspection System for Large Ductile Iron Castings

OBJECTIVE: Develop a real time, radiographic inspection system for large ductile iron castings.

DESCRIPTION: The Navy is involved in a Cast Ductile Iron Program which produces large parts by casting ductile iron. Occasionally, small and large porosities and voids are formed during the casting process. The Navy, in the past, has used ultrasound techniques to detect these defects in cast ductile iron castings. The ultrasound measurement technique requires a good coupling between the transducer and the casting in order to accurately detect the flaws. This coupling, in some cases, is difficult to maintain. Large castings lead to even greater problems since large water tanks are required for the coupling. The Navy is interested in finding better, faster, and more efficient inspection techniques for laboratory as well as production applications. Real time radiography is one of the methods which may prove to be successful.

PHASE I: Develop a system designs and carry out experiments to determine applicability and performance of a real time inspection system. The emphasis of the system design should be on the speed and accuracy of the inspection system in an automated production environment.

PHASE II: Fabricate and test the Phase I design and develop the prototype system, to include automated inspection, for evaluation during this phase.

PHASE III: The development of an automated, production oriented, real time inspection system for Navy facilities.

COMMERCIAL POTENTIAL The need for a speedy and accurate inspection system exist in the commercial areas where cast ductile iron is used. This may include automobile and other industrial parts.

NAVAL MEDICAL RESEARCH and DEVELOPMENT COMMAND

N96-133TITLE: An Automated Test Battery for Advanced Aviator Aptitude Assessment

OBJECTIVE: Develop a computer-administered test battery that predicts pilot performance.

DESCRIPTION: This requirement is for a computer-administered test battery that measures aptitudes and other enduring characteristics related to effective performance as an operational Naval and Marine Corps aviator. The Navy has developed and now implements the FAR (flight aptitude rating) battery, which is used to select persons for Naval Aviation Training. Classification, i.e., aircraft assignment, is based on individual preference, performance in undergraduate pilot training, and aircraft availability. We want to explore the possibility of a new test battery (and new tests) that could be used for selection as well as in the classification process. In particular, there is a need to identify and measure aptitudes and other traits that predict which pilots will develop the highest levels of operational flying skills. Additionally, the current tests are administered to over 20,000 applicants at recruiting stations throughout the country. We are interested in having selection tests that can be remotely updated to insert prototype questions and in "real time" continuously improve the selection instrument.

PHASE I: The contractor will provide recommendations regarding content of the test battery and demonstrate feasibility of the test(s) in the battery which can be remotely updated and accessed via connectivity such as the internet.

PHASE II: Produce a reliable and validated test battery to operate on a personal computer such as the 486/33 microcomputer which can send test answers and receive updated test instruments through remote access to a central naval selection computer server.

PHASE III: An easily administered tool for selection and classification of a complex task, such as piloting modern, combat aircraft, would easily transition to other branches of the government as well as to the private sector.

COMMERCIAL POTENTIAL: Potential for a predictive test battery would allow/enhance the selection and placement of personnel in a complex work (task) environment such as public transportation, complex equipment operation or certification requirement standardization, as in motor vehicle operators license procedures.

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N96-134TITLE: Tests of Dynamic and Temporal Visual Acuity

OBJECTIVE: Develop a predictive test battery to assess transient and dynamic aspects of vision.

DESCRIPTION: Many naval activities are visually based and depend heavily on a person's ability to detect or recognize an object (target) that is only partially detailed and/or only briefly presented. Often the target is moving or is one of multiple possibilities in the visual field. The ability to quickly move from one to another and to extract distinctive key visual information is critical for successful performance. Although there has been major advances in understanding temporal factors, the need exists to incorporate this recent knowledge into a test battery which assesses temporal factors in vision.

PHASE I: Show the feasibility of constructing a temporal factors test battery.

PHASE II: Development and demonstrate of the practical value of the test battery.

PHASE III: Demonstrate applicability to other government agencies and to non-military organizations. Produce and market the test battery.

COMMERCIAL POTENTIAL: A test battery which assesses temporal factors in vision would find application in any commercial or civilian activity requiring detection and/or recognition of moving objects. For example, driving a car or truck; piloting aircraft; or police work. Quality control involving visual inspection of moving objects (assembly lines) is another
area.

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N96-135TITLE: Improved Performance Test Battery

OBJECTIVE: Development of a test battery to detect and measure impairment of a person's readiness to perform their job in the workplace.

DESCRIPTION: Many factors can effect a person's readiness to safely and efficiently perform assigned function in the workplace. A need exists to assess any impairment in a person's readiness to work. A portable test battery is a requisite part of such an assessment program. This should not only be usable and valid before a person enter a work environment but it should also be extended to continuous monitoring of the personnel while in work places such as the cockpit of a naval aircraft.

PHASE I: Demonstrate the feasibility of constructing a test battery and recommend procedures for integrating the battery into the larger assessment program.

PHASE II: Develop the battery and overall program requirements for an assessment program.

PHASE III: Produce and market the test battery.

COMMERCIAL POTENTIAL: The need to assess fitness-for-duty in behavioral terms is felt in civilian as well as military life. Hence, successful fitness-for-duty tests and programs developed in the military might have wide application in civilian industries and occupations.

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N96-136TITLE: Rapid Detection of Pathogenic Campylobacter Bacteria Using a PCR/Immunoassay System

OBJECTIVE: To develop and field test a three step system for the detection of pathogenic Campylobacter spp. from fecal samples using a combined polymerase chain reaction (PCR) / antibody assay.

DESCRIPTION: Diarrheal diseases caused by Campylobacter spp. are a major cause of travellers' diarrhea and morbidity in military forces deployed overseas. In an operational setting, Campylobacter-mediated diarrhea has resulted in epidemics aboard ships and among troops deployed ashore. In the civilian sector, pathogenic Campylobacter remains a major contaminant of poultry and other farm products, resulting in significant illness in the
general population. Despite considerable effort over the past two decades, rapid and specific detection of pathogenic Campylobacter is still difficult. Current detection methodology requires significant resources and time in a modern clinical laboratory. This application proposes the development of a reagent kit that would be used for the rapid and accurate detection of pathogenic Campylobacter spp. using readily available reagents and hardware.

PHASE I: To develop a simple, rapid system to detect Campylobacter spp. in fecal samples using an antibody immunoassay to concentrate this bacteria and PCR to amplify Campylobacter-specific sequences to permit detection in less than 12 hours. This system would be based on the use of antibodies to specifically 'capture' Campylobacter spp. from raw samples, then detect specific DNA sequences using PCR.

PHASE II: The detection system will be tested at a pediatric diarrhea vaccine site located near Alexandria, Egypt to determine utility under field conditions and will be adapted to allow the processing of multiple samples.

PHASE III: Upon successful field testing, a reagent kit that is compatible with existing commercial hardware would be developed, permitting widespread use of the detection system in both the military and civilian sectors.

COMMERCIAL POTENTIAL: This product would have the greatest commercial potential both in the health-care and agricultural industry. Campylobacter infections in humans and in poultry are still difficult and time-consuming to detect, even in the best clinical laboratories. Development and marketing of this system would give, for the first time, a simple, rapid, and cost-effective procedure to detect Campylobacter spp. in large numbers of samples.

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BUREAU OF NAVAL PERSONNEL

N96-137TITLE: Determining the Optimal Mix of Manpower.

OBJECTIVE: Develop new methodology to determine the optimal mix of manpower skills and pay levels.

DESCRIPTION: As the Navy's drawdown continues, it must greatly reduce the number of shore military manpower spaces. In 1970, 70% of all Navy officers were unrestricted line (URL). Today, only 48% are URL officers. During the force build-up in the 1980s much of the growth in officers was in the restricted line (RL) and

staff corps (STAFF). During the early years of the current drawdown, some officer communities (e.g. medical) were exempt from reductions. As a result, the URL, which includes the Navy's primary warfighting communities (surface warfare, submarine warfare, aviation warfare, etc.) has absorbed a disproportionate share of officer reductions. This has greatly reduced career advancement and shore rotation opportunities for these communities.

PHASE I: Design a methodology to determine the optimal mix of manpower skills and pay levels using Navy officer communities and enlisted ratings as the test bed. Ensure that the procedure provides for reasonable shore rotation opportunities and equitable career advancement.

PHASE II: Develop, test, and operationally demonstrate the model(s) designed under Phase I.

PHASE III: Produce a version of the model marketable in the civilian sector.

COMMERCIAL POTENTIAL: Any industry with an interest in "right sizing" while maintaining career advancement opportunities and an optimal workforce mix (in terms of skills, experience and pay levels) would benefit from the product of this effort.

N96-138TITLE: Determining the Size and Relative Efficiency of Corporate Infrastructure.

OBJECTIVE: Develop a new methodology to (1) link reductions in primary product to infrastructure reductions and infrastructure efficiency and (2) link infrastructure manpower needs to aggregate budget variables.

DESCRIPTION: The Navy defines Manpower in four broad categories: Battle Forces, Battle Force Support, Other Support, and the Individuals Account. Navy manpower reductions from fiscal year 1989 through fiscal year 1995 will reduce Battle Forces by 31% and Other Support by 18%. Some areas in Other Support are actually growing, e.g., environmental programs and defense agencies. Some of the hardest choices the Navy must make in the next several years are where to reduce Other Support manpower. Recent CNO guidance requires that resource sponsors make greater end strength reductions from infrastructure and support (Other Support). However, ownership of these activities is often split among resource and program sponsors. This can lead to duplication of functions across activities, often in the same geographic area. Also, because ownership is split, it is difficult to directly relate infrastructure reductions to reduction in the primary product (Battle Forces), e.g. what support is related to the decommissioning of an A-6 aircraft squadron.

PHASE I: Design a methodology to (1) link reductions in the primary product to infrastructure reductions and infrastructure efficiency, (2) link infrastructure manpower needs to aggregate budget variables, and (3) determine infrastructure inefficiencies, duplication of functions and potential for reduction or consolidation.

PHASE II: Develop, test, and operationally demonstrate the models designed under the Phase I effort.

PHASE III: Produce a version of the model marketable in the civilian sector.

COMMERCIAL POTENTIAL: Workforce management in the private sector could benefit from the methods of "right sizing" demonstrated in this effort. Any industry with an interest in defining duplication of functions, inefficiencies, and potential for reduction would benefit from this effort.

NAVAL FACILITIES ENGINEERING CENTER

N96-139TITLE: Measurement of the Extent of Deterioration of Concrete in Reinforced Concrete Structures

OBJECTIVE: Develop non-destructive methods to quantitatively locate and size the extent of concrete deterioration in Navy reinforced concrete structures.

DESCRIPTION: Develop a portable hand-held nondestructive inspection tool to measure the depth and areal extent of concrete deterioration in reinforced concrete structures.

PHASE I: The contractor shall explore non-destructive techniques and tools that may satisfy the objectives of detecting the depth and areal extent of deteriorated concrete. Demonstrate proof of concept via laboratory testing for candidate system(s).

PHASE II: Develop and construct prototypes tools. Test prototype inspection tools in field-like applications for their accuracy, precision, accessibility and ease of operation. Complete a failure mode and effect analysis of the design, manufacturing and operational process associated with each inspection tool. Prepare a final report of the findings and make recommendation for preparing the tools for field use. Phase II funding will depend on the availability of advanced development funding, along with contractor's investment strategy and product development plan.

PHASE III: Construct a actual inspection tool for commercial use.

COMMERCIAL POTENTIAL: The results of this development will provide the commercial sector with an easy and cost effective method to locate areas of concrete deterioration in all types of reinforced concrete structures: piers, wharfs and buildings.

REFERENCES: US Dept Transportation: Conference on Nondestructive Evaluation of Bridges, 1992

N96-140TITLE: Tag Initiated Communications System for Real Time Asset Monitoring

OBJECTIVE: The objective is to develop a method to implement tag initiated communications in an asset management system. The protocol will retain all the advantages of the current system while allowing add-on module (temperature sensor, etc.) alarm condition to be immediately reported to the PC network.

DESCRIPTION: Develop communications hardware and firmware that will enable a tag to establish RF communication (tag initiated) with an interrogator of its own volition. Specific problems to be resolved will be the protocol to handle the communications, management of tag battery life in situations where the tag's request for communication goes unheeded and design of a multi-tasking interrogator accepting simultaneous inputs from both the PC network and multiple tags. Develop system enhancements to allow real time monitoring of a local area or portal without reducing tag battery life.

PHASE I: The first portion of the work will be to define the protocol for tag initiated communication. The tag will need a system for processing external interrupts originating from the add-on module and determining the proper routing. A method of checking the airwaves for existing RF communication will be researched to avoid RF interference and the resulting collisions. If the airwaves are clear, the tag will transmit the interrupt or data to the interrogator via it current RF transmitter. The protocol must address instances in which the tag is outside of the interrogator range or the interrogator is busy and the tag does not receive a response from the interrogator. The interrupt event must be stored in the tag memory for future retrieval and the battery cannot be drained by repeated communication attempts.

PHASE II: The contractor shall prepare a brass-board concept feasibility model and demonstration. It shall demonstrate open RF transmission protocols between tags and interrogators, and remote heads-up displays. Volume data handling will be demonstrated.

PHASE III: The contractor shall prepare a system for suitable testing on a large scale. Transmission protocols will communicate with tens to thousands of tags present within range, while interfacing the information to a variety of identified military systems. Transition will include commercially available system integration components.

COMMERCIAL POTENTIAL: The RF tag which interfaces to large information volume applications will be a benefit to the medical, manufacturing, transportation, and maintenance fields. Item control within wireless local and wide area networks will greatly increase the user ability. Tags will be compatible with the National Information Infrastructure initiatives.

REFERENCES: MIL-STDs 1780, 81, 82; FIPS PUB 1461-1; RFCs 822, 1122, 23

N96-141TITLE: Geomorphic Site Selection Software Tool

OBJECTIVE: Develop a combined database and analytic model which can predict the likelihood of sediment type and depth at a specified location on any coastline in the world, given the geographic location and certain geomorphic and oceanographic data about the site. This data is readily available through satellite imagery.

DESCRIPTION: The model will generate statistics regarding sediment properties by correlating the observable land form and ocean pattern data to likely sediment characteristics. Regional historic data , when available, and geologic theory correlating geologic provinces to plate tectonics will supplement and validate the model's predictions.The tool will most importantly provide the means for selecting suitable sites with more confidence than is currently possible today. Use of the model will expand the range of potential operations sites for planners by providing statistical information for those locations for which no specific geotechnical or geophysical data is available. The tool also will provide valuable information regarding the likelihood of foundation problems that may be encountered at specific sites, enabling the development of operations plans for overcoming those obstacles. The tool could also be expanded to predict shoaling conditions for specific sea states if adequate hydrographic and oceanographic data is available for the site.

PHASE I: Conduct a feasibility study of the proposed site selection tool. The study shall include an assessment of existing satellite imagery and its applicability to this task, and an analysis of the statistical viability of using the tool to estimate sediment type and depth at coastal locations across the world. Demonstrate proof of concept.

PHASE II: Develop prototype system and participate in field tests of the unit. Develop commercial linkages to the offshore and geotechnical industries.

PHASE III: Refine and implement the prototype system. Transition the system to the Navy, to CNO N85.

COMMERCIAL POTENTIAL: The system could be useful to offshore design and construction firms who need preliminary sediment data prior to conducting on-site investigations.

N96-142TITLE: Integrated Hydrographic, Geophysical, Geotechnical and Oceanographic Data Collection Sensors

OBJECTIVE: Develop a standard open architecture network for integration of hydrographic, geophysical, geotechnical and oceanographic data collection sensors using a real-time, multi-tasking, multi-processor operating system running a "survey executive" and operating a network of "sensor engines". This concept will allow the control of a diverse set of sensors which can be used in the search, survey, classification and localization of small metal objects in the nearshore ocean environment. Each sensor(s) hardware/software will be a processing task (sensor engine) on the network.

DESCRIPTION: The state of practice in offshore surveying involves assembling a suite of sensor, from various manufacturers, integrating them as much as possible and conducting field operations. Upon completion of the field operations the data, some in digital form, some hard copy, is assembled and interpreted. The suite is highly sub-optimal. For instance, the fathometer's signal, shows up as noise on the side scan sonar and also interferes with the acoustic navigation system. This sub-optimization of system occurs because each manufacturer has optimized their system. Such a suite may have Differential Global Position Satellite navigation with an accuracy of ± 3 meters that updates every second, but the vessel is traveling at 3 kts (1.54 m/s), thus a position update every 2 seconds is adequate. It could have an ultra short baseline acoustic system to monitor the position of the side scan sonar towfish, updating every 1 second. These are optimal systems, each is performing at it best repetition rate, but as a system they would provide better data if the DGPS updated every two seconds and immediately after an update was received the USBL system updated the towfish position. The USBL - fathometer interference could be eliminated if the fathometer was shut down for the time required to take the USBL fix. The fathometer - side scan sonar interference could be eliminated if the fathometer repetition rate was adjusted and data was logged when needed not a the fastest rate possible.The state of technology has advanced to the point that this sub-optimization can be overcome. Each of these sensor systems can be viewed as a transducer with signal processing. Thus it is possible to integrate all of these systems on a single open-architecture, multi-processor, multi-tasking computer network linked together by a "survey executive" and operate the diverse sub-system in an optimal manner. To achieve this system optimization each system in the current survey suite can be replicated in software, using industry standard computers and digital signal processing interface cards. Using system analysis techniques each system can be

reduced to a series of inputs and outputs, which are quite generic. With the proper definition of inputs and outputs it possible to consider a *sensor engine* running in software, interfacing with other programs via the network and connected to external transducers. This leads to a network of computers, each one replacing a previous hardware system.

PHASE I: Select the operating system, conduct the system analysis, determine if sufficient processing power is available, and fabricate a test bed system with a navigation engine (DGPS input) running in hardware/software and a preliminary survey executive running.

PHASE II: Validate the effort by adding a USBL sensor engine and a side scan sonar sensor engine.

PHASE III: Transition to O&M funding by a Navy Engineering Field Division. Implement a business plan and a commercial investment strategy for marketing the system.

COMMERCIAL POTENTIAL: The commercial potential is high, the contractor will be encouraged to interface with standards organizations such as National Marine Electronics Association and other government sponsored industry groups such as the Marine Mineral Technology Centers to create a commercial standard.

N96-143TITLE: Very Low Cost Miniature Radio Tag with ASIC Architecture

OBJECTIVE: The objective is to develop a small, low cost heterodyne RF transceiver. The transceiver will use ASIC designs for RF and analog circuits.

DESCRIPTION: The principle components of current high technology, state-of-the- art Radio Frequency Identification (RFID) equipment designed for asset management and inventory are the tags and the interrogators. These incorporate extremely sensitive RF transceivers and communicate using Batch Collection®, a proprietary communication protocol. Although effective, these components use discrete elements in their construction, resulting in a high cost for the tags. This high cost limits potential applications, even when technical performance is acceptable. The most revolutionary changes in cost and size will be realized only with an Application Specific Integrated Circuit (ASIC) for the RF circuitry. An ASIC based tag will reduce size and cost to provide lower end item cost visibility. Careful attention to the ASIC design will also allow use in the interrogators to reduce their cost and provide very small portable interrogators.

PHASE I: The current discrete technology consists of an UHF FM transmitter and superhetrodyne receiver. The primary objective is selection of an ASIC technology and architecture with performance similar to the current technology embodiment. The preferred ASIC would use the same transceiver architecture, but a thorough technical specific research program will be necessary to determine if the current architecture is suitable for an ASIC. The research program should result in a clear ASIC development path which is ready for a Non-Recoverable Engineering (NRE) contract with the ASIC design company.

PHASE II: The Phase I investigation will provide the information and test strategy that will be used to develop and demonstrate the ASIC design.

PHASE III: The contractor shall prepare a system for suitable testing on a large scale. Transmission protocols will communicate with tens to thousands of tags present within range, while interfacing the information to a variety of identified military systems. Transition will include commercially available system integration components.

COMMERCIAL POTENTIAL: The availability of a highly cost effective tag, made possible by the ASIC, will greatly expand the applications to which the tag may be suitable by reducing cost and size. In the private sector, particularly the warehousing and transportation industries, the use of ASIC design will expand the use of the tag by allowing its use on relatively inexpensive end items. A reduced size tag will allow mounting on smaller or irregular shaped items which present mounting difficulties for the present designs.

REFERENCES: MIL-STDs 1780, 81, 82; FIPS PUB 1461-1; RFCs 822, 1122, 23