U.S. Army

INTRODUCTION

This second SBIR solicitation for FY 1990 contains a broad range of topics from Army laboratories and centers. A total of 479 topics has been solicited under the Army SBIR Program this year for publication in the two DoD SBIR books. We plan to award contracts for this second solicitation (A207-A479) in the fall of this year. Such a schedule will link SBIR with the normal fiscal year cycle (October 1990 to September 1991) of the Army.

All 479 topics received an additional Washington level review this year to focus the work on potential benefits to the Army in Phase Two and Phase Three. This same review panel will oversee Phase Two project proposals with an eye toward Phase Two/Phase Three payoffs. The Phase One selections will remain decentralized with selections made by the individual laboratories and centers where you send your proposals. Refer to your point of contact page for telephone number for general inquiries.

Please remember to contact Defense Technical Information Center at 800-368-5211 for additional information on these topics including relevant technical reports. Good luck and thank you for participating in the Army SBIR Program.

J. Patrick Forry
Army SBIR Program Manager

Army Small Business Innovation Research Program

Submitting Proposals on Army Topics

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

Belvoir Research Development and Engineering Center
Topic Nos. A90-207 through A90-213

Mail Address	Administrative SBIR Contact
Commander U.S. Army Belvoir RD&E Center ATTN: AMSTR-PBP, SBIR Program Bldg. 314, Procurement Receptionist Ft. Belvoir, VA 22060-5606	C. Harrison 703-664-1068

Communication Electronics Command
Topic Nos. A90-214, 216, 218-224, 226-230, 233-236, 239-244, 246, 248-250

Mail Address	Administrative SBIR Contact
Commander U.S. Communications-Electronics Command ATTN: AMSEL-PCCC-BID, SBIR Program Tinton Avenue Ft. Monmouth, NJ 07703-5000	J. Crisci 201-544-2665

Topics Nos. A90-215, 225, 232, 238, 245, and 247

Mail Address	Administrative SBIR Contact
Director U.S. Army Center for Night Vision & Electro-Optics ATTN: AMSEL-RD-NV-RM-FP SBIR Program (Linda Kline) (Bldg 305) Ft. Belvoir, VA 22060-5677	J. Crisci 201-544-2665

Topics Nos. A90-217, 231, and 237

Mail Address	Administrative SBIR Contact
Director U.S. Army Center for Signals Warfare ATTN: AMSEL-RD-SW-DTI SBIR Program (Linda Monroe) Vint Hill Farms Station (Bldg 260) Warrenton, VA 22186-5100	J. Crisci 201-544-2665

Chemical Research Development and Engineering Center
Topic Nos. A90-251 through A90-258

Mail Address	Administrative SBIR Contact
Commander U.S. Army Cemical Research, Development And Engineering Center ATTN: AMSMC-PC-B(A) Procurement Directorate Edgewood Site/Bldg 4455 Aberdeen Proving Ground, MD 21010-5423	R. Hinkle 301-671-2031

U.S. Army Missile Command
Topic Nos. A90-259 through A90-268

Mail Address	Administrative SBIR Contact
Commander U.S. Army Missile Command ATTN: AMSMI-PC-FB Bldg. 4488, SBIR Program Redstone Arsenal, AL 35898-5280	J. Fulda 205-876-4684

U.S. Army NATICK Research Development and Engineering Center
Topic Nos. A90-269 through A90-275

Mail Address	Administrative SBIR Contact
Commander U.S. Army Natick Research and Development and Engineering Center ATTN: AMSTR-PN, SBIR Program Natick, MA 01760-5011	R. Rosenkrans 508-651-5296

Topic Nos. A90-276 through A90-287

Mail Address	Administrative SBIR Contact
Commander U.S. Army Tank-Automotive Command ATTN: AMSTA-IRSA Bldg. 200A, SBIR Program Warren, MI 48397-5000	R. Hostetler 313-574-5270

U.S. Army Test and Evaluation Command
Topic Nos. A90-288, 293-294, and 297

Mail Address	Administrative SBIR Contact
Commander U.S. Army Belvoir RD&E Center ATTN: AMSTR-PBP, SBIR Program Bldg. 314, Procurement Receptionist Ft. Belvoir, VA 22060-5606	C. Harrison 703-664-1068

Topic Nos. A90-295

Mail Address	Administrative SBIR Contact
Commander U.S. Army Electronic Proving Ground ATTN: STEEP-MO (SBIR Program) Greely Hall Ft. Huachuca, AZ 85613-7110	S. Marshall 301-278-3906

Topic Nos. A90-289, 291-292, 298-301

Mail Address	Administrative SBIR Contact
Commander U.S. Army White Sands Missile Range Directorate of Contracting ATTN: STEWS-PR (SBIR Program) Bldg. 126 White Sands Missile Range, NM 88002-5201	S. Marshall 301-278-3906

Topic Nos. A90-290 and 296

Mail Address	Administrative SBIR Contact
Commander U.S. Army Yuma Proving Ground Directorate of Contracting ATTN: STEYP-CR (SBIR Program) Bldg. 2100, Room 11 Yuma Proving Ground, AZ 85365-9102	S. Marshall 301-278-3906

Ballistic Research Laboratory
Topic Nos. A90-302 through A90-305

Mail Address	Administrative SBIR Contact
Commander U.S. Army Armament, Munitions and Chemical Command Procurement Directorate ATTN: AMCMC-PCM(A), SBIR Program, Ballistics Research Laboratory (BRL) Edgewood Site, Bldg E4455 Aberdeen Proving Ground, MD 21010-5423	R. Dimmick 301-278-6955

Topic Nos. A90-306 through A90-311

Mail Address	Administrative SBIR Contact
Commander U.S. Army White Sands Missile Range Directorate of Contracting ATTN: STEWS-PR, Atmospheric Science Laboratory (ASL) SBIR Program White Sands Missile Range, NM 88002-5031	D. Johnson 505-678-3608

Topic Nos. A90-312 through A90-322

Mail Address	Administrative SBIR Contact
Commander U.S. Army Electronics Technology and Devices Laboratory (ETDL) ATTN: SLCET-DT, SBIR Program Ft. Monmouth, NJ 07703-5000	R. Stern 201-544-4666

Topic Nos. A90-323 through A90-356

Mail Address	Administrative SBIR Contact
Director Harry Diamond Laboratory ATTN: SLCHD-PO-P SBIR Program 2800 Powder Mill Road Adelphi, MD 20783-1197	J. Sattler 301-394-2002

Topic Nos. A90-357 through A90-364

Mail Address	Administrative SBIR Contact
Commander U.S. Army Armament, Munitions and Chemical Command Procurement Directorate ATTN: AMCMC-PCA(A), SBIR Program, Human Engineering Laboratory (HEL) Edgewood Site, Bldg E4455 Aberdeen Proving Ground, MD 21010-5423	J. Sissum 301-278-5815

Materials Technology Laboratory
Topic Nos. A90-365 through A90-375

Mail Address	Administrative SBIR Contact
Director U.S. Army Materials Technology Laboratory (MTL) ATTN: SLCMT-TMT, Management Branch 405 Arsenal Street Bldg. 131, Rm. 144, SBIR Program Watertown, MA 02172-0001	R. Morrissey 617-923-5522

Vulnerability Assessment Laboratory
Topic Nos. A90-376 through A90-378

Mail Address	Administrative SBIR Contact
Commander U.S. Army White Sands Missile Range ATTN: STEWS-PR, SBIR Program Vulnerability Assessment Laboratory (VAL) White Sands Missile Range, NM 88002-5031	J. Arthur 505-678-5766

Aviation Systems Command
Topic Nos. A90-379 through A90-402

Mail Address	Administrative SBIR Contact
Commander U.S. Army Aviation Systems Command ATTN: AMSAV-PSLZ Bldg. 102, SBIR Program 4300 Goodfellow Blvd St. Louis, MO 63120-1798	R. Warhover 314-2263-1082

Construction Engineering Research Laboratory
Topic Nos. A90-403 through A90-405

Mail Address	Administrative SBIR Contact
Commander U.S. Army Construction Engineering Research Laboratory (CERL) ATTN: Chief, Procurement & Supply Branch 2909 Newmark Drive Bldg #1, Rm 175-1, SBIR Program Champaign, IL 61820-1305	D. Moody 217-373-7205

Cold Regions Research and Engineering Laboratory
Topic Nos. A90-406 and A90-407

Mail Address	Administrative SBIR Contact
Commander U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) ATTN: CRREL-AL, SBIR Program 72 Lynne Road Hanover, NH 03755-1290	C. Martinson 603-646-4244

Engineering Topographic Laboratory
Topic Nos. A90-408 through A90-414

Mail Address	Administrative SBIR Contact
Commander U.S. Army Engineering Topographic Laboratory (ETL) ATTN: CEETL-PR-PM, SBIR Program Bldg. 2592 Ft. Belvoir, VA 22060-5546	J. Griffin 703-664-6128

Topic Nos. A90-415 through A90-416

Mail Address	Administrative SBIR Contact
Commander U.S. Army Engineer Waterways Experiment Station (WES) ATTN: CEWES, SBIR Program-CT-C (Mr. Charles Farrior) P.O. Box 631 Vicksburg, MS 39180-0631	P. Stewart 601-634-4113

Medical Research Acquisition Activity
Topic Nos. A90-417 through A90-426

Mail Address	Administrative SBIR Contact
Commander U.S. Army Medical Research Acquisition Activity ATTN: SGRD-RMA-RC, SBIR Program Ft. Detrick, Bldg. 820 Frederick, MD 21701-5014	A. Wolfe 301-663-2744

Strategic Defense Command
Topic Nos. A90-427 through A90-450

Mail Address	Administrative SBIR Contact
Commander U.S. Army Strategic Defense Command ATTN: CSSD-H-CRT (Contracts Office) P.O. Box 1500 108 Wynn Drive Hunstville, AL 35807-3801	D. Satterfield 205-895-4819

Army Research Institute for Behavioral and Social Sciences
Topic Nos. A90-451 through A90-456

Mail Address	Administrative SBIR Contact
Commander U.S. Army Research Institute for Behavioral And Social Sciences (ARI) ATTN: PERI-BR, SBIR Program 5001 Eisenhower Avenue Alexandria, VA 22333-0001	M. Drillings 703-274-5572

Armament Research Development and Engineering Center
Topic Nos. A90-457 through A90-475

Mail Address	Administrative SBIR Contact
Commander U.S. Army Armament Research and Development and Engineering Center ATTN: SMCAR-AST, SBIR Program, Bldg. 1 Picatinny, NJ 07806-5000	G. Magistro 201-724-7349

Army Research Office
Topics Nos. A90-476 through A90-479

Mail Address	Administrative SBIR Contact
Commander U.S. Army Research Office (ARO) ATTN: SLCRO-ZC, SBIR Program P.O. Box 12211 Research Triangle Park, NC 27709-2211	W. Sander 919-549-0641

DEPARTMENT OF THE ARMY
FY 1990 SMALL BUSINESS INNOVATION RESEARCH TOPICS

Belvoir Research Development and Engineering Center

A90-207 TITLE: Aluminum-Lithium Extrusion Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop technology for extruding thin-walled tubes and multi-hollow plates from aluminum-lithium alloys for use in lightweight military bridging applications.

DESCRIPTION: The benefits of aluminum-lithium (Al-Li) alloys which include high strength, increased elastic modulus, and decreased density make them attractive for military bridge applications where weight savings is a prime consideration. Extensive research has been conducted by the major producers of aluminum-lithium to demonstrate physical and welding properties. Extrusion investigations have primarily focused on round bar forms. Funding constraints have prevented the major Al-Li producers from investigating extruding Al-Li in thin walled tubing or multi-hollow shapes, shapes commonly used on military bridges.

Phase I: Design dies and develop all technology necessary for extruding multi-hollow deck plates for the Light Assault Bridge (LAB) deck and thin-walled tubes for the top and bottom chord of the Light Vehicle/Footbridge (LV/FB). Fabricate sub-scale dies and extrude multi-hollow plate and thin-walled tube samples to verify geometry and surface finish. Determine optimal preheat temperature and ram speed.

Phase II: Modify dies in accordance with results in Phase I. Fabricate full-scale dies and extrude multi-hollow deck plates for the LAB and thin-walled tubes for the LV/FB. Verify reproducibility of strength properties and geometric tolerances. Submit design details, Level II drawings, optimum manufacturing temperature and speed, and other quality control measures.

A90-208 TITLE: Design and Development of Adhesively Bonded Joints

CATEGORY: Exploratory Development

OBJECTIVE: To help us achieve our mission of getting lighter and stronger mobile bridges.

DESCRIPTION: It is hard to use adhesives because joint design is not conducive to use of adhesives. To optimize the join so that the join is in shear, and methods for reducing the stress concentration.

Phase I: We would like to have several candidate joint designs for tubular and flat components or bridge structures.

Phase II: (same as for Phase I)

A90-209 TITLE: Mine Detectors

CATEGORY: Basic Research or Exploratory Development

OBJECTIVE: To analytically or experimentally demonstrate the feasibility of mine detection concepts

DESCRIPTION: The Army currently has only a hand held metallic mine detector in its inventory. There is a critical need for a capability to detect nonmetallic as well as metallic mines. The need is for hand held and vehicular mounted detectors.

Phase I: An analytical demonstration of the concept feasibility is required. A description of an experimental approach that would verify the analytical results is required.

Phase II: Experimental verification preferably in a natural environment is required.

A90-210 TITLE: Kerosene Base Fuels in Small Gasoline Engines

CATEGORY: Exploratory Development or Advanced Development

OBJECTIVE: Develop and demonstrate technology that will allow the Army to simultaneously achieve two policy goals:

1. Use of commercial engines that are in large scale production (NOTE: This is a cost motivated goal – lower procurement and support costs).
2. Delivery of a single kersosene base fuel to all tactical equipment, i.e., whatever is available: JP8, JP5, DF1, DF2, DFA (NOTE: This is a cost motivated goal – simpler fuel distribution requiring less people and equipment).

DESCRIPTION: The Army uses engine generator sets to produce electric power for tactical uses in ratings from 1.5 kW to 200 kW. Almost all of the smaller rated sets presently in use by the Army are gasoline engine driven. These smaller sets are present in much larger quantity than our larger rated equipment. We want to simplify logistics by eliminating the need to buy commercial equipment whenever possible, due to the savings, both the initial procurement and throughout the life cycle. Our third desire is to have high specific performance (i.e., low size and weight) necessary for tactical military use at a reasonable cost. To meet our requirements, high performance gasoline engines need to be adapted to burn diesel fuel.

Phase I: Consider various technological approaches to converting small gasoline engines to diesel fuel. Recommend the approach that is most promising in terms of meeting military requirements for small engine generator sets. Prepare plans for Phase II.

Phase II: Demonstrate the approach developed in Phase I, by converting 5 engines (of the same rating) from each of two different manufacturers, to the use of kerosene based fuel and deliver them to Belvoir RD&E Center for incorporation into engine generator set prototypes.

A90-211 TITLE: Phase Disturbing Materials for Scattering of Electromagnetic Fields

CATEGORY: Basic Research

OBJECTIVE: To develop a camouflage system that better matches targets to background terrain.

DESCRIPTION: Background terrains possess an electromagnetic phase disturbance not present in the Army's current camouflage screens. This research seeks to develop materials, suitable for use in screens, that have a greater phase disturbance than present screens.

Phase I: Development of a thin planar material capable of providing both attenuation and phase randomization of electromagnetic fields.

Phase II: Test and evaluation of Phase I materials integrated into a screen.

A90-212 TITLE: Alternatives to Reverse Osmosis for Bulk Water Purification

CATEGORY: Basic Research

OBJECTIVE: Develop a new method to purify any raw water, including seawater desalination and nuclear, biological and chemical contaminant removal.

DESCRIPTION: Currently, the Army sues water purification systems based on reverse osmosis (RO). RO is effective, but considerable energy is required to overcome the osmotic pressure of raw water. Also, elaborate pretreatment systems must be used to prolong the life of expensive RO elements. The Army desires a system that is at least as effective as RO for water purification, yet is smaller, lighter, more economical, and longer-lived than the current systems.

Phase I: Present a theory for a new water purification technique, and demonstrate its feasibility in the laboratory.

Phase II: Build a scale model and demonstrate at several seawater and freshwater sites. Technology gained from this effort will be applicable to commercial water treatment and purification.

A90-213 TITLE: Interactive Video for Deception and Camouflage Evaluation

CATEGORY: Exploratory Development
OBJECTIVE: To design and fabricate a video interactive terminal/system to evaluate different materials or construction for decoys of, and camouflage patterns on, Army equipment.

DESCRIPTION: Video simulations of camouflage patterns and deception materials could be tested to maximize their effectiveness in a variety of terrains in which the equipment might be expected to operate. The combination of video electronics and personal computers would allow the image of the test item to be inserted into a variety of standard terrains. Changes in the camouflage pattern or decoy material's colors and gloss could be made and their effect observed.

Phase I: Demonstrate ability to insert a correctly-size video image of the equipment (e.g. a tank) into a specific location of a background (e.g. a treeline). Then control and change target pattern parameters such as shape, color and gloss in the composite imagery.

Phase II: Expand on simulation capabilities, such as providing scene rotation to view the target from different perspectives.

Communication Electronics Command

A90-214 TITLE: Soldier's Computer, Design of Modular Architecture

CATEGORY: Advanced Development

OBJECTIVE: To design a modular architecture for a pocket size computer based on a projection of future computer component sizes.

DESCRIPTION: The "Soldier's Computer" is a program which will require a pocket size computer consisting of modules for processing, memory, digital radio, global positioning system, battery, helmet-mounted display, input device and potentially numerous other components.

This effort twil require the contractor to design the modular architecture (not any of the specific modules) of a pocket size computer. The physical architecture should be based on a projection of module sizes in the 1995-2000 time frame. A configuration of modules with a total size of 1 1/2" x 7" and a weight of less than 2 lbs. would be desirable. Weight, size and ruggedness are critical factors to the soldier. Offerors should consider proposing a fully ruggedized container into which the lightweight modules are inserted.

Some of the design factors to be considered include the data bus, materials, physical interface of modules, power distribution and conservation, dimensions, and radio antenna.

Further information on the Soldier's Computer can be obtained from U.S. Army CECOM, Advanced Systems Concepts Directorate, AMSEL-RD-ASC-S (James Schoening), Ft. Monmouth, NJ 07703-5000. Phase (201) 532-0014.

Phase I: Conduct a study (including a projection of module sizes) and develop a conceptual approach. Submit a comprehensive proposal for Phase II.

Phase II: Design, build and test prototypes. Note that the actual modules will not be available at this point. Define specifications or architecture.

Phase III: It is hoped that the contractor will pursue a commercial market for this architecture, thereby making the modules commercially available to the government from multiple sources.

A90-215 TITLE: Neural Network-Based Classification Demonstration of Vehicle Laser Radar and Infrared Data

CATEGORY: Exploratory Development

OBJECTIVE: Develop methods to classify military vehicular targets using government furnished laser radar (10.6 micron) vibrational spectra or range data, for eventual integration into an infrared/laser-radar multi-sensor.

DESCRIPTION: The Center for Night Vision & Electro-Optics has had some successes over the years in the classification of military targets, especially vehicles, by traditional image processing and statistical classification methods, using either infrared or laser radar data. However, the use of neural networks may provide better classification then traditional statistical methods, particularly when used in conjunction with both infrared imagery and laser radar vibrational spectra and range data.

Phase I: Develop a neural network-based vehicle classifier using 10.6 micron laser radar range (i.e., 3D) imagery or vibrational spectra.

Phase II: Integrate laser radar and infrared classifiers to demonstrate a multi-sensor classifier showing high probability of classification and low false-alarm rate.

A90-216 TITLE: Target Classification in High Clutter Environment for MTI Radars

CATEGORY: Advanced Development

OBJECTIVE: Determine what modern advances in technology can do to improve radar signal processing in the identification of targets in high clutter environment.

DESCRIPTION: Current U.S. Army radar systems have a problem identifying targets in high clutter environment. This effort will identify advances in technology that will have a significant impact on how well future Army radars will identify targets in high clutter environment.

Phase I: A study will be conducted to determine the impact of recent technological advances on target identification. This study will provide an outline of how technology has grown in the following areas: System noise reduction, increase in receivers, dynamic range, low radar cross section detection, improvement in A/D converter, Filter designs, and clutter suppression. In addition, techniques used to identify targets (e.g. helicopter vs. ground vehicle, track vs. wheel) will also be outlined.

Phase II: A study will be conducted to determine the impact of radar absorbing material, Radar Cross Section reduction, for Track vs. Wheel vs. Helicopter Classification.

A90-217 TITLE: Computer Virus Electronic Counter Measure (ECM)

CATEGORY: Exploratory Development

OBJECTIVE: The objective shall be to determine the potential for using "computer viruses" as an ECM technique against generic military communications systems/nets. The goal shall be to determine the feasibility of remotely introducing a virus into a system/net and analyzing its effects on various subsystem components.

DESCRIPTION: The purpose of this research shall be to investigate potential use of computer viruses to achieve traditional communications ECM effects in targeted communications systems. These effects can include data (information) disruption, denial, and deception, but other effects should also be researched such as effects on executable code in processors, memory storage management, etc. Research in effective methods or strategies to remotely introduce such viruses shall also be conducted. Efforts in this area should be focused on RF atmospheric signal transmission such as performed in tactical military data communication.

Phase I: Phase I shall analyze the feasibility of using viruses as an ECM technique. Analysis shall include validity studies of the concept, types of viruses suitable to be employed in this concept, strategies for virus injection, and analytical and/or simulated predictions of effects. Phase I shall culminate with the submission of a final report that details the above analysis and outlines a method that can validate the concept.

Phase II: Based on analysis performed under Phase I, develop a demonstration method that can validate the virus ECM concept and demonstrate various ECM techniques or strategies. Phase II shall culminate with this demonstration and a final report describing demonstration methodology, results, and analysis of effects compared with predicted effects from the Phase I effort. The final report shall also summarize or make conclusions as to the future potential of using virus ECM techniques or strategies.

A90-218 TITLE: Ada/UNIX Compatibility for Real-Time Applications

CATEGORY: Exploratory Development

OBJECTIVE: To support high performance capability (i.e. similar to bare target implementation) while running Ada on UNIX.

DESCRIPTION: Several issues have been identified related to the interoperability of UNIX with Ada. The most obvious incompatibility is that the Ada concurrency (tasking) can not be implemented efficiently using the standard UNIX concurrency (process) primitives. This forces implementations to use a single UNIX process to contain all of the tasks in an Ada program. The result is that nay system service which suspends an Ada task, also suspends the entire program, effectively negating the desired goal of concurrency. Other problems have been noted, such as difficulty using Ada address clauses, interrupt entries, and accurate timing services. These features are absolutely critical for proper execution of real-time programs.

These limitations of UNIX have no caused serious concern in the past because UNIX was considered only for use as a software development environment. This has now changed with the availability of real-time implementations of UNIX that are designed to support embedded control applications. These implementations achieve response times and support for priorities that allow real-time developers the ability to use UNIX as a target environment.

Phase I: The Phase I of this project will attempt to resolve the incompatibilities between Ada and UNIX for real-time use. Specifically, an implementation of an Ada runtime that provides real-time support features will be designed for an appropriate real-time UNIX system or POSIX extension.

Phase II: The Phase II effort will produce an initial version of the real-time Ada runtime for execution on UNIX and begin preliminary (beta) application testing of the runtime. Phase III would improve the features according to the experience gained from beta testing, ensure the implementation can be validated, and provide the documentation necessary for a commercial product.

A90-219 TITLE: Method for Detecting Pinholes in Hermetic Coatings of Optical Fibers

CATEGORY: Exploratory Development

OBJECTIVE: Develop New on-line methods for detecting pinhole defects in hermetic optical fiber coatings. The detection should be an automatic process implemented after the hermetic coating process and prior to spooling on the draw tower take up reel.

DESCRIPTION: The hermetic coating of optical fiber prevents the degradation of fiber performance when the fiber is exposed to harsh environmental conditions. The coatings not only preserve the pristine strength of the glass but also act as a barrier to hydrogen and hydroxyl ions that can optically degrade the performance of the fiber over time. In fiber optic systems where continued high performance is required over a range of difficult operating conditions, these coatings can be invaluable. Identifying pinholes in these coatings is an important step in improving the production process of these fibers.

In Phase I a thorough investigation of state-of-the-art detection methods should be made. The investigation should include some type of standard by which the effectiveness of pinhole detection methods can be evaluated. Size of the pinhole, location of the pinhole, and percentage of pinholes detected should be included in this standard. Deficiencies in present pinhole detection methods should be identified and a plan for improvement should be formulated. This plan should include an implementations scheme that describes how the hardware/process will be integrated into a draw tower.

In Phase II the plan formulated in Phase I will be executed. This will include the implementation of the detection method on an actual draw tower. The performance of this new system will be evaluated as per the standards developed in Phase I and the results will be documented.

Phase I: Produce a report that contains a survey of present pinhole detection methods, a set of standards to evaluate pinhole detection methods, and a plan to develop a new method of pinhole detection.

Phase II: Implement the plan developed in Phase I with the outcome of producing hardware and procedures for automatic detection of pinholes in hermetic coatings of optical fibers. Emphasis is on the demonstration of this process on a fiber draw tower.

Phase III: Transition of the process demonstrated in Phase II into an operational stage of manufacture that can be used for the everyday production of hermetically coated optical fibers.

A90-220 TITLE: Automated Quality Deficiency Report (QDR) Utilizing Commercially Available Smart Card Technologies

CATEGORY: Exploratory Development

OBJECTIVE: To improve life cycle software support problem reporting and problem resolution processes by utilizing microchip card technologies in lieu of paper forms for supporting large, software-driven Communications-Electronics (C-E) systems.

DESCRIPTION: Present reporting system does not supply all the technical data required by the software engineer to identify and resolve reported problems with software. A system resident technical database containing the systems' hardware and software configuration, serial numbers, revision letters, and other pertinent technical data would be created and maintained using radio frequency/identification (RF/ID) or smart card technology. When a software problem occurs, the system operator or maintenance repairman electronically reads and transfers the database information onto another smart card, manually enters his required inputs describing the software problem observed, and either forwards the card of uploads the information through an appropriate management information system for transfer to the cognizant software engineering center for resolution. Potential exists for also reporting hardware problems in a similar fashion.

Phase I: Conduct a feasibility study to examine the various microchip concepts and technologies which could be utilized to provide a system solution with the desired capabilities. The study should address currently available off-the-shelf products and components, system costs, technical and technological risks, human factors, and ergonomic considerations. The study should also examine alternatives and define a hardware and software system solution approach to support the field reporting process.

Phase II: Design, develop, fabricate, and conduct test and evaluation activities on a prototype demonstration system to demonstrate system feasibility, utility, and worthiness.

A90-221 TITLE: Artificial Intelligence (AI) for Command and Control

CATEGORY: Advanced Development

OBJECTIVE: Develop an artificial intelligence based decision aid for evaluation by Regular Army personnel in a realistic command and control testbed.

DESCRIPTION: A successful proposal must contain both detailed descriptions of the technologies on which the potential decision aid is based; and the specific Army application it is intended to serve. Example include, but are no limited to, the following:

a. A seamlessly integrated geographic information system and knowledge base. Such a system could be designed for one of these applications: determining and evaluating possible avenues of approach, defining optimal positions for artillery emplacements, assisting in the development of combat engineer barrier plans, properly situating signal centers, determining the best lines of communications for logistics support, structuring the best air defense network, or efficiently placing sensor systems.
b. An object oriented tactical simulator with automatic reasoning capabilities. The knowledge base for such a simulator should be populated with relevant information on Red and Blue tactics, equipment, order of battle, terrain constraints, etc. Such a simulator should be designed for realistic wargaming by G-3 staff officers.
c. A cooperative problem solving environment for command and control in a dispersed command post. Such a system must facilitate the formulation of plans and the distribution of orders based on the combined requirements of maneuver, logistics, fire support, air defense, and intelligence units. Inputs and constraints from both higher and lower echelon units must be accounted for and properly prioritized. Methods for ensuring security, accountability, and retention of command authority must be considered.
d. Pattern recognition techniques applied to: terrain analysis (geometric computing); planning (plan monitoring and explanation); or image processing (intelligent image analysis). Applications include sensor interpretation for G-2 staff, tactical plan assessment, and rank ordering of messages entering signal center.

A90-222 TITLE: Detection of Slow Speed Targets in Clutter

CATEGORY: Exploratory Development

OBJECTIVE: Determine what modern advances in technology can do to improve radar performance in detecting slow speed targets in clutter.

DESCRIPTION: Current U.S. Army radar systems have a problem detecting slow speed targets in clutter. These scanning radars were primarily build in the mid 1970's. This effort will identify advances in technology that will have a significant impact on how well future Army radars will perform against clutter. This effort will demonstrate how advance technology can be incorporated to satisfy the Army need.

Phase I: A study will be conducted to determine the key microwave radar technology advances that will improve performance in clutter. This study will provide an outline of where technology has advanced to reduce radar system noise, increase receiver dynamic range and improve clutter suppression. The product of this study will be a receiver design plan that incorporates existing technology for improved radar performance.

Phase II: This effort will consist of producing a brassboard model of the radar receiver from the design plan of Phase I. Receiver parameters will be measured and performance simulated for high clutter-signal ratio input. A report will be generated to assess the impact advance technology has for improved radar performance against clutter.

A90-223 TITLE: Electronically Scanned (E-Scan) Antenna Technology for a Lightweight Battlefield Surveillance Radar (LBSR)

CATEGORY: Advanced Development

OBJECTIVE: To develop small E-scan antenna technology for use in the LBSR program.

DESCRIPTION: The LBSR will replace the AN/PPS-5 and AN/PPS-15 man-portable personnel detection radar systems. The weight of the LBSR must be less than the current systems while its performance must be better. Current man portable radars use manual scan which requires heavy mechanics (e.g. motor and gearing) and a large amount of power to scan the antenna. Since the LBSR has a requirement to weigh under 35 pounds and operate from battery power for long periods of time, the development of small E-scan antenna technology for it is a must.

Phase I: The first phase of this program will result in an analysis and paper design for a small E-scan antenna which will operate at x-band. The antenna must be small enough and light enough to be carried in a pack by a single man. The antenna gain shall be greater than 30 dB and the sidelobes shall be minimized. The antenna shall have the capability to scan from -45 to +45 degrees in azimuth but will not be required to scan in elevation. The azimuth and elevation. The azimuth and elevation beamwidths shall be 4 degrees. A final report will be due at the completion of this phase.

Phase II: The second phase of this program will result in a hardware demonstration of the antenna designed in Phase One. The demonstration will show that the antenna will meet each of the stated requirements. A final report will be due at the completion of this phase.

A90-224 TITLE: Voice Authentication/Recognition

CATEGORY: Exploratory Development

OBJECTIVE: Develop a generic UNIX shall to enable multiple verbal communications with command and control system applications, and demonstrate the feasibility for replacing input/output (I/O) devices for current applications.

DESCRIPTION: Current command and control applications use various input/output (I/O) devices as a mouse, trackball or joystick to allow a user to interface with a computer system. It would be highly advantageous to develop a UNIX shall which allows a user to verbally communicate with the applications on the system. The shell would be required to accept inputs from various users and would, therefore, have to be able to recognize inputs from a variety of tactical personnel under severely degraded conditions. Due to the variety of currently available command and control systems, this tool should be generic enough so that it could, with minimal effort, easily replace an I/O device for current applications.

Phase I: Phase I will result in the initial development of the UNIX shell and a demonstration in which a user verbally communicates with a specific command and control application on the system.

Phase II: Phase II will extend the results of Phase I to accomplish the generic capability requirement to accept inputs from a variety of multiple users under severely degraded conditions, and demonstrate that it can reliably replace an I/O device for current command and control applications.

A90-225 TITLE: Dry Etch and laser Ablation Methods for Processing of Infrared Detector Arrays

CATEGORY: Exploratory Development

OBJECTIVE: To develop a high-yield low cost processing technology for infrared detectors.

DESCRIPTION: Infrared detector arrays are currently manufactured primarily by conventional silicon photolithography. To improve the low yield, high cost of these devices, it is necessary to (1) reduce the number of processing steps and (2) remove the device from the potentially hazardous influences of the atmosphere. To implement (1), CCNVEO proposes the development of dry etch and/or laser ablation processes. To meet the requirements of (2), the processes must be conceived such that they will produce infrared detector arrays in the high vacuum environment of a molecular beam epitaxy (MBE) chamber.

In Phase I, feasibility studies to develop dry etch and/or laser ablation techniques for producing detector arrays on mercury cadmium telluride epitaxial layers will be conducted. These techniques must demonstrate compatibility with MBE processing environments.

In Phase II, the lowest risk processes will be optimized and tested. Testing will be accomplished by constructing vacuum processing modules, delivering them to CCNVEO, coupling them to the new CCNVEO MBE chamber, and demonstrating feasibility of the substrate-in array-out concept.

Phase I: Propose and show feasibility of new concepts for fabricating infrared detector arrays using dry etch and/or laser ablation processes.

Phase II: Optimize dry etch and/or laser ablation processing techniques to demonstrate feasibility of application in vacuum environments.

Phase III: Commercialize the process and equipment for high yield low cost infrared focal plane arrays.

A90-226 TITLE: Low Probability of Intercept/Detection (LPI/D) Techniques

CATEGORY: Communications

OBJECTIVE: Develop a family of operational and/or technical techniques for use in covert short range and long range communications.

DESCRIPTION: This effort will support the application of emerging NSA developed TRANSEC Chips or Modules for achieving a wide range of voice or data covert communications dependent on the particular mission scenario. The resulting Low Probability of Intercept or Detection (LPI/D) capability could then be applied to host Line of Sight (LDS) VHF or UHF systems as well as Non Line of Sight (NLDS) communications systems such as SATCOM or HF systems.

Phase I: In Phase I of this effort, a family of operational and/or technical LPI/D techniques will be identified and developed to support both voice and data communications for use in short range as well as in long range tactical applications. Of particular importance in this Phase will be the actual evaluation of Breadboard/Brassboard versions of the candidate techniques against representative threat systems to categorize potential performance capabilities. This evaluation will either develop or, more likely, use a recognized NSA system for the grading of the level LPI/D capability provided by a particular technique. Further, this grading will address the level of the threat against which the LPI/D technique was evaluated.

Phase II: In Phase II of this effort, the techniques developed earlier will be integrated into suitable host transmission systems to allow for more representative field evaluations. Further, the capability of applying the LPI/D techniques through increasingly more capable levels of Product Improvement to existing host equipments will be evaluated.

A90-227 TITLE: Application of Neural Networks to Command and Control

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic will be to convert state-of-the-art work that has been completed in Neural Networks to software, which can be used for information processing and decision making in a command and control operating environment.

DESCRIPTION: Command and control on the battlefield of the future – i.e. 2000 and beyond – will require extremely fast reaction times and the handling of vast amounts of information. In airborne operations this problem is complicated by the transition from air to land operations. Neural Networks have promise for providing significant improvements in reaction times by providing quantum leaps in the ability to quickly process information and perform decision aid tasks.

Phase I would be the development of a systemized plan and limited demonstration software for applying neural networks to the Army command and control systems.

Phase II would be the development and testing of a working system in a field environment, which could be used in Non-Development Item (NDI) hardware procured for Army command and control systems.

A90-228 TITLE: Software Reuse Tools

CATEGORY: Exploratory Development

OBJECTIVE: To develop tools and/or software metics that will aid in the selection of reusable software assets.

DESCRIPTION: Software has become the major cost of ARMY C3I Systems when considered over the entire life cycle. The Department of Defense (DoD) mandate for the use of Ada endorses the concept of software reuse. Several factors, including non-technical factors, have contributed to the current situation where software reuse has not lived up to the expectations of the DOD. A significant problem when trying to reuse previously developed software assets is the selection of the best asset for the intended application. Current library tools focus on the insertion of components into the library and the identification of components that could meet the requirements of a new application. The objective of this proposal is to develop automated tools which will assist the reuser in the evaluation of assets provided by the search of a reuse database. The asset may be anything form the software development process, from a requirement to a piece of Ada code. Given the nature of software reuse, this is rarely an objective process, but one which increases the confidence of the users choise. This proposal tool will enhance the evaluation process and increase the confidence of the user that the best available asset was selected. Since the time required to select the reusable assets directly affects the cost saved by reuse, automated tools are required to quickly assist the reuser in the selection process.

Phase I: This is the concept validation phase. The result of Phase I will be the development of an approach for determining the usability of software assets and a description or specification of a proposed tool. The deliverable in Phase I will be a technical report describing the tool itself and the types of software assets that the tool can beused with. Demonstration software, if any, will not be deliverable.

Phase II: During Phase II, a prototype tool will be constructed. A demonstration of the prototype in operation will be required to show how the production tool will facilitate the component selection process. Software developed during phase II will be deliverable to the government for evaluation purposes only. After a government evaluation, suggestions on how to make the tool more applicable to C3I systems, may be offered for incorporation into the Phase III production quality versions.

A90-229 TITLE: Software Reuse Technology and Tools

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the Runtime environments needed to reuse software coded in Ada or other language, with respect to the need to port the Runtime environment to the user as well as the application programs.

DESCRIPTION: Software has become a major cost of Army C3I systems. The mandate to use Ada as the code language for the opportunity to reuse portions of an approved tested application program. However, this requires that the fielded systems provide the runtime environment for which the programs were developed. The reuse of embedded machine code would be possible if the required runtime environment were embedded within the applications. Thus the original High-order application code would run on any system which provided a minimum bare-machine environment.

Phase I: Phase I will investigate the bare-machine capabilities of existing and anticipated Army tactical computers with respect to the ability to simulate or emulate the required runtime support software.

Phase II: Develop a composite application software package in Ada or C which will provide the runtime environment needed for a category of embedded Ada or C applications.

A90-230 TITLE: Development of Laser Beam Pointer

CATEGORY: Advanced Development

OBJECTIVE: Development of electro-optic or acousto-optic technology to direct/point laser beams as a substitute for mechanical gimbal assemblies.

DESCRIPTION: The U.S. Army is developing electro-optical systems that require very accurate pointing accuracies to direct laser energy. These systems no use mechanical gimbal assemblies which are heavy and expensive. We would like to evaluate the usage of electro-optical or acousto-optical techniques to direct laser energy as a substitute for these mechanical gimbal assemblies. These techniques would be used in a system that is equipped with a sensor and a processor that determines the position of an aimpoint with high accuracies (20 microradians). The sensor and processor will not be developed under this topic, but will be considered to be commercially available. A one joule neodymium-YAG source at its prime and harmonically generated wavelengths can be assumed for the laser. We would like to determine the capabilities of the above techniques to direct a laser towards the aimpoints with a final pointing accuracy of less than 40 microradians (RMS 1 sigma).

Phase I: The first part of this effort will involve a complete analysis of electro-optical or acousto-optical pointing techniques to determine their performance and feasibility as beam directors.

Phase II: Upon completion of the analysis one technique will be selected, and equipment will be developed based upon the selected technique. A laboratory bench-top experiment will be set up to obtain accuracy data on the device and demonstrate the equipment.

A90-231 TITLE: Acoustic Charge Transport Technology for Electronic Counter Measure (ECM) System Applications

CATEGORY: Exploratory Development

OBJECTIVE: The objective shall be to determine and demonstrate suitable applications for Acoustic Charge Transport (ACT) devices for communications system for ECM system designs.

DESCRIPTION: Increased emphasis on non-European war time environments dictates that smaller, lighter weight and more power efficient systems are needed. While digital signal processors have high accuracy and flexibility, they are also expensive in terms of size, weight and power. Recent advances in Acoustic Charge Transport (ACT) technology have shown considerable promise for low power military applications. ACT devices combine SAW technology and CCD technology and therefore exhibit similar characteristics to today's compressive receivers.

They are fabricated with GaAs material, however, and therefore analog and digital circuitry can be combined on the same chip. Since the input/output circuitry causes much of the power consumption in digital circuits and also because ACT devices are inherently low power, the potential for substantially reduced power requirements exist. This also brings the benefit of higher reliability due to reduced component count. This effort shall investigate the creation and/or improvement of ACT devices to handle certain receiver functions such as signal compression, detection, correlation, programmable delay line, filtering and frequency dehopping to name a few. The reductions in size, weight, and prime power should break new ground as the Army moves toward common modules for ground, air, and UAV applications.

Phase I: Analyze, investigate, and perform studies of the state of ACT technology for application in communications ECM systems. Perform trade-off analysis of various approaches for integrating ACT technology into communications system ECM.

A90-232 TITLE: Application of Anisotropic Thermal Expansions in Crystalline Materials for Use in Interconnect Circuit Boards

CATEGORY: Exploratory Development

OBJECTIVE: To grow materials with desirable anisotropic thermal expansions and to process these materials into interconnect circuit boards for focal plane arrays.

DESCRIPTION: C2NVEO would like to develop a new interconnect circuit board (ICB) for infrared focal plane arrays. The proposed ICV will consist of a wafer of material (approximately 4cm X 4cm X .1cm) which exhibits anisotropic thermal expansion across its surface. The thermal expansion between 300 degrees K and 80 degrees K along one direction on the surface of the water must match silicon (-2.3E-4). Along the perpendicular direction on the surface the thermal expansion must match HgCdTe(-9.2E-4). These thermal expansion properties can be achieved by either of two methods. The first method requires finding a material whose thermal expansion matches Si along one direction in the boule and matches HgCdTe in a perpendicular direction. A wafer would then be cut in the plane of the two axes. The second method requires finding a material with thermal expansion greater than silicon in one direction and less than HgCdTe in the perpendicular direction. For this second method a wafer would be cut at the appropriate angle on the boule which would result in the desired thermal expansion across the surface. Graphite, tellurium, and boron nitride are possible materials. There are no known sources for single crystal tellurium or boron nitride.

Phase I: Demonstrate the feasibility of growing single crystals of candidate materials (or highly oriented polycrystalline materials) and cutting and processing these materials into ICB's.

Phase II: The candidate crystal with the optimal combination of properties and cost will be processed into ICB's. These ICB's will be demonstrated to have the desired thermal expansion properties and to be suitable for use in focal plane arrays.

Phase III: Commercialize the growth and processing of the chosen material. The proposed ICB's will then be supplied to other government contractors.

A90-233 TITLE: Laser Detector Intensifiers

CATEGORY: Advanced Development

OBJECTIVE: Development of intensifier for use with laser detectors.

DESCRIPTION: The U.S. Army is developing electro-optical systems that are required to detect very low levels of laser energy at long ranges. One of the techniques used to detect these low levels incorporates a PIN silicon detector. This technique works well, but we would like to improve on its present performance. One way of improving its performance is to incorporate an intensifier in front of the silicon detector material. We would like to

evaluate the concept of intensifying PIN silicon detectors with a microchannel place (MCP). A one joule neodymium-YAG source at its prime and harmonically generated wavelengths can be assumed for the laser.

Phase I: The initial effort will include an in-depth analysis of the technique which will be used to predict the increase in performance of the detector along with any possible problems associated with the technique.

Phase II: Upon completion of the analysis survey, development of a PIN silicon detector equipped with a MCP will be pursued. The PIN detector with MCP wil be subjected to exhaustive testing to determine its performance parameters and to evaluate its potential.

A90-234 TITLE: Optical Modulator

CATEGORY: Exploratory Development

OBJECTIVE: To develop an efficient electro optical light modulator for use in EO/IR countermeasure systems.

DESCRIPTION: Development of a novel opto-electronic device to modulate light, particularly in the 1 to 5 micron spectral band, radiated by high temperature sources such as arc lamps and incandescent emitters. Desired characteristics are: High throughput power, low insertion loss, modulation rates from 20 to 2000 Hertz and modulation rate agility in times less than 0.1 second.

Phase I: Demonstrate feasibility of approach through analytic procedures. Resolve materials problems/availability. Define Phase II program.

Phase II: Construct prototype modulator(s). Set up an instrument test bed to evaluate performance. Demonstrate performance consistent with program goals.

A90-235 TITLE: Video Bandwidth Requirements for Remoted Applications

CATEGORY: Exploratory Development

OBJECTIVE: Establish a range of video frame rates (data requirements) to allow a remoted operator to confidently drive an unmanned ground vehicle and allow acquisition and tracking of moving targets while operating at only allowable (approved) frequency bands.

DESCRIPTION: The ability of a remoted driver to confidently operate an unmanned ground vehicle is dependent upon the information content available to the operator. Video compression techniques have been investigated that reduces information content of the scene through decreasing update rates or varying update rates of selected portions of an image. Initial acquisition of target would be accomplished by the operator (probably with a low video frame rate) with target tracking accomplished via real-time video. In all cases, the selected operational frequencies will be in Army approved frequency bands.

Phase I: Correlate driving speeds with video frame rates/compression ratios (using approved frequency bands) and to establish minimal bandwidth requirements to accomplish remote driving.

Phase II: Incorporating results of Phase I investigation, the target acquisition/tracking functions will be investigated to correlate video rates with angular tracking rate as a function of target speed. Capabilities of tracking airborne and ground vehicles will be demonstrated at various frame rates established in the initial investigation of Phase II.

A90-236 TITLE: VHSIC Application to Neural Network Systems

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the application of VHSIC High-density integrated circuit technology to large Neural Network (NN) Systems.

DESCRIPTION: Recent development in Neural Network technology demonstrates that effective application of NN technology to advanced computational requirements is dependent on the ability to produce very large connectivity networks. VHSIC technology, with up to one million gates on a single chip, can provide such connectivity.

Phase I: Phase I work will consist of identification of specific very large Neural Networks which could be implemented using VHSIC technology, and development of a demonstrable design.

Phase II: Phase II work will consist of fabrication and test of a hardware brassboard for one or more specific applications.

A90-237 TITLE: High Efficiency Power Combining Techniques

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this research is to develop high efficiency power combining techniques that willr educe the losses that normally occur when power amplifiers (in ECM systems) are combined to produce high output power for Electronic Warfare missions.

DESCRIPTION: Power combining is a technique used in mobile ground based stand-off ECM systems to achieve the required transmitted power to effectively jam distant communications receivers. Techniques and hardware to increase the efficiency of this power combining will improve the effectiveness of the given ECM system. This research effort should consider techniques and hardware to most efficiently combine power outputs from at least two 300 Watt power ampliers. Analysis should also include additional combining results for increased available transmit power. Research should consider requirements and limitations placed on power amplifiers, jamming waveforms, and antenna matching networks in implementing power combining approaches. Typical output connection is assumed to 50 ohm antenna impedance. The operational band of interest is 1-500 MHz. Other considerations to be considered are the military applicability of the technology approaches and the size and weight of potential designs.

Phase I: Phase I shall analyze and determine viable power combining techniques, approaches, designs, and materials that have the best potential for achieving the objectives of this program. Trade-off analysis will result in recommendation of one or more approaches for demonstration. Simulations and/or calculation of expected results shall be presented as part of this analysis.

Phase II: Develop feasible approaches into prototype models and demonstrate performance.

A90-238 TITLE: Fractals Applied to Synthetic Image Generation

CATEGORY: Exploratory Development

OBJECTIVE: Create realistic three dimensional background clutter descriptors which utilize minimal Random Access Memory (RAM) and disk storage requirements. These descriptors will be utilized in the generation of 3D synthetic images. The images will be applied to various Automatic Target Recognizers (ATR) to evaluate their performance.

DESCRIPTION: Fractals are based on the repetitive character of forms in nature that are, for instance, apparent in the small canyons that become visible during an approach to the Grand Canyon, or the little falls in the vicinity of Niagara Falls. There are similarly repetitive forms in branch structures of trees.

Memory requirements are minimized because equations used to create pictures instead of final picture matrices are stored. In approach sequences the shapes are broken up into similar yet randomly distorted smaller structures originated by the same general procedure.

It is desirable to base the fractals on environmental properties instead of artistic intuition of users; therefore considerable research into the causes of the fractal structures is required.

Phase I: Compilation of a library of trees and rock formations that can act as background clutter. Pines and other formations, but not deciduous trees, lend themselves to being stored economically by fractal methods; therefore a discriminate use of fractals is to be planned.

Phase II: Analyze the environmental causes of the structures and the similarities and differences between natural and manmade objects. Phase II is to stress the physics that governs the choice, and clarify its impact on ATR performance.

A90-239 TITLE: Tactical Multi-Media Information Communication System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a viable multi-media information communication system.

DESCRIPTION: Recently, intense research and development efforts have been devoted to a new system concept: multi-media information communication system (MMICS). However, the issues and significance of using a MMICS in the battlefield, have no been explored. A MMICS consists of personal computer-based intelligent terminals and an ISDN. The terminals provide processing and management capability for handling the different media: voice/text/graphics/still picture. The terminals are capable of receiving still pictures from high resolution cameras and free-hand drawing from digitizing tablets or display screens, and converting from one type of media to another (e.g. accepting voice commands and translating to text). The processing capabilities include a text editor, a graphics editor, a picture editor (cut/paste, reduce/enlarge) and a combined editor (superimpose text and graphics on picture). The management functions of the terminals include multiwindow displays, friendly I/O interfaces, and interactive ISDN communications. The network provides various types of communications services, including multi-media information exchange and desk-to-desk conferencing. An example is the distributed blackboard services, in which each conferee can view and draw graphics on the same picture displayed. Tactical utilization of these capabilities not only includes command posts using scenario pictures or terrain maps, but also field stations conducting video reconnaissance and surveillance activities.

Phase I:

a. Develop the system concept of a tactical MMICS.
b. Identify the services capability and utilization possibilities for each of the functional describedin the Air Land Battle 2000 document.

Phase II:

a. Investigate the environmental, operational, and technical issues, including requirements and constraints of the system.
b. Provide system development guidelines, design philosophies, and hardware/software/protocol architecture alternatives, which will be used as a basis for specifying a MMICS using existing systems with modifications and a MMICS using future broadband ISDN systems.

A90-240 TITLE: Improvements in High Frequency (HF) Propagation

CATEGORY: Exploratory Development

OBJECTIVE: Automatic Selection of the Best Channel

DESCRIPTION: HF spectrum has been used for Extended Line of Sight (ELOS) communication for many years. The communication is critically dependent on ionospheric channel. Most of the ionospheric channel models are statistical in nature and have almost reached a state where little would be gained by improving the statistical date base. This solicitation is intended for innovative concepts whereby realistic physical models can be integrated into HF propagation network. The HF network should have adaptive frequency management capability and should utilize the real time environmental data for prediction in both space and time. The model and the associated link management should be simple and be capable to operate in a PC type environment.

Phase I: The contractor will be required to develop his proposed approach into an advanced conceptual design for meeting the above requirements. A feasibility analysis and design shall be performed and demonstration of key concepts provided.

Phase II: Extend the results of Phase I to accomplish the capability requirement to accept inputs from a variety of sources. Demonstration of laboratory scale system.

A90-241 TITLE: Technology for Reengineering Tactical Software Systems

CATEGORY: Engineering Re-Development

OBJECTIVE: To develop tools, methodologies and/or techniques to facilitate reengineering of tactical software systems.

DESCRIPTION: Studies have shown that the maintenance phase is the single most expensive phase of a systems lifecycle costs. Factors which contribute to this expense are that many of the systems currently being maintained were written in assembly language or Fortran, and were not designed using modern software engineering principles or practices. These systems were also documented using standards which were in effect at the time of their conception. Additionally, during maintenance, enhancements to the software is often required due to the system's evolution over its lifetime.

The existence of tools, methods, and techniques for quickly and efficiently reengineering these systems (i.e., producing software engineered versions in Ada) would permit these existing systems to continue to be used, evolved and maintained in a cost engineered version in Ada) would permit these existing systems to continue to be used, evolved and maintained in a cost effective manner. Unfortunately, existing tools and techniques that purport to "reverse engineer" existing software, more often than not produce an Ada version of the Fortran or assembly language code, without reengineering or structuring the software in a software engineering sense. This results in "Adatran" code that has the appearance of Ada, but the structure and problems of Fortran code. The ability to overcome this barrier and to be capable to determining the functional and behavioral characteristics of existing software is essential to the success of quality Software Reengineering CASE Tools.

The objective of this effort is to develop tools, methodologies and techniques to assist in determining the functional and behavioral characteristics of existing tactical software systems for the purpose of reengineering these systems to enable them to be continually refined and improved.

Phase I: This phase should be a concept validation phase. The output is expected to be a report along with some demonstration software. The software does not have to be a deliverable. The report and documentation should illustrate the viability of the approach.

Phase II: This phase should develop a functionally complete prototype version of the proposed software tool(s). The software from Phase II should be delivered for evaluation purposes.

Phase III: This phase will take the prototype along with recommendations from the evaluation, and develop a production quality Software Reengineering CASE Tool.

A90-242 TITLE: Passive and Active RF Decoy Effectivity

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this project is to develop a simulation of passive and active RF decoys. The simulation should be capable of evaluating the effectivity of decoy deployment on various Army airframes against single and multiple threats.

DESCRIPTION: The model should have the following capabilities:
- Single platform vs. single threat decoy simulations
- Single platform vs. multiple threat decoy simulations.
- Capability to optimize parameters such as dispensing time, dispensing range and tow length for a given decoy technique, given platform, and given threat.
- Simulation of active and passive decoy effectiveness for given platform and threat.

Phase I: Establish a software framework. Demonstrate effectivity for a single test case against a single specific threat radar.

Phase II: Develop full scale model to include multiple decoy techniques, multiple Army platforms, and multiple threats.

Phase III: Focus tune model on specific Army/Navy/Air Force decoy projects. Phase III funding would be provided by the project office developing the decoy.

A90-243 TITLE: Digital Interface Between Multispectral Force Laydown and Multispectral Environment Generator

CATEGORY: Exploratory Development

OBJECTIVE: The Advanced Concepts Division of CECOM Center for Electronic Warfare/Reconnaisance Survaillance Target Acquisition (EW/RSTA) has a multi-spectral environment generator (MSEF) capable of simulating radar and laser sources. The MSEG currently consists of 9 RF single point sources coordinated through an RA-100 Radar Signal Simulator and multiple laser bands. The MSEG is designed to test 1553B aircraft survivability equipment integration strategies. A variety of sources to simulate a given threat environment for a flight path through a given laydown.

DESCRIPTION: The program should have the following characteristics:
- Use of structured programming in the Ada language.
- User friendliness for changing flight paths and aircraft types A visual real time display of the threat engagement using computer graphics will be provided.
- Input/Output will be configured in such a manner that changes to tests can be made quickly and economically.
- Software shall be easily restructured to accommodate improvements in the MSEG capabilities. Code shall be well documented.

Phase I: Establish a software framework. Recommend software and hardware purchases to supplement equipment the government already owns. Develop a test plan for the final software product.

Phase II: Write and test Ada code. Deliverables shall include all code and code generating programs (other than compilers) used to develop the software. Host the product in CECOM Center for EW/RSTA's Advanced Concepts Laboratory.

Phase III: Phase III would include modification of this software to accommodate testing on an integrated EW systems such as LHX or modification of the software to accommodate other platforms. Sources of big business funding for phase III efforts would include EW integration contractors.

A90-244 TITLE: Adaptive Array Technology for Transportable Long Wavelength Ground Based Bistatic Radar Systems

CATEGORY: Exploratory Development

OBJECTIVE: Development of survivable ground based bistatic radar systems for surveillance, weapon location and air defense.

DESCRIPTION: Transportable and quickly deployable bistatic long wavelength ground based array radar systems with a ground wave mode of transmission meet Army survivability requirements, and may be applied to fulfill the Army needs for the detection of masked moving targets, and in particular hovering helicopters. These systems must operate in an interference environment which, in addition to ground clutter, includes deliberate sidelobe jamming, multiple narrow band 'friendly' interference sources and natural interference phenomena such as lightening. In addition, because of the long wavelength, transportability requirements, and field installation conditions, a riged array may not be practical. The separate installation of antenna elements of subarrays will yield a significant misalignment from a uniform spaced array. Distortion of the wavefront due to propagation anomalies may also occur.

Phase I: Adpative array techniques need to be developed, during the Phase I program, which achieve coherent cancellation of the sidelobe interference sources, and the best achievable target detection, under the described conditions.

Phase II: The Phase II program will be based on acquiring recorded field test data for a validation and further development of the developed designs.

A90-245 TITLE: Integration of Defense Mapping Agency (DMA) Data Digital Terrain Elevation Data (DTED) and Digital Feature Attribute Data (DFAD) with Texture Overlays

CATEGORY: Engineering Development

OBJECTIVE: Develop a 3 dimensional (3D) terrain model (computer program) to generate a synthetic digital terrain map to be used in synthetic image generation.

DESCRIPTION: Development of this computer program will enable synthesis of a 3D terrain model with texture overlays. The 3D terrain model (computer program) will provide the user with the flexibility of using either DTED or DFAD from the DMA, to produce a 3D map or to develop a totally synthetic terrain map.

Phase I:

a. Develop software programs to generate a co-registered 3D digital terrain map from DFAD and DTED.
b. Develop interpolation schemes to generate a high resolution digital terrain map (less then .5 Meters/Pixel) from low resolution DFAD and DTED.

Phase II:

a. Develop algorithms which completely synthesize the 3D digital map similar to the DTED and DFAD maps. Develop procedures to use the generated 3D digital terrain map for texture overlays.
b. Develop software programs to generate various realistic texture patterns which conform to currently available DFAD and Landsat maps. Develop procedures to map these texture patterns on to the 3D digital terrain map.

A90-246 TITLE: Neural Network Sensor Fusion for Apache Escort Jammer Countermeasures System

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this project is to develop an EW situational display and countermeasures power management system based on neural networks to perform sensor fusion of avionics and electronic warfare systems. Typical avionics information may consist of aircraft speed, direction, altitude, digitized topographical maps, IFF, and aircraft position. Electronic warfare systems will include a minimum of jammer, radar warning receiver, missile detector, and the chaff/flare dispenser. Information will be communicated from the main 1553 bus controller to the EW 1553 bus. The neural network will be an embeddable module within the Apache Escort Jammer processing module interfacing with an Ada software environment.

DESCRIPTION: The neural network shall have the following capabilities:

a. The capability to better perform countermeasure management and situational awareness functions previously performed through standard knowledge-based or expert system techniques. Better performance means improved accuracy and/or increased processing speed.
b. The capability to enhance the pilot's decision-making ability in a dense threat environment.
c. The capability to improve the selection of appropriate countermeasures, reduce jammer beaconing, and the increase speed of countermeasures initiation.

Phase I: Define the inputs and outputs to the neural network. Define the neural network architecture. Define the training methodology for the neural network. If possible, emulate the neural network architecture and demonstrate it against a small test environment.

Phase II: Emulate the neural network in a manner that approaches real time performance. Test the neural network against a good series of test cases. Modify the neural network accordingly. Interface/embed the network in an Apache Escort Jammer countermeasures management system and demonstrate the capability for improved performance.

Phase III: Implement the neural network in hardware. Big businesses involved in Electronic Warfare integration and businesses involved in the development of neural network chips constitute possible funding sources.

A90-247 TITLE: Binary and Amacronic Optics

CATEGORY: Basic Research

OBJECTIVE: The objective is to reduce the cost and increase the performance on the second generation FLIR sensors on the weapon systems to be used for aviation, air defense, and close combat (e.g., LHX, AWAS-H, Heavy Force Modernization, LSAT).

DESCRIPTION: Binary optics and Amacronic optics are terms used to describe optical elements made by micro lithographic techniques that provide optical power and correction by phase differences in the optic's aperture. This technology was developed at MIT Lincoln Laboratory. The benefits of these technologies is in the case of Binary optics to reduce the cost of a FLIR sensor by $1000 (eight elements vs. thirteen elements). In the case of Amacronics the improvements come in the increase of the signal to noise of the detector. In addition, the Amacronics is only the current possible approach for second generation to reduce the signature.

Phase I: Design two imagers incorporating Binary optics, one imager will be for the top hat configuration of the SADA DEWAR and the other will be for the proximal configuration of the SADA DEWAR. During this design effort consider not only the optical performance but also other system parameters such as packaging. Initiate the process for the fabrication of the candidate surfaces.

Design Amacronic optics for SADA back sided illuminated detector. Initiate the process for the fabrication of the Binary optic on the detector substrate.

Phase II: Continue the development of the binary surfaces required for both Top-Hat and Proximal cold shield approaches. Demonstrate the two developed imagers.

Demonstrate the actual improvements of the Amacronic optic on the detector focal plane for four or more adjacent detectors. Continue the process development to cover a 960 x 4 HgCdTe array.

A90-248 TITLE: Microelectronic Display (MIDIS) Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop state-of-the-art generic microelectronic display (MIDIS) technology, mountable on printed circuit boards (PCB) via microcircuit package, to record, store, and display fault detection/isolation data and other system information.

DESCRIPTION: Advances in technology and diagnostic software permit more accurate built-in-test (BIT) at the PCB and to the component level. However, there is no effective and efficient way of sensing faults and fault location, storing the information and displaying failure and other related system data to maintenance personnel, especially once the failed PCB has been removed from its end item. The MIDIS would provide a direct view, readable nonvolatile indicator for identification/isolation of failed PCBs and components and display other relevant system data. Other applications may include prognostics monitor (e.g., green, yellow, red), event recorder (e.g., identification or redundant circuit usage/failure) and inventory/logistics system status indicator. Display devices should be low power, minimum weight/size, reliable, reusable, resettable and designed with human factor considerations.

Phase I: Address concepts/designs/breadboards for this display technology implementation. Conduct investigations, technical analyses and trade-offs on microcontroller/memory requirements, display technologies and strategies, power, operator effectiveness versus design concepts and hardware costs, human factors, and effective architecture for hardware/software implementation. Consideration should also be given to different types of information to be displayed and a potential family of devices.

Phase II: Prototype MIDIS components having undergone successful test and evaluation of various MIDIS applications.

A90-249 TITLE: Signal Bandwidth/Center Frequency Measurement

CATEGORY: Exploratory Development

OBJECTIVE: Develop a means to detect the presence of many simultaneous signals in a wideband IF and to determine the center frequency and bandwidth of each signal present. The output will be real time tuning commands to an adaptive channelizer.

DESCRIPTION: Modern ESM/ELINT receivers must utilize a wide instantaneous bandwidth to intercept modern radars. The present technology for obtaining the instantaneous spectrum over the IF passband consists of SAW dispersive delay lines, Bragg cells, and digital fast Fourier transforms. Programmable filters utilizing acoustic charge transport (ACT) technology exist. If a channelizer is constructed of such programmable filters, it is possible to optimally tune each filter to a signal of interest in the passband, thus overcoming many of the problems with fixed bandwidth/center frequency channels. A means is desired to extract the bandwidth/center frequency of each signal present in the wide instantaneous bandwidth in real time. This data is then to be processed to determine the signals of interest, passed to the receiver signal processor, and used to tune a set of programmable filters to process suitable delayed signals. These signals will typically consist of pulses with durations of 50 nsec to CW, bandwidths from a few hertz to spread spectrum covering several hundred megahertz, and center frequencies which can lie anywhere in the passband. Several pulses from different emitters can be present simultaneously and overlap in frequency. The equipment developed will be integrated and tested with the MEDFLI testbed under actual field test conditions. This technology will subsequently be transitioned into the next generation of ELINT/ESM receivers for the 2000-2010 timeframe.

Phase I: Theoretical analysis addressing the limitations of the proposed technique in terms of: Sensitivity; number of simultaneous pulses; timing analysis including the processing time required to generate/implement the required tuning commands and their duration, signal delay required, and any systematic "dead time" before a new signal could be detected; effectivity analysis in terms of signal density and characteristics which would degrade performance. This should result in a computer simulation which demonstrates the basic feasibility of the proposed approach by generating the appropriate tuning commands from a given input spectrum, and incorporates the theoretical analysis equations/results so that the computer program can be utilized as a design tool for the implementation with specific hardware in Phase II.

Phase II: Implement the proposed technique in an IF processor which is interfaceable with the MEDFLI testbed. Three wideband IF signal channels who phase relationships determines the angle of arrival are provided as an input. The digital output format to the MEDFLI processor is specified and consists of a pulse descriptor word for each pulse received (time of arrival, angel of arrival, frequency, modulation, pulse width, amplitude). Depending on the proposed approach and available hardware, either existing hardware may be modified, or a plug compatible IF processor developed. The system will be tested on simulator, installed on a ground based version of MEDFLI, and later flown on an airborne MEDFLI under actual field test conditions. The technology developed and proven in Phase II will be designed into the next generation of ELINT/ESM receivers or be inserted in preplanned product improvements to existing systems.

A90-250 TITLE: Diode Pumped Dye Laser System

CATEGORY: Advanced Development

OBJECTIVE: Develop a diode pumped dye laser system.

DESCRIPTION: Conventional dye lasers are either flashlamp or laser pumped. New developments have made diode pumping of lasers attractive for military systems. The goal of this tudy is to determine the conditions necessary for diode pumping of dye lasers, the performance that can be obtained, and the demonstration of the system.

Phase I: A survey and complete analysis of conditions for diode pumping of dye lasers is required. Innovative designs based upon the analysis will be presented and the most promising one(s) selected for development.

Phase II: Based upon the findings of Phase I a laboratory bench-type diode pumped dye laser will be developed and demonstrated. An exhaustive analysis of the performance of the system will be made and the potential of the system assessed. The assessment should include realistic comparisons with conventionally pumped systems. A quantitative measure should result for improvements in performance output, conversion efficiency, overall system efficiency, and decreases in system weight and volume.

Chemical Research Development and Engineering Center

A90-251 TITLE: Propagation of Monoclonal Antibodies by Non-Mammalian Vectors

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this project will be to investigate alternate means of the propagation of antibodies in support of point detection systems.

DESCRIPTION: At present, the propagation of monoclonal antibodies is usually conducted in vivo in mize or by in vitro mammalian cell culture techniques. These approaches are both labor intensive and expensive. The use of bacteria or other non-mammalian vectors should dramatically decrease the cost of the production of these materials, resulting in cheaper reagents for implementation into point detection systems.

Phase I: The contractor will demonstrate the growth of a government supplied monoclonal cell line in a non-mammalian vector. The antibodies generated will then be purified, characterized, and evaluated for use in immunoassay systems against conventionally prepared antibodies.

Phase II: Propagate additional types of monoclonal antibodies from such sources as the mouse, rat, and human. Antibodies produced will also be purified, characterized, and evaluated for use in immunoassay systems. A cost vs. benefit analysis will be prepared on these techniques for comparison against conventional systems.

A90-252 TITLE: Use of Polysaccharide Adhesive Infield Pathogen Detection Devices

CATEGORY: Basic Research

OBJECTIVE: To implement the use of a polysaccharide adhesive produced by marine microorganisms for use in field pathogen detection devices. Also, proof of enhanced stability and reactivity of immobilized biologies is required.

DESCRIPTION: The need for detection of threat agents from environmental samples has prompted the use and evaluation of immobilized antibodies for capture and characterization of toxins, bacteria, and bacterial products. Unfortunately, the ideal method for immobilization with retention of biologic activity has not yet been established. Chemicals currently used, such as silane compounds, glutaraldehyde, and other cross-linking agents, exhibit stable immobilization properties but result in a low percentage of reactive antibodies.

Sensitivity of detection of very small amounts of biomass is a critical element of pathogen detection from environmental samples. Therefore, optimal reactivity is essential. Recently, a naturally synthesized polysaccharide from marine bacteria showed adhesive properties strong enough to withstand underwater ocean currents. The successful use of naturally occurring adhesives for immobilization of antibodies could improve sensitivity compared to existing methods for surface capture of threat agents.

Phase I: Demonstrate the use of naturally occurring adhesive substances as immobilization agents for antibodies. Further show that more biologic reactivity is preserved by these adhesives, resulting in high sensitivity of detection, when compared to existing methods.

Phase II: Use the immobilization agent within an instrumented flow analysis design to achieve detection of 1-10 microorganisms per ml from environmental samples.

A90-253 TITLE: Alternate Low Cost Optics for Application to Infrared Chemical Detection

CATEGORY: Basic Research

OBJECTIVE: The purpose of this project is to design an infrared optical window and beamsplitter for use with a lightweight FTIR chemical detector. The use of low cost infrared transmitting materials would greatly improve the feasibility of lightweight FTIR chemical agent detectors.

DESCRIPTION: The U.S. Army Chemical Research, Development and Engineering Center (CRDEC) has recently been engaged in an extensive in-house research program to improve passive infrared chemical detection technology. This research program has focused on developing new infrared technologies to allow for the construction of small, low cost sensors to detect chemical vapors from moving platforms. During the previous two years the research program has made significant advancements in the areas of digital signal processors, digital signal processing algorithms, sampling hardware and optomechanical designs. The recent advancements have the potential of greatly reducing instrument costs over currently available infrared chemical detector devices. However, a significant problem remains in that the currently used optics (ZnSe and Germanium) are a significant cost (approximately $6,000 per beamsplitter) of an infrared chemical detection system. Recently, several low cost materials have been developed for use in the mid-infrared spectral region (8 to 12 microns). One of these materials is an amorphous glass composed of equal mixtures of Selenium, Arsenic, and Germanium. The properties of this material appear to

offer the potential of replacement of the ZnSe optics; however, optical window components have never been constructed of this material for applications involving infrared interferometers. Another candidate infrared transmitting material is a blend of acrylic and polycarbonate polymers. It is known that an infrared bandpass filter was made of this material.

Phase I: The desired result of this investigation would be to review the technology and select a material for application to FTIR chemical detection. The contractor would specifically evaluate the transmission properties, hardness factors, tolerance to chemicals, and the range of dielectric optical coatings that can be used (e.g. Thorium Fluoride).

Phase II: After selection of a material the contractor would fabricate two infrared windows and beamsplitters for evaluation by the in-house passive IR team.

A90-254 TITLE: Low Profile Filter for Nuclear Biological Chemical (NBC) Protective Masks

CATEGORY: Exploratory Development

OBJECTIVE: Due to growing chemical threat, the need for a low-profile/high efficiency filter is necessary. A thin, flexible, and breathable filter material is envisioned to replace the current NBC canister.

DESCRIPTION: As chemical protection levels for the Army continue to increase, the need for a high efficiency/low profile filter is apparent. The size and bulk of the existing canister is already affecting mission performance and cannot be repositioned to alleviate all interface problems. By increasing the surface area of the filtration media, a thin, flexible filter material is envisioned to substitute for the current NBC canister. This thin, flexible, and breathable filter material could serve as both the NBC filter and the protective hood.

Phase I: Specify design concepts and fabricate prototypes

Phase II: Desired results would include production type fabrication and testing of the concepts delivered in Phase I.

A90-255 TITLE: Biogeneration of Obscurants

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate technical feasibility of biologically generating sub-micron diameter particles with aspect ratios greater than 600 to 1.

DESCRIPTION: The project is directed toward the manufacture of obscurant materials by biological processes. Direct generation is the preferred method. However, generation of material followed by another process, e.g., pyrolization, is acceptable.

Phase I: This phase will determine through literature search and laboratory generation the feasibility of producing material in gram quantities.

Phase II: This phase will generate gram quantities of the material and test optical properties in a chamber.

A90-256 TITLE: Urease-Linked Immunoassay Reagent Stability Studies

CATEGORY: Exploratory Development

OBJECTIVE: Investigate means for increasing the stability of immunoreagents used in a particular class of enzyme-linked immunoassays of interest to CRDC. These immunoreagents include urease conjugates, avidin conjugates and

biotin conjugates. Reagent activity can be measured using technology embodied in a commercially available instrument (THRESHOLD, Molecular Devices Corporation, Menlo Park, CA), described below.

DESCRIPTION: The aforementioned sensor technology is being incorporated in a detection system for the Army. Present assay methods in this detection system involve an avidin-biotin binding event to lock the analyte complex of interest onto a nitrocellulose membrane. This membrane-complex is then analyzed in a "reader" which monitors the change in pH due to a urease (present in the complex) – urea reaction. In order to be of value as a field detector, the reagents must be stable over long periods of time (i.e. 5 years) and over a wide temperature range (up to 600 degrees Centigrade). They cannot be refrigerated. A central problem, for example is urease conjugate stability.

Phase I: The contractor will review the sensor and assay technology in question and identify the pertinent areas of concern. A systematic study of a model system urease-antibody conjugate will be conducted to assess methods to enhance its stability and maintain its activity not only during storage but also during its preparation. This phase will be a concept demonstration, primarily aimed at identifying promising avenues of approach for Phase II.

Phase II: Will be concerned with maximizing the urease-antibody conjugate preparation and storage stability to meet Army requirements. Emphasis during this phase will shift as quickly as possible to the actual urease conjugates used in Army applications. It is expected that the Phase II effort will produce protocols for optimum preparation and stable, long term, non-refrigerated storage of urease conjugates, and perhaps other associated immunological reagents, with maximum retention of enzyme and antibody activity.

A90-257 TITLE: Advanced Technology Microphone for NBC Protective Masks

CATEGORY: Exploratory Development

OBJECTIVE: To find a microphone that is smaller and lighter, and exploits more advanced technology than the unit which is currently used in the Army's Chemical/Biological Protective Masks. Implementation of an advanced technology microphone will enable mask designers to reduce mask deadspace which will enhance compatibility with weapon systems, improve intelligibility of communications and improve field of view.

DESCRIPTION: The Army seeks a smaller and lighter microphone to replace the currently implemented Dynamic Microphone. This microphone employs antique technology and is bulky in size. The advanced microphone should be designed taking into consideration that it will be used inside a protective mask. This advanced microphone would allow mask designers to reduce the space needed inside the mask as well as improve intelligibility of communications. Reducing the deadspace in the mask will enhance compatibility with weapon systems and improve field of view.

Phase I: Identify all potential candidates from microphone manufacturers.

Phase II: Development of microphones to meet Army specifications after a preliminary screening has been conducted.

A90-258 TITLE: Surface-Ionization Detection as Applied to Aerosol Mass Concentration and Aerodynamic Size Distribution Analysis

CATEGORY: Basic Research

OBJECTIVE: When the ionization potential of an atom is exceeded by the work function of a heated surface, an electron is released from the atom. This process is called surface-ionization. By using ion collectors and signal amplification, an electrical pulse is generated. Pulse height is a function of particle size and elemental composition. By suitable calibration, surface ionization could be used to monitor the aerosol mass concentration of military smokes. Combining surface ionization detection with a means of achieving particle size selectivity (e.g. electroacoustic/aerodynamic size separation) would provide real time aerodynamic size analysis.

Phase I: Build and calibrate a prototype surface ionization detector for the real time analysis of aerosol mass concentration. Concentration range is 1 to 100 milligrams/cu. Meter for a variety of aerosols (i.e. metallic, graphite, and petroleum based). Work to be completed within nine months at a cost of $50K.

Phase II: Improve the sampling efficiency/response of the surface ionization prototype of Phase I. Incorporate remote readout, battery operation, and unit ruggedness into the improved prototype. Integrate surface-ionization detection into an electrostatic/aerodynamic (or equivalent) particle size classifier for aerosols. Explore commercial applications of the surface ionization aerosol mass/size analyzer. Work to be completed in twenty four months for $250K.

U.S. Army Missile Command

A90-259 TITLE: Development of Warheads with Dual Mission Capability

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate the technology for the development of lethal mechanisms that have dual mission capabilities: armor and fixed wing rotary aircraft.

DESCRIPTION: Commanders and troops prior to engaging the enemy frequently have incomplete intelligence data. This is especially true with respect to the types of offensive weapons to expect. For example, both armor and helicopters will be targets of opportunity in many future battles. Therefore, a warhead effective against both these targets is extremely desirable. Advantages are obvious; increased versatility, simpler logistics, and hopefully reduced cost. The Army desires to develop a technology capable of producing a weapons system and/or warhead that is effective against multiple and diverse targets. Of particular interest are sensing, fuzing, detonation, and profile considerations.

A90-260 TITLE: Model Based Synthetic Discriminant Functions for Pattern Recognition

CATEGORY: Exploratory Development

OBJECTIVE: To optimize the use of SDF's in the tactical missile environment and the target acquisition systems for fire control applications.

DESCRIPTION: Development and test of three types of Synthetic Discriminant Functions (SDF) methods on a model data base shall be evaluated for pattern recognition. Testing shall also be conducted on actual IR and TV data of the same target type. All testing shall be validated on the Sensor Signal Processing System (SSPS) facility at MICOM. Analysis of all tests on both model and actual data shall be fully documented in the final report. The data base and methodology will be provided by government to perform this work.

A90-261 TITLE: Innovative Methods of Fabricating High Performance Fiber Reinforced Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate innovative composite fabrication methodology to eliminate the use of autoclaves or fiberwinder machines in the fabrication of high performance missile components.

DESCRIPTION: High-modulus high-strength fiber reinforced composite structures are presently fabricated only by companies with specialized equipment. This requires companies to make substantial investments before being able to fabricate high performance composite components. Hence, the industrial base for manufacture of composite components is small and the components are expensive. To consolidate and cure fiber reinforced composite components usually requires an autoclave and the component to be vacuum bagged. The autoclave exerts pressure on the surrounding bag and raises the temperature to either cure or melt the resin. Components, which are surfaces

of revolution, also require specialized tooling because they are frequently wound as fibers or tapes on to a mandrel and cured in an oven.

This research will develop methods of fabricating high specific strength and high specific modulus fiber reinforced components which do not depend on an autoclave or a fiber winding machine.

Phase I: Develop and demonstrate innovative composite fabrication methodology. Select a material system and fabricate a test component. The high performance of material must be verified by measuring the following properties: static tension and compression strengths, elastic moduli, and coefficients of thermal expansion. Performance must be comparable to materials fabricated by conventional means.

Phase II: Hardware and methodology for production of components of interest to the U.S. Army must be developed. Life of components in fatigue, static loading, and thermal environments must be determined.

A90-262 TITLE: Probe for Fluctuating Temperature Measurements in Turbulent Supersonic Flows

CATEGORY: Exploratory Development

OBJECTIVE: To measure the high frequency, fluctuating components (as opposed to the mean components) of stagnation and static temperature in high Mach number, high enthalpy, multi-species flows using optical thermometry.

DESCRIPTION: There exists a need to measure the high frequency, fluctuating components (as opposed to the mean components) of density, pressure, velocity, and temperature in high Mach number, high enthalpy and multi-species flows with mixing. Non-intrusive measurements techniques are high desirable, but even intrusive proves can improve on the state-of-the-art.

Optical thermometry offers a promising technique for the measurement of fluctuating temperature since the technique has the required sensitivity and accuracy, has no calibration problems in multi-species flows, and works well in severe environments. This effort would entail the Exploratory Development of a prove suitable for fluctuating temperature measurements.

Phase I: An optical thermometric probe would be designed to measure the fluctuating components of stagnation and static temperature in a Mach 8, 1250 K flow.

Phase II: The probe designed in Phase I would be built and assembled for testing in a government wind tunnel facility.

A90-263 TITLE: Programmable Field of Regard Optical Proximity Fuze

CATEGORY: Exploratory Development

OBJECTIVE: To provide adaptable geometry proximity fuze technology to enhance aimable warhead effectiveness.

DESCRIPTION: Adaptable geometry proximity fuze technology is required to optimize aimable warhead effectiveness in support of high performance air defense. The effective use of aimable warhead technology requires fuzing capable of:

- Adjusting look angle to compensate for different target velocities
- Adjusting axis angle to enhance warhead aiming.
- Providing precise directional information to enhance warhead accuracy.

A fuzing concept capable of achieving these requirements is discussed in Technical Report RD-AS-89-18. The need exists for integration of this concept into a laboratory prototype for further proof-of-principle studies.

Phase I: First phase objective for proposed task is to continue conceptual analysis initiated in-house. Range equation development and signal to noise analysis is required to complete design of laser transmitter/receiver package and lens assembly described in TR RD-AS-89-18.

Phase II: Second phase objective for proposed effort is to design, fabricate, and deliver a prototype laser transmitter/receiver package and lens assembly capable of performing above mentioned fuzing requirements. Prototype fuze packaging should be suitable for in-house laboratory and range experiments.

A90-264 TITLE: Coherent Feed for Spatially Distributed 94 GHz Radar Antenna Array

CATEGORY: Exploratory Development

OBJECTIVE: The objective of the existing and new Millimeter Wave (MMW) Facility is to provide a reliable, cost effective, target scenario signals at 94 GHz and to be coherent to the antenna array and spatially distributed over a field of view of 60 degrees with a path length of 15 meters to the receiver.

DESCRIPTION: Conventional waveguide and space feed techniques of generating simulated target returns from radar illumination in the 94 GHz frequency region are expensive and require high power to obtain the desired ± 10 dBm ERP level at each antenna. Cost-effective concepts are needed to route phase-coherent 94 GHz radar signals, representing target or background returns, to the appropriate elements of a matrix array of antennas spaced at 12-16 milliradian intervals over a field-of-view covering a 60 degree range in azimuth and 10 degree range in elevation. Amplitude and phase weighting among a triad of antennas fed by the target signals is required to achieve the desired angle-of-arrival control. The simulated target return signals are generated at an intermediate frequency (IF) in the range 3-10 GHz and the angle of arrival weighting may be performed at either IF or 94 GHz. Proposed feed techniques should provide ± 1 GHz bandwidth, 120 dB dynamic range and 1.5 degree phase control accuracy.

Phase I: Design a means of feeding a simulated radar return signal to a large field-of-view antenna matrix array for angle-of-arrival control in a hardware-in-the-loop simulation facility for evaluation of coherent 94 GHz missile guidance radars.

Phase II: Fabricate, install and demonstrate the hardware resulting from the Phase I design.

A90-265 TITLE: Joining Techniques for Full Diameter Motorcase to End Closure

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop an efficient means of joining a closure to a full diameter opening rocket motorcase made of composite material.

DESCRIPTION: Small diameter rocket motorcases are most frequently designed with one or both ends having full diameter openings in order to effectively load propellant into the motorcase. In motorcases made of composite material, this head end opening is then fitted with a closure which attaches by some mechanical means such as a pin or key joint. This is an inefficient method and results in a "beefed up" section in this area in order to react the loads through the area where fiber were cut to accommodate the pins, key, etc. A more efficient means of joining a closure to a full diameter opening motorcase is needed.

A90-266 TITLE: Development of High Performance Inertial Measurement for Hypervelocity Missile Applications

CATEGORY: Exploratory Development

OBJECTIVE: To develop an economical, small, and lightweight inertial equipment that will operate in the high 1000 g's environment for hypervelocity missile applications.

DESCRIPTION: In the past, some guidance and control applications required inertial equipment to survive high g shock in a non-operating mode before sequencing to the operational mode in a less severe environment. Requirements for inertial equipment to not only survive but operate through high g environments are becoming more prevalent. Some applications require operation in the ± 1000 g's range. For such a hostil operating environment, the instruments should be small and lightweight.

The availability of rate sensors with these physical characteristics that will operate in the 1000 g's regime appears to be the leading problem area. An exception is the ring laser gyro, whose size (miniaturized version), weight, and performance would make it an excellent candidate for high-g applications. The major current drawback is its relative high cost.

Phase I: The objective of the first phase is to develop a low cost alternate method of measuring angular rate in a high-g environment (up to 1000 g's) that does not require the use of conventional ball bearing or laser gyros and provide a basic design with supporting analysis that will establish feasibility of the proposed design.

Phase II: The objective of the second phase is to build a prototype of the rate sensor designed during Phase I and demonstrate its performance in a high-g (up to 1000 g's) environment.

A90-267 TITLE: High Speed, High Resolution Correlator

CATEGORY: Exploratory Development

OBJECTIVE: To develop a cost effective, fieldable, high speed, high resolution correlator package which is compatible of supporting frame rates required for pointing and tracking accuracies.

DESCRIPTION: High speed, high resolution correlators offer a potential solution to the background clutter and fast retargeting required for the Forward Area Air Defense (FAAD) applications. The techniques have the potential of allowing FAAD concepts to be packaged in cost effective fieldable systems as a result of improved pointing accuracies. Transputer and similar parallel processing technologies show promise in handling the large data through-puts and manipulations required to feed a central pointing and tracking system at a 300Hz to 500Hz rate. A partial frame pixel array with a minimum of 50 x 50 pixels and total grey levels as required for reliable correlations is required. Typical cameras are CCD/CID and their selection may limit or enhance the correlator capabilities.

Phase I: Design, fabricate and deliver a prototype correlator based on commercially available components such as; transputer boards, utilizing inputs from existing CID cameras and with data outputs which interface to existing central control system components. The configuration of this prototype shall be sufficient to prove the basic functional performance and low cost of the design. Although the prototype shall not be required to meet operational requirements of a non-cooperative target, analysis and basic algorithms shall be formulated to allow the correlator to be insensitive to size change and/or rotation.

Phase II: Design, fabricate, and deliver a fully integrated package including a high resolution camera optimized for performance at a minimum of 300Hz, with 500Hz desired and compatible with existing control systems. This package must minimize correlation problems resulting from target rotation and/or size changes during the targeting process.

A90-268 TITLE: Integral Starter/Generator for Small Turbo Jet Engines

CATEGORY: Exploratory Development

OBJECTIVE: To design, fabricate, test, and deliver a prototype starter/generator system for a missile expendable turbojet engine.

DESCRIPTION: For several current and future missile and RPV Systems a turbojet engine is an attractive propulsion system that can provide significant range increases. However, these range increases also result in increased flight times, and thus lead to increased vehicle electrical power requirements. An attractive solution is to install a direct drive shaft mounted generator on the turbojet engine to provide onboard electrical power. Such a generator would eliminate bulky thermal batteries reducing missile weight and volume. This generator could also operate as an electric motor to serve as a starter for the turbojet engines that are up to 7.0 inches in diameter. The system shall be capable of: being integrated with existing engine designs, achieving engine starts in less than 30 seconds, and generating at least 1.0 kw of electrical power continuously for the life of the engine.

Phase I: The objective of the first phase of the proposed effort is to design, fabricate, test, and deliver a prototype starter/generator system. The prototype starter/generator shall be designed for, and integrated with, a small expendable turbojet engine (government furnished engine hardware is available). The prototype system shall be capable of starting the engine and then generating electrical power. The engine mounted starter/generator shall be a flight-weight configuration and fully integrated with the engine. Any supporting electronic controls may be produced in a breadboard configuration. The engine with integrated starter/generator and all electronic controls shall be delivered to the government for evaluation.

Phase II: The objective of the second phase of this effort is to design, fabricate, demonstrate, and deliver a fully integrated, flight-weight, flight-ready starter/generator system. This system shall consist of a turbojet engine with integral starter/generator and all associated electronic controls. This system will be completely compatible with launch vehicle and airframe integration. The contractor shall deliver one or more systems for evaluation.

U.S. Army NATICK Research Development and Engineering Center

A90-269 TITLE: Chemical Heat Sources

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to identify different chemical compounds that produce a usable exothermic output.

DESCRIPTION: Natick has developed an electrochemical heating pad for heating the Meal. Ready-to-Eat (MRE) that is called the Flameless ration Heater. The program has been very successful and has started people thinking that perhaps other problems, including some cold weather problems, could be solved with this or some other type of chemical heater. For example, in the food area: tray packs could be heated or kept warm for extended periods, snow could be melted, and water could be heated for sanitation and beverage; in the clothing area: gloves, boots, and sleeping bags could be heated; in the medical area: patients, blood, and medical supplies could be kept warm; in the equipment area: batteries and communications equipment could be preheated in cold weather; in counter surveillance: cheap IR decoys could be deployed. Chemical reactions of substantial exothermic output need to be identified so that appropriate selections can be made to produce products with differing heat output characteristics including duration and temperature.

Phase I: Analyze different chemical reactions with a potentially useful exothermic output and identify heat characteristics, environmental impact, potential logistics concerns, relative costs, reusable potential, physical limitations and physical hazards.

Phase II: Produce and deliver chemical heat prototype products using several chemical compounds with the greatest potential for selected military applications.

Phase III: Phase III of the program will be used to commercialize the heaters, which if successful, have considerable market potential for outdoor recreation enthusiasts.

A90-270 TITLE: Expression Systems for Fibrose Proteins

CATEGORY: Basic Research

OBJECTIVE: The development of expression systems for the efficient production of recombinant fibrous proteins in high yields.

DESCRIPTION: Protein/genetic engineering techniques are being employed to produce fibrous proteins for various material applications. Although the cloning techniques for proteins/genes are well established, the expression/synthesis of fibrous proteins in high yield with low purification costs has not been standardized. The construction of new high level protein expression systems from eukaryotic/prokaryotic systems are critical and will involve the scaling up of these systems in a commercial process to fulfill military requirements.

Phase I: Analysis and construction of high level protein expression systems derived from eukaryotic and prokaryotic cell lines for the proteins. These expression systems should be designed to simplify gene insertion, identification and product recovery while maintaining high yields of protein and gene stability. Consideration for reducing production and purification costs should be integral with any constructed expression system.

Phase II: Scale-up production of the desired proteins from the optimized expression systems designed in Phase I above. Yields of protein will be determined for each expression and compared to current commercial operations. Protein products will be characterized and estimates of costs for production analyzed in detail.

A90-271 TITLE: Eye Protection Against Tunable Laser Sources

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate materials and methods for reducing the intensity of all laser wavelengths from 400-1065nm.

DESCRIPTION: Eye protection against several fixed-wavelength lasers operating simultaneously in the visible and near-infrared has been feasible for some time. However, is not yet possible to provide similar protection against all wavelengths in this region of the spectrum at the same time. A system of protection is desired that will respond in the subnanosecond time frame, to provide such protection. In the absence of laser radiation, the system should exhibit a high level of visual transmittance, high optical quality and a wide field view.

Phase I: The first phase will include all work necessary to establish the soundness of the proposed approach, including demonstrations of its theoretical validity, if appropriate. In this phase, also, demonstration devices embodying the proposed protective system shall be constructed. The device should exhibit the property of attenuating any laser wavelength in the visible and near-infrared region (400-1054nm) to a significant degree, in less than a nanosecond. The potential for construction of a lightweight, headborne device, using the proposed approach, should be considered.

Phase II: The second phase shall include further development of the technical approach demonstrated in Phase I, to optimize essential characteristics, reduce or eliminate undesirable properties, and demonstrate methods of reducing size and weight.

The second phase shall also include construction of at least three complete goggle-type devices. These shall show improvements in operating characteristics over those exhibited in Phase I devices, in response and recovery times, field of view, optical properties, etc.

Potential manufacturing problems to be anticipated in volume production should be discussed and addressed.

A90-272 TITLE: Diesel-Fueled Refrigeration for Nonpowered Field Kitchens

CATEGORY: Exploratory Development

OBJECTIVE: To develop a diesel-fueled heat source for commercially available heat-driven, ammonia/water cycle refrigerators.

DESCRIPTION: The current Army Field Feeding Systems (AFFS) uses ice chests to preserve perishables. This capability is subject to the availability of ice. Commercial Recreational Vehicle (RV) refrigerators operate off battery power or refined fuels (such as propane, or kerosene). Conventional diesel heat sources are either not reliable and not capable of low firing rates or require air pressure or electric power to operate. There are, however, new technologies (such as the Babington thin-film-burner) that are capable of low firing rates, smoke-free combustion, and operation with minimal electric power (such as disposable batteries or self-powered with a small thermoelectric generator).

A90-273 TITLE: Man-portable Microclimate Cooling Device Utilizing Air-Cycle Technology

CATEGORY: Exploratory Development

OBJECTIVE: To develop a lightweight, man-portable microclimate cooling device that will deliver cool, dry, filtered air to the wearer. This device will use air-cycle technology (reverse Brayton cycle) to achieve this objective.

DESCRIPTION: There is a need to provide portable microclimate cooling to the individual soldier. Currently, the Army is investigating vapor-compression refrigeration to meet its goals. Air-cycle refrigeration, however, offers the opportunity for the development of a lighter-weight, less complex, portable device. The air-cycle approach is totally compatible with the existing microclimate air vest that is currently in the Army system. This air-cycle approach is also currently used in the M1A1 Abrams tank to supply conditioned air to each crewman.

It is desired that this lightweight microclimate backpack be capable of supplying, to the individual, 18 cubic feet/min or air with a maximum of 80 and 55 deg F, dry bulb and dew point, respectively. The design should concentrate on energy recovery in the expansion process of the air cycle to maximize efficiency, as well as compressor and heat exchanger design. This backpack will be powered by a heat engine utilizing a liquid fuel, gasoline or diesel (diesel preferred). The contractor may use a heat engine of his choosing or utilize one under development by the Army.

Phase I: of this contract should be devoted to the design of the air-cycle device, concentrating on the compressor, expander and heat exchanger, with an emphasis on minimizing weight and maximizing efficiency. Information from Phase I should be adequate to determine the feasibility of continuing to Phase II.

Phase II: a working prototype will be constructed and demonstrated to verify design goals.

A90-274 TITLE: Dynamic Optical Camouflage Systems

CATEGORY: Basic Research

OBJECTIVE: The development of dynamic colorant systems that will be able to change color “chameleon-like” with the environment.

DESCRIPTION: Biological systems will be sought that produce pigments that have spectral properties that change with the environment or that blend with the natural environment. Photoactivated pigments will be isolated from natural systems, characterized and modified as necessary. Static pigments will be sought from fungal, algal, and bacterial sources that absorb in the color ranges required for camouflage systems. Variable pigments and organisms have been selected to carry out production, isolation, and purification procedures. Purification and characterization of static pigment from fungi, algal, and bacteria are ongoing.

Phase I: Proof of concept, with the demonstration on a small simplified scale that color signals and color intensities from the environment can be mimicked on a flexible surface. The colors displayed must be able to change with changes in the incoming signals, and these changes must be imaged 180 degrees from the source.

Phase II: Demonstration on a larger scale that the concept developed in Phase I above can be scaled up and is workable with different colors and intensities. The demonstration should approach a flexible fabric as the base material.

A90-275 TITLE: Coated Fabric for Five Soldier Crew Tent

CATEGORY: Advanced Development

OBJECTIVE: Develop fabric to existing Five Solder Crew Tent

DESCRIPTION: The Army has a need for a new, lightweight, fire water and weatherproof fabric for the newly developed Five Soldier Crew Tent. The existing fabric cracks and delaminates following short term exposure.

Phase I: Determine if stated minimum requirements are feasible with current state-of-the-art techniques and materials. Determine if any trade-offs may be required to achieve the desired physical performance characteristics and provide the ramifications of each. Propose possible commercially available materials which may possess the desired minimum requirements and determine prototype cost estimate.

Phase II: Initiate material developed program to continue exploration of promising materials with the goal of obtaining a quantity of prototype yardage to be used in actual end item test applications.

U.S. Army Task-Automation Command

A90-276 TITLE: 2D Raster to 3D Vector Modeling Utilities

CATEGORY: Exploratory Development

OBJECTIVE: To develop a utility to transfer engineering drawing data back and forth between the Army DSREDS and the Intergraph CADEM System.

DESCRIPTION: Currently, any DSREDS drawing is in 2D Raster format and must be manually modeled from scratch into the Intergraph CADEM System. Similarly, drawings generated from CAD models must be plotted and then scanned or photographed into DSREDS. This forces the maintenance of two separate independent databases of much of the same data and involves excessive manpower waste and duplication of efforts.

Phase I: Identify the requirements to achieve such a 2 way transfer and demonstrate it with a sample model/drawing chosen by TACOM.

Phase II: Develop an automated/semi-automated utility usable by TACOM engineers to perform the transfer on a daily basis.

A90-277 TITLE: Personnel Heater

CATEGORY: Exploratory Development

OBJECTIVE: Design, fabrication, and testing of a personnel heater applying technology advances in heat transfer, fluid flow, and combustion.

DESCRIPTION: Presently, the Army uses two sizes of personnel heaters in tracked vehicles. The smaller one provides up to 30K BTU/Hr and the larger one up to 60K BTU/Hr. These units were designed over 40 years ago using technologies available at that time. Subsequent research in combustion, heat transfer, and fluid flow lead to significant advances in these technologies. Application of these technologies to any Army personnel heater has the potential to improve performance and reduce the size, weight and fan power requirements of these units.

Present heaters are 8 inches in diameter and 30 inches long. The replacement heater has to fit within this envelope. On the ventilation side the back pressure is 1.3 inches of water and on the gas side the back pressure is 0.9 inches of water.

The fuels to be used are DF1, DF2, DFA and JP8. The unit should be capable of starting and operating between temperatures of 70°F and -60°F, with the fuel at the ambient temperature.

Phase I: Identification of the innovative emerging technologies and concept design of a complete personnel heater using these technologies. The design should also include controls.

Phase II: Fabrication and laboratory test of selected critical components, such as the burner with controls heater exchanger, igniter, etc. Also, fabrication of the complete heater and bench test for performance.

A90-278 TITLE: Four Input Stacked Microwave Antenna

CATEGORY: Exploratory Development

OBJECTIVE: This program will provide another tool for potential users of robotic system to enable them to achieve multiple vehicle control. The objective is to develop a microwave antenna which consists of four non interfering omni directional microwave antennas combined into one antenna. This antenna would be mounted on an unmanned ground vehicle and would connect directly to four microwave transmitters, without the use of a combiner, for transmitting four video signals.

DESCRIPTION: Current robotic vehicles can transmit up to four simultaneous video back to a command and control center. When one omni directional microwave antenna is mounted on the vehicle, a combiner must be used to connect four microwave transmitters to the antenna. This introduces substantial loss on each of the four video channels. The other alternative is to use four separate microwave antennas mounted far enough apart on top of the vehicle to avoid interference. Each of the four antennas would be connected to one transmitter. This would reduce loss but is not satisfactory because of little available room on the vehicle for mounting antennas. It would be desirable to have a single microwave antenna which could connect to four transmitters and transmit four video simultaneously. The antenna would be required to operate in either the 1710-1850 or 220-2300 MHz bands.

Phase I: In Phase I the contractor would develop a concept for a four input microwave antenna and perform testing of that concept in the laboratory. The concept and testing shall be documented in sufficient detail to allow the government to determine if it will satisfy the requirements for unmanned ground vehicles. Documentation should include projected dimensions and gain of the antenna as well as any interference between the four transmitted signals. The contractor shall submit a final report detailing all work performed during phase one of the contract.

Phase II: In the Phase II effort, the contractor shall fabricate and test a breadboard prototype four input microwave antenna. A vehicle will be provided by the government for integrating the prototype antenna and field testing at TACOM to explore the performance capabilities of the system. The following items shall be deliverable under this effort: design drawings, test report, final report, and the breadboard prototype.

A90-279 TITLE: Investigate Heat Pipe Cooling of Critical Components

CATEGORY: Exploratory Development

OBJECTIVE: Determine if the principle of the sealed "heat pipe" employing a liquid vapor, phase change is feasible means of lowering certain critical lubricant temperatures.

DESCRIPTION: Power steering systems, hydraulic systems, transfer cases, axle sumps are typical applications where passive radiation is often insufficient to adequately control temperature.

Phase I: Develop a suitable sealed heat pickup for immersion in an axle sump, and which conceivably could convey the vapor phase outboard for example, along the axle tubes to increase the heat rejection from the axle system, thereby lowering the critical temperature of the lubricant at the gear mesh. Measure and correlate the results.

Phase II: Explore other potential application for the principle to solve critical temperature problems. Build prototypes, and demonstrate effectiveness of the approach.

A90-280 TITLE: Multiple Purpose Robotic Vehicle Camera Platform

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to design, fabricate, and test a camera platform for robotic vehicles to provide either stereo vision or three camera peripheral operation. Only three cameras would be mounted on the platform with only two being used for the stereo vision mode and all three being used for the peripheral mode.

DESCRIPTION: Current robotic vehicles normally provide either stereo vision cameras or 180 degree peripheral cameras but not both. Those vehicles that do provide both, mount separate cameras for each operation which requires five video cameras. It would be desirable to have a camera platform with three cameras mounted on it that could be selected to provide either stereo vision of three camera peripheral operation. In stereo vision mode, two of the cameras would have to be automatically aligned to provide stereo images. In peripheral mode, all three cameras would be aligned to provide a three camera non overlapping peripheral view. Camera field of view should be selected to best satisfy the combination of requirements.

Phase I: In Phase I the contractor would develop a concept for a multipurpose camera platform and perform testing of that concept in the laboratory. The concept and testing shall be documented in sufficient detail to allow the government to determine if it will satisfy the requirements for unmanned ground vehicles. Documentation should include projected camera mounting locations and alignment techniques, types of cameras and projected alignment accuracies. The contractor shall submit a final report detailing all work performed during phase one of the contract.

Phase II: In the Phase II effort, the contractor shall fabricate and test a breadboard prototype multipurpose camera platform. A vehicle will be provided by the government for integrating the prototype camera platform and field testing at TACOM to explore the performance capabilities of the system. The following items shall be deliverable under this effort: design drawings, test report, final report and the breadboard prototype.

A90-281 TITLE: Intergraph Modeling Libraries

CATEGORY: Exploratory Development

OBJECTIVE: To develop standardized model libraries of commonly used components and drawing symbols used on the Intergraph CADEM System.

DESCRIPTION: There are no standard modeling practices for creation of commonly used parts such as nuts, bolts, bosses, etc. Parts are constructed as needed in random orientation and large duplication of effort is occurring.

Phase I: Identify standard 3D and 2D components for the CAD system, their orientation, and how they will be used (what type of libraries) in models and drawings. A demonstration of some simple examples shall be provided.

Phase II: Develop the CAD model libraries and provide a completed document containing the following information for each model: its part name, its CAD filename, a 3 view graphic picture and ISO view picture, and the component origin.

A90-282 TITLE: Combat Unity Vision Device with Modular Laser Filter

CATEGORY: Advanced Development

OBJECTIVE: To provide a combat unity vision device that provides laser protection flexibility.

DESCRIPTION: Current laser protected unity devices provide fixed laser protection: the laser protection filters are not removable or interchangeable. Future combat unity devices require removable, modular laser filters that will allow the soldier to quickly and easily change the type and level of laser protection. This modular design will allow the unity device to be continuously upgraded to protect against future laser hazards/threats.

Phase I: Redesign an M1A1 commander's short periscope utilizing a modular laser filter design. The bonded body and top level dimensions must remain unchanged. The periscope shall be designed to meet the military specification for tank periscopes (MIL-P-62420). The replaceable section should be bale to incorporate up to two laser filters.

Provide level 1 drawings and an optical analysis of the device.

Phase II: Construct two of the periscopes designed in Phase I, incorporating modular laser filters corresponding to a Category VIII and a Category XI filter, per MIL-F-62543. Test the periscopes in accordance with MIL-P-62420.

A90-283 TITLE: Advanced Drivers Station

CATEGORY: Engineering Development

OBJECTIVE: Develop a driver's station for the VETRONICS Crew Display Demonstrator (VCDD) capable of representing new designs for future vehicles.

DESCRIPTION: The VCDD is a research and design tool used to optimize the Soldier-Machine Interface (SMI) in new or improved combat vehicles. The VCDD currently consists of three major subsystems: computer resources, two crewstations and a control station. The two crewstations currently represent a commander's station and a gunner's station and the driving is done from the controller's station. For best evaluation on the VCDD, a driver's station is needed that is capable of representing a wide spectrum of current or future vehicles.

Phase I: The Phase I effort will consist of designing and building the hardware for the driver's station. The drivers station will consist of metal framework, a drivers seat, displays touch panels and controls. This station will be capable of interfacing and working the the VCDD's current Computer Generated Imagery (CGI) system and A/D interface. A Phase II plan for advanced features and an independent CGI channel for the drivers station will be developed.

Phase II: The Phase II effort will consist of developing advanced features and an independent CGI channel. The advanced features will be to incorporate new seats, controls and displays and make the station as reconfigurable as possible. The independent CGI channel will need to be compatible with the current CGI system and capable of integrating into the VCDD host computer. The effort will be completed when the driver's station along with the new CGI channel is integrated into the VCDD and demonstrated with a run configuration.

A90-284 TITLE: Advanced Displays and Controls

CATEGORY: Engineering Development

OBJECTIVE: To develop Advanced Displays and Controls for the VETRONICS Crew Display Demonstrator (VCDD) with a generic interface that will allow the VCDD to be used in development of future vehicles.

DESCRIPTION: The VCDD is a research and design tool used to optimize the Soldier-Machine Interface (SMI) in new or improved combat vehicles. The current displays and controls that exist resemble M1A1 equipment. As resemble M1A1 equipment. As new displays and controls are developed for the M1A2 (i.e. thumb cursor, flat panel displays) and other future vehicles, the VCDD will have a hard time evaluating the total system unless these controls and displays are in the VCDD. To keep up with these new designs, new displays and controls (i.e. cursor controls, mouse, track ball, form fit handles, new designs in touch panels, flat panel displays, CRT's, programmable push buttons) and a generic interface for these controls need to be integrated into the VCDD.

Phase I: The Phase I effort twill consist of the development of software and hardware to provide cursor controls on both crew stations and at the controller's station. The controls will interface with the VCDD computers and displays. A Phase II plan for integrating future controls and displays with a generic interface will also be developed.

Phase II: The Phase II effort will consist of developing and integrating new controls and displays into the crew stations (i.e. a new commander's handle, a new gunner's handle, flat-panel displays, …). For the integration of these new devices a generic interface consisting of new hardware and software needs to be developed with the capability of connecting with cursor controls, new displays, discrete switches, programmable switches or any other future controlling devices. The effort will be completed when the generic interface is incorporated into the VCDD and is capable of responding to the inputs given by both the crew and the computer simulation control.

A90-285 TITLE: Modular Army System and Attachment Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Devise, design, and demonstrate advanced technology modular armor protection concepts and attachment systems. Design of interchangeable modular armor attachment methods.

DESCRIPTION: Future combat vehicles will employ "Modular Armor" protection systems that can be changed to meet different threat levels. Advanced armor protection units will be mounted and dismounted from the basic vehicle structure as needed. A system of advanced protection units and attachment methods will be designed and developed. This project seeks innovative modular armor concepts and attachment methods for mounting of advanced armor concepts and attachment methods for mounting of advanced armor protection units against large caliber tank fired projectiles and anti-tank missiles. The mounting and attachment hardware, as well as the rest of the vehicle structure, will have to survive the ballistic shock effects transmitted through the armor protection units. A ballistic shock effects absorption system may be required.

Phase I:
- Literature and technology survey.
- Vehicle requirements analysis, threat impact analysis.
- Concept design and evaluations.

Phase II:
- Concept testing and demonstration.
- Application considerations.
- Concept development.
- Breadboard construction and demonstrations.

A90-286 TITLE: Combat Vehicle Final Drive Monitoring for Maintenance on Demand

CATEGORY: Basic Research

OBJECTIVE: To develop an on vehicle final drive monitoring system which can be used to predict impending failure to allow final drive replacement prior to catstrophic failure which could feedback into the transmission.

DESCRIPTION: The concept of Maintenance on Demand is being used by major industries throughout a broad spectrum of applications. These applications vary from aircraft engines to large power generating equipment. The basic principle is to monitor a systems performance characteristics against known or expected performance data. As the system information deviates from this expected performance criteria, an accurate prediction of impending failure can be made. By monitoring the system, these failure predictions can be used to enable corrective maintenance action to take place prior to catastrophic failure of the system. By avoiding catastrophic failure, you avoid secondary damage and over stressing other parts in the system which have greater impact on the system than the primary failure mode.

Systems characteristics which have proven useful as monitoring parameters included such parameters as temperature, pressure, vibrations, stress/strain and acoustical signature. By monitoring one or more of these parameters throughout the duty cycle, they can be used in a predictive manner to prevent a catastrophic condition which would cause loss of mission capabilities of the system. It has been shown in the past that rotating machinery has unique characteristics of vibration and acoustical noise which have proven to be excellent candidates for an on vehicle systems monitoring tool.

This SBIR proposes the development of an on-board final drive monitoring system which will monitor the final drives to prevent catastrophic failure of same. This system must be rugged enough to survive in a combat vehicle environment and have a mean-time-between-failure higher than the final drive system. The monitoring system is to include the latest technology in sensors, instrumentation, artificial intelligence and expert system technology in the design criteria.

Phase I:

- Selection of best parameters to monitor to predict final drive failures.
- Build a prototype system to monitor final drive performance.
- Test the prototype monitoring system in vehicle to substantiate its predictive performance.

Phase II:

- To field harden the prototype final drive monitoring system design to adapt the design across a range of combat vehicles.
- Review all current final drive designs to asses the adaptability of each design to a “standard” monitoring system design package
- Redesign the prototype design to field harden the system.
- Install hardened units on vehicles operational at training sites to assess their durability.
- Successful completion of this SBIR project will stimulate technical innovation in the private sector.

A90-287 TITLE: Investigation of Bearing Technology

CATEGORY: Exploratory Development

OBJECTIVE: Identify and demonstrate new bearing technology and materials for High Mobility Multipurpose Wheeled Vehicles (HMMWV) U-Joints and 5-ton truck sleeve bearing applications that will provide maintenance-free service, increase durability and life in future tactical trucks.

DESCRIPTION: Emerging bearing technology and current bearing designs will be tested side by side. The prototype tests will record speeds, loads, and temperatures and identify bearing type and lubricant. The evaluation of prototype will include cost savings and maintenance improvement, bearing life. For example, this evaluation will be used to enhance the Army’s knowledge of bearing reactions to harsh environments (temperature, water submersion and lubrication contaminants). The analysis of new bearing technology will lead to improved vehicle reliability and cost savings for the Army.

Phase I: Design and fabricate a U-Joint prototype for the HMMWV vehicle and sleeve bearing prototypes for the 5-ton truck. Conduct laboratory tests to compare existing bearing designs with the prototype bearing concepts.

Phase II: Finalize design and modify bearing prototypes. Install bearing prototypes in tactical vehicles and demonstrate the reliability of these bearings in a military application.

U.S. Army Test and Evaluation Command

A90-288 TITLE: Fiber Optic Chamber Pressure Transducer

CATEGORY: Exploratory Development

OBJECTIVE: The Phase III effort will involve manufacturing a quantity of sensors.

DESCRIPTION: It is anticipated that rapid development of electro-thermal (ET) guns will lead to production testing requiring routine measurement of chamber pressures from 50,000 to 120,000 pounds per square inch. A fiber optic transducer is needed to measure high pressures in the intense electromagnetic pulse (EMP) environment of an electro-thermal gun.

At the present time, conventional piezoelectric transducers are used for making pressure measurements in weapons systems. The transducers are optically isolated and then fed to recording instrumentation. Past attempts to develop an entirely optically based pressure transducer have been unsatisfactory.

A transducer is needed to measure high pressure inside electro-thermal guns. The transducer must measure pressures from electro-thermal guns. The transducer must measure pressures from 50,000 to 120,000 pounds per square inch (psi) to an accuracy of ± 1% of reading. Fiber optic techniques must be used because of the large electro-magnetic pulses (EMP) present when the gun is fired. The smallest practical size possible is needed so that the transducer can be used on both large and small caliber weapons. A 10 mm by 1 metric thread is desired. The outside diameter of the transducer must be ½" or less and the length must not exceed 1 ½". A configuration that is externally compatible with the KISTLER 6211 transducer would be ideal. Government owned facilities at Aberdeen Proving Ground, MD may be used on a limited basis to proof test the transducer up to 120,000 PSI.

Phase I: This effort must provide a demonstration (proof of concept) with fiber optic hardware of the prototype transducer. Phase I should focus on new fiber optic technologies, since previous attempts to develop a fully optically based pressure transducer have been deemed unsatisfactory.

Phase II: This effort will involve engineering development of the concept to demonstrate the required measurement accuracy and the capability to produce the transducer consistently.

A90-289 TITLE: Man-In-The-Loop Surrogate for the White Sands Air Defense Test Bed

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype forward area air defense (FAAD) command and control (C2) surrogate node. The C2 surrogate node will provide actual air defense systems under test with the realistic interfaces that one might expect in an actual operational environment. The C2 surrogate node will be used during an actual test when the tactical C2 node is unavailable for the test. The surrogate node will also have the capability of receiving simulated battlefield information from a prescribed scenario, and thus enable the air defense system under test to interface with a C2 component that is subjected to both live and simulated test events.

DESCRIPTION: Design a FAAD C2 element surrogate node. The C2 element is the FAAD command and control node that receives information from a sensor or possibly another command and control node, processes the information, and disseminates it to the appropriate air defense unit. The design of the C2 element surrogate node will not require actual tactical hardware or software. However, both the hardware and software must be of sufficient

fidelity so that actual air defense systems under test that are required to interface with the C2 surrogate element will perform as if interfacing and coordinating with an actual C2 element command and control node. The C2 surrogate will be designed with modifiability as a major attribute. Both the hardware and software should have the capability of being reconfigured to accommodate product improvement changes to the operational C2 off analysis studies used to develop the design. The design specifications can be in the contractor's own format but must contain the essential information required by MIL-STD-490 and DOD-STD-2167.

Phase I: Develop the specifications for the design and development of the man-in-the-loop (MITL) surrogate. The specifications shall include the system specification (A-level), the development specification (B-level) , and product specification (C-level). The A, B, and C-level specifications shall be developed in accordance with the intent of MIL-STD-490 and DOD-STD-2167. The cost, risk, and utility tradeoff analysis studies shall be included in the contractor's product.

Phase II: Develop the prototype MITL surrogate software according to the specifications developed during Phase I. The software shall be tested and demonstrated on existing MacIntosh computer equipment at WSMR. The MITLA surrogate node shall interface and be compatible with both higher and lower level FAAD nodes and with FAAD fire units.

The method of remotely measuring yaw and spin of projectiles in-flight should easily be adaptable to similar needs where the motion of rotating or vibrating platforms is needed.

A90-290 TITLE: Improved Projectile Sensing Methods (Skyscreens)

CATEGORY: Engineering Development

OBJECTIVE: The development of projectile passage sensing devices (skyscreens) which are capable of detecting smaller/faster/more-distant projectiles with greater reliability and ease than present devices.

DESCRIPTION: The sensor is required to detect the passage of a projectile through a fixed plane in space. It is required that the device detect the passage of standard and proposed rounds reliably. The method should be capable of detecting rounds over a 40 by 40 foot area. Existing fin stabilized rounds have a round diameter of about 30 mm with velocities in excess of 4000 ft/second. Projectiles under development can be expected to include somewhat smaller sizes with some having velocities to 10,000 ft/second. Although somewhat dependent on test requirements, timing repeatability to less that 10 microseconds is generally required. Method must be capable of routine precise alignment of the sensing plane.

Phase I: Would consist of complete analytical characterization of proposed techniques and the construction and test of breadboard prototypes of key subsystems.

Phase II: Would consist of the design, fabrication and test of field-capable prototypes. This process would be iterated as necessary.

A90-291 TITLE: Research, Design, and Prototyping of a High Speed Aerial Cable Target Trolley

CATEGORY: Basic Research

OBJECTIVE: To conceptualize, design, and prototype a self-contained high speed trolley that travels on a 16,000 foot two-point suspended single cable and provides for the moving of a suspended airborne target used in missile testing.

DESCRIPTION: The requirement exists to develop a high speed trolley that will travel on a single trolley that travels on a single two inch KEVLAR (reg. trade name) cable. The cable is supported by two mountain peaks and the separation between the mountain peaks is approximately 16,000 feet. The trolley must be self-contained, meaning that it has a propulsion and braking system, power, lights, instrumentation, space for user instrumentation,

and provisions to attach to a tow trolley. Trolley shall self-accelerate down and along the cable to speeds up to 550 knots and maintain constant speed during the test. Braking will be applied appropriately.

Very little experience exists in this field of high speed trolleys that are used to support a target for missile testing. The contractor shall perform study and research in order to develop the basis for designing and prototyping such a trolley.

Phase I: The concept must be developed of suspending and controlling a high speed trolley on an aerial cable. The trolley must maintain neutral lift on the cable as the trolley moves down the cable at speeds of as much as 550 knots. Some of the considerations include; the attachment of the target to the high speed trolley, total control of the trolley as the trolley follows the catenary curve of the cable, and safe braking of the trolley at the end of the test, or as needed. The resulting concept will be a well documented conceptual design.

Phase II: This phase requires the investigation into ways of building an inexpensive, user-instrumentation-adpatable, repairable and controllable trolley, with subsystems, and will not emulate IR/Visual/RF/Ultraviolet signature data of an enemy aircraft in the cable sector where missiles will be fired at a target suspended below the trolley. The deliverables for this phase shall be the comprehensive documentation of the investigation into ways of building the trolley and subsystems, and detailed construction descriptions and drawing package. This design shall include the trolley and the subsystems described as the trolley, trolley suspension and traveling system, propulsion system, braking system, tow trolley attachment system, power/power distribution/lights, control, emergency control, antennas, instrumentation, and container space for user instrumentation. Areas of interest include: not emulating an enemy aircraft in the RF/IR/Ultraviolet and visual areas of electromagenetic spectrum, in the sector of test; addressing the possible flyability of the trolley and the maintenance of neutral lift; providing active control of the trolley so it does not fly; making the target and target subsystem easily removable from the trolley for transport from the test area by standard truck and trailer systems; and investigation of the suspension and traveling system for the trolley on the trolley.

A90-292 TITLE: Conceptualization, Design and Prototyping of High Velocity Simulated Airplane Targets Operating on an Aerial Cable Trolley

CATEGORY: Basic Research

OBJECTIVE: The objective will be to research ways and means, develop specifications, design and build an inexpensive, easily repairable, reusable airborne target that can be attached to an aerial-cable-supported and guided trolley traveling at speeds as high as 550 nautical miles per hour. This trolley-attached target must look like a full-sized enemy aircraft in terms of the infrared, visual, ultraviolet and RF regions of the electromagnetic spectrum.

DESCRIPTION: The requirement exists to develop reusable, inexpensive, easily repairable targets that can be attached to a large aerial cable trolley at a safe distance from the trolley. This trolley will be accelerated along a cable approximately three miles long to speeds up to 550 knots. The target must be well controlled and must present minimum danger to the aerial cable. The target shall emit signature data in the Ultraviolet, Infrared, Visual, and RF regions of the electromagnetic spectrum that emulate real enemy aircraft. Very little experience exists in this field of aircraft simulated targets that attach to able trolleys. Research and study damage and ease of repair when the target is hit.

Phase I: The concept must be developed of suspending and controlling a high speed target below an aerial-cable-supported trolley. The target must maintain neutral lift on the cable as the trolley moves down the cable at speeds of as much as 550 knots. Some of the considerations include: the attachment of the target to the high speed trolley, control of the target as the trolley follows the catenary curve of the cable, and safe release and downward ejection of the target if cable damage is imminent. The resulting concept will be a well documented conceptual design.

Phase II: This phase requires the investigation into ways of building an inexpensive, low damage, repairable and controllable trolley-suspended target with subsystems that will emulate IR/Visual/RF/Ultraviolet signature data of an enemy aircraft. The deliverables for this phase shall be the comprehensive documentation of the investigation into ways of building the target and subsystems, and detailed construction descriptions and drawing package. This

design shall include the target and the subsystems described as the target to trolley suspension system, target control system, and the emergency target ejection/downward thrust system. Areas of interest include: emulating an enemy aircraft in the RF/IR/Ultraviolet and visual areas of electromagnetic spectrum; addressing the probable flyability of the target and the maintenance of neutral lift; providing active control of the target so it does not fly; making the target and subsystems easily removable from the trolley for transport from the test area by standard truck and trailer systems; and investigation of the suspension system for the target below the trolley.

A90-293 TITLE: Upgrading Relative Humidity Measuring Techniques

CATEGORY: Engineering Development

OBJECTIVE: the Phase III effort will involve manufacturing a quantity of sensors.

DESCRIPTION: The current method of measuring humidity levels in the chambers during temperature-humidity testing is to use a series of lithium chloride sensors in the chamber in order to measure the humidity level over the specified range of temperature-humidity. This is necessitated because the lithium chloride sensors are manufactured for only a relatively small range of humidity per model. As a specific model sensor can only be calibrated at a single point, and a series of sensors are used in a single test, there becomes a range of accuracy rather than a single level of accuracy of measurement. The desired system is one that employs a single sensor that can be calibrated and used over the entire temperature-humidity range of a test which is 40 to 160 degrees F with humidity levels from less than 5% relative humidity (RH) to at least 98% RH.

Phase I: The Phase I effort will involve a feasibility study of the system concept design.

Phase II: This effort will initiate prototyping of a humidity measuring system for evaluation of systems accuracy, reliability, and operational ease.

A90-294 TITLE: Heat-Flux Sensor for Transient Convective Fluxes

CATEGORY: Exploratory Development

OBJECTIVE: The Phase III effort will involve manufacturing quantity of a proven sensor with a known and experimentally verifiable time constant as a new piece of valuable instrumentation for use in live fire testing.

DESCRIPTION: A sensor is needed which responds to step change in incident convective heat flux so that 98% of steady state is reached within a time of 20 ms. It must be compact and readily attachable to body clothing for making convective heat flux measurements which could cause burn injury to military crews in compartments penetrated by munitions. The sensor may be configured to control the air stream velocity past the sensor and to prevent response to radiative flux. It must have a known and experimentally verifiable time constant.

Phase I: The Phase I study must produce a theoretical rationale and model for the design. The model must agree with the experimental results obtained for the time constant.

Phase II: The Phase II effort will involve the fabrication of a prototype sensor that can be evaluated under field conditions.

A90-295 TITLE: Artificial Intelligence (AI) Technology Classification Aid

CATEGORY: Exploratory Development

OBJECTIVE: To complete the database and update the system based on “Beta” testing in Phase II.

DESCRIPTION: This research effort will determine the feasibility of developing a software aid to provide the technology manager and staff with the information necessary to understand, employ or test a specific artificial intelligence (AI) model in an embedded system context. The aid will give the manager access to literature, references, programs or source code via a taxonomy of AI techniques mapped into a taxonomy of available data and knowledge base entries. The first taxonomy will establish a framework for categorizing AI disciplines and associated theories, algorithms, techniques, and methods. The second taxonomy will categorize the available data terms of theoretical descriptions, theoretical or empirical analyses, tools applications, test data, or benchmarks. AI technology covered by the first taxonomy should include expert systems robotics, vision, and natural language. The ultimate use of the aid/tool will require that the architecture selected be one that allows straightforward migration to the Ada language for production versions.

Phase I: This research effort will determine the feasibility of developing a software aid to provide the technology manager and his staff with the information necessary to understand, employ, or test a specific AI model in an embedded system context. This aid will give the manager access to literature, references, programs or source code via a taxonomy of AI techniques mapped into taxonomy of available data and knowledge base entries. The first taxonomy will establish a framework for categorizing AI disciplines and associated theories, algorithms, techniques, and methods. The second taxonomy will categorize the available data in terms of theoretical descriptions, theoretical or empirical analyses, tools applications, test date, or benchmarks. AI technology covered by the first taxonomy should include expert systems robotics, vision, and natural language. One of the products from this effort will be an estimate of the magnitude of work for a fully operational tool as well as an indication of the magnitude of the database maintenance effort. The initial tool should contain as complete a taxonomy as possible, although only sample branches may be populated in the database. The final Phase I product should include a recommendation as to which portions of the taxonomy appear closest to actual implementation. The ultimate use of the aid/tool will require that the architecture selected be one that allows straightforward migration to the Ada language for production versions.

Phase II: During this effort, the databases for one or more primary candidate technologies recommended in Phase I will be populated and maintenance initiated. The database population effort for the prototype willf oxus on material related to testing of specific AI models or model combinations to validate the implementation. Initial prototyping of the aid/tool is acceptable in any suitable development environment. The architecture selected will allow straightforward migration to the Ada language for production versions. The software tool will experience initial use and evaluation by a subset of Army technology managers. Some “Beta” testing would be required at this time also.

A90-296 TITLE: Detection of Depleted Uranium Penetrator Fragments

CATEGORY: Engineering Development

OBJECTIVE: Development of equipment and procedures needed to reasonably rapidly survey depleted uranium (DU) contaminated ranges and selectively detect DU fragments.

DESCRIPTION: DU is essentially natural uranium with a substantial fraction of the U235 removed. DU alloy is used in antiarmor ammunition (penetrators). The testing of the ammunition results in DU penetrators in the test range. Because of environmental and other reasons, these penetrators need to be located and removed. It is not required that a suitable detection method detect deeply buried rounds. A detection depth of 2 feet for full penetrators while maintaining reasonable search speed would be fully adequate. Complete penetrators weigh about 10 lbs, and it is desired that the method be capable of locating fragments down to about 1 lb. Precise location of DU during high speed search is not required. Because of the large potentially contaminated area, identification of large areas as being non-contaminated would greatly reduce the area requiring more detailed search.

Phase I: Complete analytical treatment of the proposed techniques in sufficient detail to determine search speeds and detection limits of a system based on the techniques. Experimental (Laboratory or Field) demonstration of the proposed detection techniques. Preliminary system concept design for implementation of techniques.

Phase II: Design, Fabrication, and Test of (full-scale, if feasible) prototype detection system. Prototype would be capable of actual field use in order to demonstrate experimental performance on actual contaminated ranges.

A90-297 TITLE: Warhead Fragmentation Velocity and Mass Measurement

CATEGORY: Exploratory Development

OBJECTIVE: The objective of the Phase III project would be to procure and construct a warhead fragmentation velocity and mass measurement system.

DESCRIPTION: The development of increasingly complex and efficient warheads increases the requirement to accurately and quickly determine the mass, velocity, and the distribution of warhead fragments. Fragment mass typically varies from 0.5 to 3000 grains. Fragment velocity may range from 500 to 7000 feet per second depending on warhead size and configuration. Currently, fragment mass is determined by recovering the particles from fiber board panels and weighing them. Fragment velocity is determined from high speed photography. These existing measurement techniques are slow, labor intensive, and are no longer considered acceptable from the standpoint of accuracy and efficiency.

Phase I: Phase I should incorporate a conceptual plan and a feasibility study.

Phase II: The Phase II effort will involve further refinement of the concept and the design of a fragmentation measurement system.

A90-298 TITLE: Information Processing Utilizing a Database Computer

CATEGORY: Advanced Development

OBJECTIVE: Contract for two database computers for HELSTF.

DESCRIPTION: Data acquisition, data processing, and data management requirements at the High Energy Laser Test Facility are continuing to increase at a rate which makes meeting user requirements almost impossible with the current computer architecture. Handling of data is the overwhelming problem. Addition of a computer to the network that is design to handle data could drastically improve the overall process.

Phase I: The research activity would investigate the feasibility of utilizing a data base machine, as part of the overall computer architecture, to store the many signal parameters of information and to reduce the load on the current data processing equipment. The investigation would also include researching the possibility of also providing distributed base environment to minimize the problems of managing the enormous number of databases and to provide a standardized database environment.

Phase II: Obtain a database computer, port existing data from the current system, and determine the improvement over existing methods.

A90-299 TITLE: Minimize High Energy Laser Systems or Subsystems Preparation Time

CATEGORY: Exploratory Development

OBJECTIVE: Contract which will assess and implement procedural/facility changes needed for optimization of preparation time for the mobile test support system.

DESCRIPTION: High energy laser system pretest activities characteristically take seven to eight hours on the day of test to activate, stabilize, checkout, and align supporting subsystems. The proposed study would evaluate pretest preparations and provide methods to minimize the required time.

Phase I: The research activity would investigate the feasibility of reducing total test preparation times. The investigative task would look at beam alignment activities since they consume the largest increment of system preparation time as well as other promising areas where substantial time savings could be achieved. The suggested solutions would identify changes which would range from procedural changes with minimal impact to implement to recommendations for facility changes with increased costs to implement.

Phase II: A detailed analysis of the test day alignment procedure shortening problem will be presented and recommended facility/procedural changes will be implemented to the degree possible. Any other problem area would receive similar analysis.

A90-300 TITLE: Modification to Mix Helium and Ethylene in Real Time

CATEGORY: Advanced Development

OBJECTIVE: Contract for two controllers to mix the Helium and Ethylene in real time.

DESCRIPTION: The mid-infrared advanced chemical laser uses an ethylene/helium mixture as fuel. The ethylene and helium are currently mixed in a precise ratio before a test, then stored in the run tank. This process of mixing the ethylene and helium presently takes up to several days per batch and can impact the test schedule if sufficient quantities (i.e. batches) can not be made in time to support the various tests. The proposed change would mix the ethylene and helium in the proper ratio in real time during the test. This improved method would increase the number of tests which could be performed with attendant benefits realized from an improved reimbursement rate.

Phase I: The research activity would investigate the feasibility of producing ethylene/helium mix in real time. This investigation would include locating controllers that would mix with the necessary accuracy and the effects of the thermodynamic properties of ethylene on this process.

Phase II: Provide a demonstration to the government of a prototype system that will reliably mix the ethylene and helium in the proper ratio.

A90-301 TITLE: Improved Modeling of Laser Exhaust Atmospheric Diffusion

CATEGORY: Advanced Development

OBJECTIVE: Develop improved model of laser exhaust and atmospheric diffusion.

DESCRIPTION: The exhaust of the high energy chemical laser contains components that are hazardous in nature, specifically, Hydrogen Fluoride (HF) and Nitrogen Tri-Fluoride (NF3). Presently, a meteorological model using existing condition data often predicts that a hazardous toxic corridor of excessive length will occur. Based on this prediction, laser testing is held in abeyance until the model predicts improved conditions. This significantly impacts the test schedule of the nation's only Tri-Service Laser Test Facility and incurs a significant cost to the government. The model presently used in corridor prediction is flawed in several ways and should be updated to reflect latest data on atmospheric diffusion of gases.

Phase I: The research activity would investigate the latest information pertaining to atmospheric diffusion of gases, develop computer models to predict the diffusion activity of the specific gases of concern in the laser exhaust, perform tests, and compile information which confirms the actual behavior of the specific gases, and finalize the computer model.

Phase II: Obtain necessary hardware and software to implement the use of the model and integrate it into a functional method for supporting test operations.

Ballistic Research Laboratory

A90-302 TITLE: Upscaled Self-Propagating High Temperature Synthesis (SHS)/Dynamic Compaction Processing

CATEGORY: Exploratory Development

OBJECTIVE: Determination of the potential for economically mass producing low porosity monolithic ceramic material by SHS/Dynamic Compaction in the quantities and sizes required for ballistic applications.

DESCRIPTION: Self-propagating High temperature Synthesis (SHS) is a potentially economic process for producing a wide variety of ceramic and refractory materials. Materials synthesized by this method are generally quite porous which is undesirable for applications where high structural strength is required. Thus, the SHS process has been combined with dynamic compaction processing to yield a technique fro producing low porosity ceramic material. To date, the majority of this research has been conducted on a laboratory scale. This process has been optimized for the TiB2 and RiC systems to the point where economic and feasibility studies of pilot-plant processing are warranted. Such an investigation must include conversion of the laboratory process into a production process that can be conveniently upscaled by the use of readily available components, evaluation of relevant economic factors and materials evaluation of final products for assurance of quality control.

Phase I: Demonstrate the ability to apply the SHS/Dynamic Compaction technique by fabricating 4 inch diameter by 1 inch thick pieces of TiC at 95% of theoretical density and TiB2 at 98% of theoretical density. Microhardness values for those samples should be comparable with materials prepared by conventional hot pressing methods.

Phase II: Carry out scaled-up production of TiC and TiB2 samples at a rate which will allow the economic factors of full scale production to be extrapolated. Samples fabricated at this time are to be ballistically tested for further material characterization and process optimization.

A90-303 TITLE: High Performance Ultraviolet Through Infrared Optical Fiber System

CATEGORY: Exploratory Development

OBJECTIVE: Demonstration and delivery of high transmission and damage threshold, flexible and durable optical fibers to be utilized at laser wavelengths 0.193-10.6 microns for field applications.

DESCRIPTION: There exists a great need for the U.S. Army to develop optical fibers, couplers and fiber bundles for the transmission of intense laser radiation to single and multiple point locations. This system will be used for laser initiation and chemical analysis in the field. The fibers should be capable of high transmission (›50% from the source) of laser radiation (continuous through pulsed (psec) at wavelengths 0.193 through 10.6 microns through lengths greater than 10 meters). The fibers should have a very high damage threshold, be flexible but durable, and capable of withstanding ›100 laser firings from a pulsed laser source or several hours of irradiation from a continuous laser source. The optical fiber diameter should not exceed 1 mm and the ends should be terminated as a flat polished surface or as a focusing lens. An electro-optic module which is capable of both programmed delivery of laser radiation through individual fibers and of integrity verification, is desirable.

Phase I: An optical fiber materials development and engineering feasibility study will be performed to determine the design parameters required to build the system. An early prototype delivered to BRL for evaluation is desired.

Phase II: Construction of a refined system will be accomplished and delivered to BRL for evaluation.

A90-304 TITLE: YAW Sensing Telemetry

Category; Exploratory Development

OBJECTIVE: To develop a method of making in-flight measurements on the motions of artillery shell and other projectiles. This method should not use optical techniques or use the Sun as a reference nor depend upon location of firing or direction of fire.

DESCRIPTION: The in-flight measurement of the yaw and spin motion of artillery shell has, for many years, been accomplished with the use of optical sensing techniques and standard radio-frequency (RF) telemetry techniques. This is called a yawsonde and uses optical sensors to sense the passage of the Sun as the projectile spins. Pulses from the sensors are telemetered to a ground receiving station using a standard frequency modulation (FM) telemetry system on the projectile. The current yawsonde system, while very successful, can only be used under certain conditions. The sky has to be clear, and since the system depends upon having the sun as a reference, there is a "window in time" in which the yawsonde can operate, depending upon direction of fire, quadrant elevation and ephemeris data. This window can be quite narrow and can be restrictive at times.

What is desired is a system of measuring the yaw and spin motions of artillery shell in free flight. This system should not use the sun as a reference nor be contained by local weather conditions or depend upon firing conditions. Components mounted in the projectile have to survive a launch accelerations up to 60,000 G's. The system should have the same range and accuracy of operation as the current yawsonde and be able to be packaged in a configuration of typical nose fuze for artillery shell or smaller.

Possible candidates for sensing the motion would be single or multiple axis accelerometer or perhaps a system that involves the measurement of phase between sharp nulls in a radiation pattern.

Phase I: To determine and specify alternative methods of measuring yawing motions and spin rates of artillery and other projectiles in-flight. To provide an analysis of accuracy and resolution of proposed systems and an analysis of operation. Feasibility of the methods are to be addressed as well as are methods of data analysis for the proposed method.

Phase II: To deliver to the government units that can be both laboratory test and flight tests to demonstrate the viability of the method of measuring yaw and spin motions of artillery shell, in the nose fuze area and be made to survive the launch conditions. There is a need to demonstrate the method over a wide range of possible motions and to demonstrate the method of data analysis required, i.e., the extraction of yaw and spin time histories form the data obtained.

The method of remotely measuring yaw and spin of projectiles in-flight should easily be adaptable to similar needs where the motion of rotating or vibrating platforms is needed.

A90-305 TITLE: Optical Techniques for Projectile Parameter Measurements in Ballistic and Full Field Ranges

CATEGORY: Exploratory Development

OBJECTIVE: To develop systems that use light for sensing motion and associated acceleration of projectiles, with the goal of measuring the yawing and spinning motion of a projectile in flight. Ultimately, projectile guidance and control will use the system. One use of a simple system is the measurement of the spin of a finned projectile in free flight.

Additionally, a detection and triggering system is needed that detects projectiles from 25mm to 250mm in diameter and at speeds from 60 to 2000 meters/second. The system must detect a projectile independent of whether its tracer is on or off.

DESCRIPTION: To enhance the capabilities of the Army's guidance and control systems on projectiles by using optical techniques, such as micro-electronics coupled to fiber-optic sensors with diode-laser light sources.
Guidance and control in fielded weapon systems relies on technology, such as accelerometers, that, although tried and true, is limited by space and operating conditions.

One initial application of the system is to replace the current method (the "spin box") of obtaining the spin of finned projectiles. The spin box contains sheets of cardboard places such that the projectile is approximately normal to the plane the cardboard sheets form. When the projectile passes through the box, some reference structure on the projectile (a projectile fin, for instance) leaves it mark on the cardboard. The sheets are separated by a short distance so that when the projectile traverses the spin box, the references is not lost, e.g. the fin of the projectile does not rotate enough to be confused with its neighbor. In this way, projectile spin can be measured.

This is a time consuming process: the box must be prepared for each firing; each piece of cardboard must be "read" by a person; the data transferred by hand. These disadvantages are significant.

An optical technique is desired to replace this very awkward system. The optical technique has the advantage of being non-intrusive. It requires no lengthy set-up. It has the ability to be connected directly to a data acquisition device that "reads" the data and transfers them electronically.

The system might be a series of short duration, high energy pulses of light to obtain data in two-dimensional slices. The pulses of light can be obtained from either a laser or a series of high energy flash tubes. Another approach might be to use a laser to track an intentional anomaly on the projectile. Interrogation of the resulting images might require high speed (possibly parallel) computing and the associated image processing hardware and software.

Another technique may be to use an on-board measurement system and to telemeter the information back to a ground station. This would be a direct spin-off of the system that would be used for guidance and control.

The detection and triggering system should also rely on optical techniques. It has a specific application in spark ranges that produce shadowgraphs of projectiles in free flight from which time and position can be measured accurately. Large caliber tape; the projectile is detected by breaking the light sheet between the two. Triggering comes directly form detection, with some time delay included.

A light sensitive film is used to photograph the projectile and its image on highly-reflective screens located on two walls at each individual station so the triggering system can not interfere with this operation. The current system is undesirable because it triggers for tracing OR non-tracing projectiles. This is a problem when the tracer intensity is inconsistent throughout the range.

The first system should be designed for use in a range that has a cross-section 10 meters by 10 meters. The detection window should be 2 meters by 2 meters, and a total of 25 systems would be needed. There are 1 meter square trenches located on the floor of the range and the triggering device should be located in this area to fully protect it from any fragment damage.

Other applications: the detection and triggering system could be used in any instance where detection of a moving object and subsequent action is required (in an elevator, for example).

Measurement of projectile motion and acceleration is akin to measuring the same on aircraft or spacecraft. It could even be applied in robotics where the need for small components is also of interest.

Phase I: Identify best techniques for obtaining on-board projectile motion and acceleration. Identify best technique for obtaining spin data. Identify and develop light sources and collection media. Perform initial spin measurements; interrogation by hand. Design of detection and triggering system.

Phase II: Develop prototype system for measuring projectile motion and acceleration. Develop interrogation equipment and techniques. Develop interface to computer resources. Perform automated or electronic data acquisition. Construct a prototype detection and triggering system.

Atmospheric Science Laboratory

A90-306 TITLE: Airborne Detection of Gaseous Constituents

CATEGORY: Exploratory Development

OBJECTIVE: Development of an airborne sensing device to detect and identify molecular off-gassing of controlled/suspicious substances.

DESCRIPTION: There is a need for information regarding the location and production of illegal substances. An airborne remote sensing system can help identify such such clandestine operations.

Phase I: Design and engineer a remote sensing package for operation from an aerial platform. The system should be assembled and fully tested prior to incorporation onto an aircraft.

Phase II: Fabrication and demonstration of the optical remote sensing system in an airborne mode.

A90-307 TITLE: Field Measurement of Bi-directional Energy Reflectance in Ultraviolet to Millimeter Wave (MMW) Electromagnetic Wavelengths

CATEGORY: Exploratory Development

OBJECTIVE: Development of a methodology to make field measurements of bi-directional energy reflectance in ultraviolet to MMW electromagnetic wavelengths.

Descriptions: The current thrust in modeling electro-optical phenomenology is toward physically based models which require, for initialization and/or validation, measurements of the multi-directional nature of the reflectance of energy from surfaces. Techniques for measurement of these parameters in certain wavelength bands (3-5 micrometers) are currently available in a laboratory setting but are neither portable nor multi-spectral.

Phase I: Develop methodology for field measurements of the hemispherical reflectance from surfaces as a function of wavelength and position on the hemisphere. Develop and/or modify existing instrumentation to provide a field portable capability to measure bi-directional reflectance in selected wavelength bands.

Phase II: Validate measurements.

A90-308 TITLE: Impact of Target Shadows on Target Acquisition

CATEGORY: Exploratory Development

OBJECTIVE: Development of an algorithm or methodology that can be used to include the effects of target shadows on target acquisition by devices operating at visual or near infrared wavelengths.

DESCRIPTION: Target acquisition models currently being used to develop tactical decision aids could be greatly enhanced by the inclusion of a shadow model that quantifies the effect of target shadows in the visual scene on target acquisition.

Phase I: Develop a computer model to characterize the effects of shadows on target acquisition for visual and near infrared wavelength devices. This shadow model would account for the effect of shadows due to the target. Some targets might be acquired at significantly larger ranges because of shadows. A model like the one being described here should transition naturally into use in a visualization scheme where a scene and target are computer drawn and shadows of targets would provide additional realism. The model should use modest amounts of computer time and space, and should use standard meteorological information and solar position as input. The existing target

acquisition model already contains a module for computing the solar position from the following information: year, day of the year, time of the day, and position on earth surface.

Phase II: Evaluate the shadow model developed in Phase I comparison for field data. Integrate shadow model into the Atmospheric Sciences Laboratory target acquisition model.

A90-309 TITLE: Impact of Scene Shadows on Target Acquisition

CATEGORY: Exploratory Development

OBJECTIVE: Development of an algorithm or methodology that can be used to include the effects of scene shadows in the environment on target acquisition by devices operating at visual and infrared wavelengths.

DESCRIPTION: Target acquisition models currently being used to develop tactical decision aids could be greatly enhanced by the inclusion of a shadow model that quantifies the effect of shadows in the scene on target acquisition.

Phase I: Develop a computer model to characterize the effects of shadows on target acquisition for visual, near infrared wavelength devices. This shadow model would account for the effect of shadows due to clouds, mountains, and other environmental factors on a scene. Such shadows can drastically change the contrast of a scene, depending upon the sun's orientation. The model should use modest amounts of computer time and space, and should use standard meteorological information and solar position as input. The existing target acquisition model already contains a module for computing the solar position from the following information: year, day of they year, time of the day, position on the earth surface.

Phase II: Evaluate the shadow model developed in Phase I by comparison to field data. Integrate shadow model into Atmospheric Sciences Laboratory target acquisition model.

A90-310 TITLE: Four Dimensional Mesoscale Nongaussian Multispectral Smoke Model

CATEGORY: Exploratory Development

OBJECTIVE: Develop a nongaussian multispectral smoke model for the simulation of diffusing obscurants in the surface and planetary boundary layers as a function of time with respect to a Lagrangian wind field.

DESCRIPTION: There is a need for a facile nongaussian diffusion model that may be used to rapidly estimate concentrations of obscurant clouds originated by various dissemination methods. The model should be capable of producing meaningful solutions on a microcomputer with one megabyte of RAM.

Phase I: Develop an algorithm with the capability of characterizing 4D smoke cloud diffusion utilizing readily available meteorological observations. The model should be compatible with and driven by terrain-influenced Lagrangian mesoscale wind model.

Phase II: Evaluation and testing of the prototype code using a variety of input observations obtained over variegated terrain, in all seasons and several climates.

A90-311 TITLE: Atmospheric Boundary Layer Stability Estimators for Urban Areas

CATEGORY: Exploratory Development

OBJECTIVE: Develop an atmospheric stability estimating methodology for urban areas that will characterize the stability spectrum as a continuous function and gracefully transition form open areas.

DESCRIPTION: There is a need for a method to replace the Pasquill Stability Categories as a turbulent typing scheme for the surface boundary layer. The Pasquill approach, which may not be appropriate in the urban environment, provides step-function estimates of stability and turbulence. As a consequence, discontinuities occur as stability increases and decreases.

Phase I: Develop an algorithm for urban areas that determines stability as a continuous function. The model should be conservative in computer time and space usage and should be written in PC-compatible form. It should use standard meteorological parameters as input.

Phase II: Evaluation and testing of a prototype code using a variety of input observations obtained over urban and open terrain types in all seasons and climates.

Electronics Technology and Devices Laboratory

A90-312 TITLE: Cathodes for High Temperature Molten Salt Lithium Batteries

CATEGORY: Exploratory Development

OBJECTIVE: Development of new cathode materials for high temperature molten salt lithium batteries.

DESCRIPTION: The U.S. Army requires high temperature rechargeable molten salt lithium batteries for pulse power applications. The formulation which presently comes closest to meeting projected power density requirements consists of a lithium alloy anode, lithium halide-alkali halide eultectric mixtures as electrolytes and iron disulfide as the cathode material. The cell is operable in the temperature range of 350-500 C. For pulse power applications, projected discharge densities of the order of tens of amperes per square centimeter are required in the fractional second range and hundreds of amperes per square centimeter in the millisecond range.

The above goals can be furthered through the development of new cathode materials capable of delivering high power pulses with higher energy and low operating temperatures than the present system. These new cathode materials must be chemically and electrochemically stable in the molten salt cell environment. The new cathode materials will be characterized in half-cells using modern electrochemical techniques and tested in full cells for their current carrying capabilities.

Phase I: Phase I should result in one or more candidate high energy cathodes and compatible electrolytes. Validity of the cathode/electrolyte formulations should be demonstrated through voltammetry in laboratory half-cells and through preliminary studies of chemical stability.

Phase II: One of the candidates cathode/electrolyte combinations shall be explored more thoroughly. Complete cells or bipolar stacks of cells, having electrodes of at least several square centimeters in area, will be constructed and evaluated for pulse-carrying capability, rechargeability and chemical stability.

A90-313 TITLE: Quartz Resonator Aging Reduction

CATEGORY: Exploratory Development

OBJECTIVE: Develop methods for reducing the aging quartz crystal resonators.

DESCRIPTION: One of the major limitations on the performance of quartz crystal resonators is aging, i.e., the frequency change with time. One of the principal causes of aging is mass transfer due to the absorption and desorption of contamination inside the hermetically sealed resonator enclosure. Since it is not so much the contamination, as such, but the transfer of contamination which produces aging, the goal of this program is to minimize the contamination transfer rates. Past efforts aimed at reducing the effects of contamination have concentrated mainly on reducing the amount of contamination inside the enclosure via improved cleaning and ultrahigh vacuum processing techniques. This program is intended to develop novel methods of reducing the aging

due to contamination transfer, by not only minimizing the amount of contamination inside the resonator enclosure but also by surface treatment methods (e.g., Langmuir-Blodgett (L-B) films) that can result in a significant reduction in mass transfer due to adsorption-desorption, without introducing new aging mechanisms (e.g., stress relief).

Phase I: Phase I will explore novel contamination control and surface treatment methods (e.g., L-B films), or a combination of the two. The method(s) shall be applied to the fabrication of precision quartz resonators. Evidence shall be obtained to show the efficacy of the method(s).

Phase II: Phase II will refine the contamination transfer reduction method(s) explored under Phase I. Laboratory-scale equipment shall be built (or purchased) for applying the method to quartz resonators. Resonators shall be fabricated with and without method(s), and shall be evaluated to show the performance difference(s) due to the method. Aging and other analytical tests shall be performed during the evaluation.

Potential Applications/Impact: The accuracy of the crystal oscillators is directly related to the jamming resistance of communication, navigation, surveillance, and identification-friend-or-foe systems (e.g., in frequency hopping systems, the higher the accuracy of the clock's oscillator, the faster can be the hopping rate). The aging of crystal oscillators also has a major effect on logistics costs (after a certain amount of aging, the oscillator must be recalibrated or replaced), on autonomy (radio silence) intervals, and on signal acquisition times.

A90-314 TITLE: Metal-Organic Chemical Vapor Deposition (MOCVD) of High Temperature Superconductors

CATEGORY: Exploratory Development

OBJECTIVE: To develop the requisite precursors and process parameters, and to control material variables necessary for the metal-organic chemical vapor deposition (MOCVD) of high quality thin films of high transition temperature superconductors (HTcS).

DESCRIPTION: At present, no single method for the depostition of thin films HTcS is superior to others. If perfected, MOCVD can offer many significant advantages over current techniques including the twin advantages of conformal coverage at low temperatures. The proposed effort will address the reproducible growth by MOCVD of superconducting epitaxial films with uniformity and compositional homogeneity. Once precursor reagents have been identified, numerical simulation of epitaxial growth, governing fluid flow, energy and species conservation equations will be solved.

Phase I: This phase will study the deposition kinetics and evaluate potential precursors for the deposition of HTcS and MOCVD. Modeling of the gas phase reaction kinetics will be performed and a preliminary reactor design will be derived from the analysis.

Phase II: Phase II will address the deposition of high quality HTcS films MOCVD. A prototype MOCVD system, incorporating recommended precursors and optimized MOCVD chamber design, will be fabricated, tested and evaluated. Thin films of HTcS will be deposited on various surfaces (flat, convex, concave, etc.).

Potential Applications/Impact: The applications for the use of high-temperature superconductors include a wide variety of military areas with a potential for high ROI, including: frequency control, infrared sensors, microwave detection, magnetic sensors, high-speed information processing, pulse power, and projectile launchers.

A90-315 TITLE: Collision Avoidance Systems for Low Flying Aircrafts

CATEGORY: Exploratory Development

OBJECTIVE: Design and develop sensor components for determining altitude and rate of closure for a low altitude aircraft.

DESCRIPTION: the need exists for an integrated sensor that can detect altitude and rate closure for low flying aircraft. Trees, hills, and other ground clutter are of potential danger to this type of aircraft. The sensor should be able to determine distance and rate of closure. High resolution is required to discern ground clutter. The approach should utilize the latest integrated circuit technology to reduce both size, weight, and cost.

Phase I: Perform study to determine the optimum design for the high resolution sensor defined earlier. Special attention should be given to component size, weight, performance, and cost. This study will concentrate only on integrated sensor technology.

Phase II: Develop and demonstrate performance of components identified in Phase I study. Components will be integrated and system level performance demonstrated to verify approach.

Potential Application/Impact: For use in a collision avoidance and ground closure rate warning system on military aircraft. This system would provide pilots with a quick and accurate method for taking evasive action reducing potential loss of life and aircraft.

A90-316 TITLE: Microwave Hardware Descriptive Language (MHDL)

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop and document a standardized language that captures the documentation, design and behavioral aspects of RF circuits.

DESCRIPTION: The intention of this program is to identify, investigate, and provide preliminary development of Microwave Hardware Descriptive Language (MHDL). Various formats and language exist, such as EDIF (Electronic Design Interface Format) and VHDL (Very High Speed Integrated Circuits Hardware Descriptive Language), but none fully capture the design and behavioral aspects of microwave and millimeter wave circuits. Proposals emphasizing a MHDL that builds upon existing languages, formats or netlist is desired but not necessary.

Phase I: Proposed efforts should include a comprehensive survey of present documentation techniques, such as hardware descriptive languages, netlists, etc., and their applicability for evolution into MHDL. The effort should identify current limitations and requirements for the extension to fully capture all aspects of a microwave circuit design. A feasibility study should be included to determine to what level of detail should a MHDL capture the design.

Phase II: A proof-of-principle prototype language, indicative of the findings, should be developed and provided for delivery. The prototype MHDL should be utilized to fully document the hierarchical and behavioral aspects of a microwave circuit and subsystem. Additional requirements pertaining to this research effort include the submission of monthly technical and financial reports, and a final technical report to be delivered with the software.

Potential Applications/Impact: A MHDL would provide a standardized manner for efficiently transporting and documenting RF designs. The logistics of all military systems would be stream lined and the system life extended; a MHDL would economize form, fit and replacement of systems as new technologies or new vendors emerge.

A90-317 TITLE: Built-In-Self-Test (BIST) for Off-The-Shelf and Application Specific Integrated Circuit (ASIC) Very Large Scale Integrated (VLSI) Designs

CATEGORY: Emerging Technologies

OBJECTIVE: To explore and develop built-in-self-test (BIST) approaches for board and system designs that employ a mixture of custom (ASIC) and non-custom (off-the-shelf) VLSI parts, both digital and analog.

DESCRIPTION: In many electronic systems designed today, a mixture of customizable devices (e.g., gate arrays, standard cell devices) and non-customizable devices (e.g., microprocessors or signal processors) are used. There

will be a variable amount of circuit information available to the module and system designer necessary for designing a BIST capability, depending on the parts used. This effort should explore BIST approaches and techniques for mixed custom and non-custom circuitry to be used in module and system testability (BIST) design.

Phase I: Phase I should result in a technical report that explores different techniques/methodologies that could be used in the design of Self-Testing boards and systems that are comprised of a mixture of customizable and non-customizable components. Proof of concept demonstration of these techniques is desirable.

Phase II: For Phase II, a subset of these techniques should be developed and applied to an example sample.

Potential Applications/Impact: The impact of Self-Testing systems (and modules) will be increasing confidence of field test as well as higher levels of fault isolation. This will result in a minimum number of operational devices sent to the depot for repair. Self-Test also has a major impact in the area of operation and support. Specifically resulting in decreased Mean Time to Repair (MTTR) and a decreased amount of ATE necessary.

A90-318 TITLE: Innovative Millimeter Wave Integrated Circuit Concepts for Anti-Jam/Low Probability of Intercept, and Missile Seeker Applications

CATEGORY: Exploratory Development

OBJECTIVE: An investigatory and developmental effort directed towards the development of new integrated circuit concepts which will make millimeter-wave systems more transparent to intercept and jamming in heavy countermeasure environment.

DESCRIPTION: Presently, millimeter-wave missile seeker and submunition sensor designs use non-coherent either short pulse or continuous wave radar waveforms, which does not provide good protection against jammying and intercept. An innovative circuit concept able to generate coherent speed spectrum radar waveform and requiring only a single antenna would result in a compact counter measure resistant front-end design applicable to missile seekers and submunitions sensors. This design should also emphasize planar circuit configurations easily adaptable to millimeter wave monolithic integrated circuit techniques.

Phase I: An investigatory development of generic planar millimeter-wave integrated circuit techniques to provide coherent spread spectrum radar waveform for high resolution range/Doppler detection and target discrimination. Demonstrate functional feasibility of the circuit techniques investigated.

Phase II: Refine the spread spectrum circuit techniques developed under Phase I. Incorporate into the design anti-jam and low probability of intercept characteristics. Develop, design, and fabricate and demonstrate a functional planar front-end missile seeker possessing strong resistance to intercept and jamming.

Fire control radar communications systems requiring anti-jam and low probability of intercept capabilities. Army weapons systems requiring missile seekers and submunitions sensors capable of providing accurate angular and range resolutions for precise target discriminations in heavy countermeasures environment.

A90-319 TITLE: Image Compression Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Recent developments have led to techniques for compression of image data at ratios ranging from 200 to 10,000. Applied to map, graphics, video, FLIR, and radar data, these techniques can eliminate the problems inherent in storing and distributing vast amounts of visual information on the battlefield.

DESCRIPTION: This effort will study the applicability and implementation of image compression techniques for various tactical uses. In the case of maps and other graphic information, where storage capacity and recovery speed are requirements, but compression of the data need not be done in real time, high compression ratios can be

achieved. For real time distribution of image data, such as video, FLIR and radar, rapid compression algorithms will need to be developed with tradeoffs in compression ratio dictated by the distribution bandwidth.

Phase I: The first phase will study the range of U.S. Army needs for compression of data and tradeoffs in recovery for displaying the images in battlefield situations. Selection of prototype demonstrations will be made and the approaches will be determined for satisfying several representative tactical applications.

Phase II: In phase II, demonstrations of several approaches representing capability against the widest range of needs will be completed and the approaches documented for further refinement and development. The end products should be basic compression algorithms for several types of needs and a documented approach for applying such techniques to individual U.S. Army systems.

Applications include a wide variety of C^3, maintenance, logistics and training equipment which require the storage and display of large amounts of image data and presentation of this data on equipment operating under battlefield conditions.

A90-320 TITLE: Resonator Packaging Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop a packaging technology for high precision resonators that retains the advantages of ceramic flatpacks but reduces their cost.

DESCRIPTION: Ceramic flatpacks have been developed for packaging the high precision quartz crystal resonators that are being developed for future C^3, navigation, IFF, and surveillance systems. Unfortunately, this packaging technology is expensive. Moreover, low yields due to failures at the sealing step have resulted ins ignificant added costs. The high temperature sealing methods used in sealing other types of ceramic packages cannot be used because high temperatures can damage quartz resonators. A new resonator package that retains the advantages of ceramic flatpacks but which is significantly lower in cost is needed.

Phase I: Phase I will explore novel packaging methods for quartz crystal resonators. The study will consider all aspects of the influence of the package on resonator performance and cost. Prototypes of a new package that can accommodate high precision 15 mm diameter resonator plates shall be fabricated and evaluated.

Phase II: Phase II will refine the package, construct a laboratory-scale fabrication system for producing resonators in the new package, fabricate and evaluate high precision resonators enclosed in the new package, perform a study to determine the steps that will be needed to scale the system to manufacturing at least 100 “good” resonators per eight hour day, and project the yields and cost for such production rates.

Packaging of the quartz resonator is one of the major factors that determine the aging of crystal oscillators. The accuracy of crystal oscillators is directly related to the jamming resistance of communication, navigation, surveillance and identification-friend-or-foe systems (e.g., infrequency hopping systems, the higher the accuracy of the clock’s oscillator, the faster can be the hopping rate). The aging of crystal oscillators also has a major effect on logistics costs (after a certain amount of aging, the oscillator must be recalibrated or replaced), on autonomy (radio silence) intervals, and on signal acquisition times.

A90-321 TITLE: Nanoelectronic Fabrication Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Develop semiconductor nanoelectronic device fabrication techniques relevant to one, two and three dimensional carrier confinement.

DESCRIPTION: As semiconductor technology continues to pursue the scaling down of integrated circuits (IC) device dimensions into the nanoelectronic regime (‹ 100 nm), new and interesting effects will emerge allowing for many new device concepts. If devices can be made using these concepts, they will be used to sense electromagnetic signals and pre-process and process information with relatively high throughput, and also will have the capacity to be integrated with high powered computational tools.

Phase I: Identify novel concepts, issues, and technology barriers to be overcome in the fabrication of nanoelectronic structures.

Phase II: Overcome the technology barriers identified in Phase I: assemble and implement an achievable, functional fabrication technique to demonstrate proof-of-principle and/or feasibility.

The goal is to achieve light weight, affordable electronic components and integrated sensors for future brilliant and autonomous munitions, weapons, and vehicles. Specific emphasis is focused on structures that will handle sensing data fusion, and decision making protocols, yet in spatial volumes as small as a missile head or even approaching the size of a bullet.

A90-322 TITLE: Automated Multifunction Monolithic (MMIC) Wafer Probe Measurement System

CATEGORY: Advanced Development

OBJECTIVE: Develop test configuration and methodology for multiparameter on-wafer characterization of monolithic microwave integrated circuits.

DESCRIPTION: Testing of monolithic microwave integrated circuits (MMIC) remains a difficult and expensive task. Current methods require multiple and separate isolated tests to be performed. Methods to integrate multiple tests with a single die attach are required to simplify the overall test procedure. A single integrated test stand support by efficient automated test procedures and software is required to improve data management, test accuracy and reduce test time.

The test system must be very flexible to accommodate a wide variety of tests and die configurations. Testing capability should include noise, power, scattering parameters and spectral analysis. Additional capabilities for pulsed RF measurements is also desirable. Software should be highly modular, menu driven, and user friendly. Data management should take advantage of industry accepted procedures and report generation should provide for rapid visualization and selective formatting.

Phase I: Investigate test concepts and plan for integration of multifunction wafer probe test equipment and software to demonstrate an accurate and high throughput test capability for microwave monolithic circuits.

Phase II: Develop complete test capability as defined under Phase I. Demonstrate functional capabilities for automated noise, power, S-parameter, and spectral analysis. Laboratory facilities to support this effort are available.

High volume testing of monolithic microwave circuits for improved productivity and rapid insertion into U.S. Army systems. Thorough, repeatable, and accurate testing of these circuits is required for improved reliability and quality at reduced cost.

Harry Diamond Laboratory

A90-323 TITLE: Optical Generation/Control Distribution of Microwaves

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop necessary optoelectronic components to allow the generation, control and distribution of microwaves in a cost effective and high-performance fashion for applications

such as phased array antennas. Examples of key limiting components for such applications include ultra-high speed optical detectors compatible with microwave integration, high-quality laser sources for heterodyne generation of microwave signals, optical manipulation of microwave signals, and satisfactory transitions to, from, or between optical waveguides.

DESCRIPTION: Implementation becomes particularly challenging at high microwave and millimeter wave frequencies. For some components, such as detectors, the potential for integration with other components, such as optical waveguides or microwave amplifiers is a key consideration.

Phase I: Identification of realistic achievable component characteristics and optimization of the trade-off of these characteristics relative to the proposed role in generation, control or distribution of microwaves. Existing technology will be cited as a sound foundation for the projection of achievable characteristics. Demonstration of key features or characteristics will be provided when available.

Phase II: Development and testing of the component with characteristics identified in Phase I. Tradeoffs of characteristics will be experimentally and theoretically explored. Optimized prototypes will be assembled and tested. Cost effective engineering will lead to a practical component prototype.

A90-324 TITLE: Improved Spatial Light Modulator

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop and test a spatial light modulator capable of advanced optical signal processing through improved transmission characteristics and/or integration with detectors, emitters, and logic circuits. Transmission characteristics having at least four levels of amplitude transmission and/or at least eight levels of phase transmission per pixel over an array size of at least 128 X128 pixels are desired.

DESCRIPTION: Current spatial light modulator technology has limited amplitude transmission dynamic range, limited phase transmission, and no on-board processing. Improved spatial light modulators are needed to take full advantage of new optical architectures for optical computing and optical signal processing, especially target recognition, and to improve overall processing throughput.

Phase I: Spatial light modulator design and development. Phase I will include the identification of a candidate technology to obtain the objective, the design of the spatial light modulator, and the development of same to verify performance.

Phase II: Advanced development and testing. Upon successful demonstration of the technology and design as a viable spatial light modulator in Phase I, development of a prototype two-dimensional modulator will be conducted in Phase II.

A90-325 TITLE: ECM Resistant Global Positioning System (GPS) Receiver

CATEGORY: Basic Research

OBJECTIVE: To develop and test a technique for implementing Global Positioning System (GPS) satellite signal tracking on a high-dynamic platform while maintaining a high level of ECM resistance. The receiver would have access to simulated navigation information of undetermined accuracy, such as a ballistic computer model. The technique may be implemented in hardware or software or a combination of both.

DESCRIPTION: The GPS system is inherently susceptible to ECM threats due to the extremely low power of the signals and constantly varying look angles from the receiver to the satellites. A high-dynamic platform for GPS requires a receiver with a large signal processing band to allow for a wide range of Doppler components. However, this runs contrary to traditional ECM techniques of maintaining a narrow clutter bandwidth.

Phase I: Identification of candidate technique. Phase I will include schematic design and mathematical analysis of any suitable techniques. The techniques will be ranked according to performance, complexity, cost, etc.

Phase II: Development and testing. Any techniques identified in Phase I will be breadboarded and tested.

A90-326 TITLE: Applications of Thin Film Technology to EM Shielding

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop and test cost effective EM Shielding applications of thin film coatings.

DESCRIPTION: The state-of-the-art in conductive film technology has advanced to the point where practically any material or combination of materials can be deposited from 10-3000A thick. These thicknesses are such that the readily available films are not useful for shielding purposes. Advances in thin film technology may provide reasonable alternative to steel plates for architectural shielding applications.

Phase I: Investigate the application of multi-layer screens and coatings to the shielding of EM radiation in the frequency range from 100 kHz to 1 GHz. Also develop optically transparent films which incorporate layers of magnetic materials and highly conductive metals.

Phase II: Test and characterize the broadband rf shielding properties of such thin films. Characterize the cost breakdown and cost effectiveness (compared to current technologies) of thing films for low to medium level rf shielding requirements.

A90-327 TITLE: Dual Polarization Ultra-Wideband Antenna

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop a small, non-dispersive, wide bandwidth antenna. The frequency range of interest is 20 MHz to 2 GHz. A critical parameter is the ring time of the antenna; ideally, it is desired that the antenna to propagate an EMP with only one zero crossing when excited by a step input. It is desired that the front-to-back ratio be 10 dB over a ±40 degree back-lobe. The front lobe can cover ±40 degrees or more. Proposals that identify structures that minimize the ringtime, maximize the efficiency with respect to size, and maximize the front-to-back ratio are solicited. Also, proposals that identify structures that can be mounted to the side of an aircraft or perhaps underneath in a raydome are solicited.

DESCRIPTION: Current wideband antenna technology is dispersive and large. There exists within the Department of Defense a need for compact, dispersionless, dual-polarization antenna for broadcasting and receiving short, high peak-power pulses that cover a bandwidth of 20 MHz to 2 GHz.

Phase I: Analysis. Phase I can focus on computer modeling of promising structures. Time domain of frequency domain Electro Magnetic (EM) codes such as Thin Wire Time Domain (TWTD) or Numerical Electromagnetic Code (NEC-2) might be modified to support analysis of promising structures.

Phase II: Development and testing. Phase II will focus on experimentally verifying the performance of a structure whose modeled performance looks good.

A90-328 TITLE: Digital Waveform Generation for Very Wideband Army Radars

CATEGORY: Exploratory Development

OBJECTIVE: New development or bandwidth extension of available integrated Direct Digital Synthesis (DDS) chips which support high clock sampling speeds and allows implementation of simple or comlex modulation waveforms. Phase III applications would involve Unmanned Aerial Vehicle (UAV) MTI and Synthetic Aperture Radar (SAR) technology, including Multistatic radar and communication link modes of operation. Power efficiency, low cost, lightweight and reliable multimode operational capabilities are UAV critical requirements.

DESCRIPTION: Present DDS and Numerically Controlled Modulated Oscillators (NCMO) chips can generate fast, accurate, regular and modulated sinewave outputs but are constrained by clock sampling rates for very wideband applications and power efficiency operation. What is needed are VLSI chips using Gallium Arsenide (GaAs) technology to generate wideband (› 200 MHz) fast-hopping, low harmonic and non-harmonic (-50 dbc) spur outputs with clock frequency stability and phase noise characteristics.

Waveform implementation for radar applications include: Linear Frequency chip modulation bandwidth of › 200 MHz; Time-Stepped Frequency Coding; Poly-Phase coding; Quadrature Synthesis output capability. Digital Communication schemes include: Binary Phase-Shift Keying (BPSK), QPSK and 16 PSK.

Phase I: Technology survey, analysis, investigation of waveform software requirements, and measurement of existing devices. The survey should include presently available or experimental IC devices that meet the bandwidth modulation requirements. Cascading or paralleling of IC devices may be warranted. Commercial temperature ranges and laboratory instrumentation environment is predicated for initial prototype demonstration. The analysis should include overall chip(s) electrical performance and recommended chip(s) fabrication processing techniques.

Waveform software requirements will be utilized by an advanced high-speed microprocessor (airborne). Measurements of existing devices will be used to extrapolate performance.

Phase II: Develop, test, characterize and deliver two working units. DDS/Modulation waveform design characteristics will be determined and IC chip functions will be simulated. Layout and fabrication of chip(s). Demonstration and evaluation of the chip(s) electrical performance.

A90-329 TITLE: GPS Frequency Translator Integrated Circuits

CATEGORY: Advanced Development

OBJECTIVE: The objective is to field a frequency translator to re-transmit Global Positioning System (GPS) satellite signals. A remote receiver will be able to determine the location of the translator by processing the translated GPS data in applications such as artillery spotter rounds, weather radiosondes, robotics, etc.

DESCRIPTION: A frequency translator chip set is required for development of locating systems utilizing the GPS. The physical size of the translator must be kept toa minimum so that antenna and power supply systems can also be packaged in a small volume suitable for a variety of applications, including artillery projectiles. Any reductions in translator size would greatly improve the feasibility of the overall system. The translator shall receive GPS signals, shift them to a selected frequency, add a pilot tone, bandpass filter the shifted signals, and transmit the composite signal at approximately 100 MW or more.

Phase I: Design of translator chips. Phase I will include design of the translator chips.

Phase II: Development and Testing. If Phase I indicates that the translator chips can be manufactured, a number of sample units will be built and tested.

A90-330 TITLE: Surface-Mounted Multi-Layer Chip Varistors

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop and test low cost and reliable surface-mounted multi-layer chip varistors for the protection of sensitive electronics.

DESCRIPTION: Recent advances in integrated circuit technology have resulted in low voltage, low power consumption chips which require low voltage surface-mounted protection from electrical transients. The most suitable candidate for this application is the Metal Oxide Varistor (MOV). An MOV, small in dimensions (~0.5mm x 1mm x 1.5mm), having breakdown voltages in the range of 2.5 to 5v and non-linear coefficients from 25 to 50 is required for this purpose. The cost is also a determining factor; it is estimated that cost per unit of the chips meeting military specification should be less than one dollar.

Phase I: This phase of the proposed SBIR study will consist of fabrication and characterization of these chip varistors. A variety of ceramic materials such as ZnO, SiC, and (Sr,Ca)TiO3 and different processes such as (1) pressing and sintering, and (2) green sheet lamination technique, will be employed in the fabrication of these varistors.

Phase II: This phase of the proposed SBIR study will involve the selection of a few types of the chip varistors developed in Phase I and their characterization and testing in the protection of the advanced, state-of-the-art integrated circuits including VHSICS and MIMICS. The results of this testing will be used to select the most promising design(s) for the chip varistor.

A90-331 TITLE: Over-the-Ground Distance Measurement Device

CATEGORY: Exploratory Development

OBJECTIVE: To develop a device that will enable the measurement of the distance traveled over the ground by a vehicle or a man without the required attachment to a wheel. This will enable installation flexibility due to the development of a navigator which is not vehicle specific as well as one that is a man portable.

DESCRIPTION: Movement of individuals (soldiers and vehicles) on the battlefield is an exceptionally important piece of information. The ability of a vehicle to know its' position at all times greatly enhances effectiveness. In order to measure over the ground movement of a vehicle the odometer is attached to an encoder and the distance traveled by the vehicle becomes a function of the pulse train generated. This is sufficient for applications where the vehicle is known and the hardware can be obtained to attach the encoder to the odometer. In cases where this is not possible, an expensive accelerometer is required and as such the system will not be fielded. If a device could be developed that would measure the linear distance of travel from the motion of the ground under the vehicle, the such a system would be usable in any vehicle available to the soldier. In addition, the device might be adaptable to a man portable navigator so that the distance of a man's travel could be accurately reported without requiring the calibration of the individuals stride length, a process which is very inaccurate.

Phase I: There are numerous devices which can measure motion, however, not all of them are suitable to the navigation application. The first phase of this effort will be focused on the search for a suitable technology to perform this task. This effort will include evaluations of radar based devices, acoustic/ultrasonic devices and concepts based on IR technology. Results of this phase will determine a sensor which would be the best candidate to replace the odometer driven encoder.

Phase II: The selected distance measurement device will be included in the navigation and system replacing the odometer connection. Performance of the navigator will be monitored over a variety of terrain conditions while monitoring the accuracy of the distance measurements.

A90-332 TITLE: Pulse Power Technology for High Power Microwave Drivers

CATEGORY: Basic Research

OBJECTIVE: Develop innovative system concepts and principal components or subsystems for driving high power microwave (HPM) sources for the Army's simulation program.

DESCRIPTION: Pulse power drivers for HPM generators are needed that can produce flat-topped voltage pulses (1-2 MV) in loads with ≤30 impedance and with pulse duration up to 1us at high repetition rates (≥10 Hz). These drivers should be semitransportable, efficient, and have high reliability. New approaches are sought in the pulse power technology of these systems and critical components such as high voltage generators, pulse forming sections, switches, and loads (exclusive of the issues concerning microwave generation and transmission).

Phase I: The results of this effort should prove the feasibility of the concept through calculations, simulations, designs, and preliminary experiments.

Phase II: The Phase II effort will include additional theoretical or computational evaluation, as well as the detailed design, fabrication, and testing of a working model. The results should provide a demonstration of the principal features of the system or device that are to be optimized in Phase III.

Phase III: The hardware should be optimized and developed to the stage where it can be routinely used for HPM generation for both the government and industry.

A90-333 TITLE: High Sensitivity Wideband Miniature Optical Links

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop and test a miniaturized analog optical data link capable of transmitting the RF output of a miniature sensor to remotely placed recording instrumentation. The size of the transmitter must be smaller than 7.5 cm3, with a sensitivity of at least 20u volts (measured from signal peak to tangential noise), and an operational bandwidth from 10K to at least 2GHz.

DESCRIPTION: With the fabrication of the Army's new criteria HEMP simulators nearing completion and fielding due within the next two years, a miniature wideband optical link has yet to be developed that can be used to isolate the output of electric and magnetic field sensors used to characterize the electromagnetic environment produced over the large test volumes of these facilities. Because of the small wavelengths anticipated, existing wideband optical links cannot be used for this application since the size of these devices will perturb the fields being measured. Areas to be investigated should include efficient laser/photodiode optical links (capable of being remotely operated for a minimum of 3 hours from miniature replaceable battery packs), passive optical bulk crystals, or electro-optic devices.

Phase I: Identify candidate optical transmitted device. Tested theoretical models or bench testing will be necessary to demonstrate feasibility.

Phase II: Development and testing. Additional development and testing to improve reliability and practicality of use. Field testing of prototype link will be necessary.

A90-334 TITLE: Apex Sensor for Mortar Fuzers

CATEGORY: Exploratory Development

OBJECTIVE: To explore the possibilities of achieving an apex sensor for motor fuse safety.

DESCRIPTION: In multi-function fuzing for mortar projectiles, one fuze function involves sensing an area target by use of a proximity sensor employing radio transmission and subsequent ground reflection from the target. It is desirable to delay the turn-on of the proximity sensor until after the apex of the trajectory in order to reduce the possibility of early functions due to electronic faults and to reduce the possibility of detection and neutralization of the fuze by jammers. However, the turn-on must be accomplished without inputs from the soldier. Thus an

approach such as the setting of a turn-on time for the proximity sensor after reference to firing table data would be inappropriate. What is needed is a simple sensor and electronic processing circuit which would use information from the flight environment to determine and indicate when the projectile has achieved the apex of the trajectory. It should be borne in mind that the projectile is in free fall and thus its internal components will not inertially recognize an up-leg versus down-leg orientation along the trajectory as the velocity changes, with minima occurring at the apex. Of these two environments, pressure seems the more useful because the drag is very small, only a fraction of a "g," under all flight conditions. However, even pressure may be difficult to sense because the range of flight conditions causes pressure changes to range from a few psi out of ten, down to a tenth of a psi out of a few tenths. A sensor dynamic range and signal processing that can distinguish the transition from pre-apex decreasing pressure to post-apex increasing pressure may be needed. Other approaches may be possible. Target size for the apex sensor is less than 0.01 cubic inch exlusive of the electronic circuit. The electronic circuit should be capable of being integrated with the rest of the fuze electronics. The target cost for the sensor exclusive of the circuitry is less than $1 each in quantities of 100,000 units. Detail designs, functional prototypes (packaged sensors and breadboard circuits), and a formal descriptive report are the desired output from Phase I. Proposals will be evaluated on various factors to include: potential to meet performance requirements, potential to meet size and cost targets, and potential reliability.

A90-335 TITLE: Frequency Translator GPS Signal Receiver

CATEGORY: Advanced Development

OBJECTIVE: The objective is to field a frequency translator to re-transmit Global Positioning System (GPS) satellite signals. A remote receiver will be needed to determine the location of the translator by processing the translated GPS data. Applications might include artillery spotter rounds, weather radiosondes, robotics, etc.

DESCRIPTION: A translated GPS frequency signal receiver is required for development of locating system utilizing GPS. The receiver should be a military GPS receiver capable of being modified to utilize aiding to locate the translator. The GPS translator may be a frequency shifter or a transdigitizer. Receiver hardware and software would be modified as needed to retrieve the GPS signal.

Phase I: Study of feasibility of modifying military receivers to operate with translators.

Phase II: Development and Testing. If Phase I indicates standard receivers can be used, one or more will be modified and tested with actual translator hardware.

A90-336 TITLE: Improved Transient Suppressor

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop and fabricate mass producible coaxial surge suppressors with subnanosecond clamping speed and stable operating characteristics.

DESCRIPTION: There is a need for an ultra fast transient protection device to protect HF, VHF, and UHF Communications equipment against EMP as defined in MIL-STD-2169. For the systems requiring protection, the antenna is the coupler of EMP into the system. Excitation of these antennas by an EMP event will induce a high voltage fast risetime transient at the input to the equipment which may cause damage. Existing protective devices with sufficient switching speed tend to behave erratically when subjected to repeated fast risetime voltage transients. Thus, there is a need for high speed transient suppressors with stable response characteristics. (The device desired should be configured in a coaxial package with type N connectors). The desired electrical characteristics are listed below.

Clamping voltage: 300 to 600 v

Response time: t ‹ 1 nS

Surge withstand capability: ip › 100 A

Off state resistance: › 1 megaohm device must withstand 100 pulses at rated clamp voltage and surge current

Insertion loss vs. frequency for coaxial package: ± 1 dB from DC to 1 GHz

Phase I: Phase I would include the survey and identification of candidate varistor materials with the requisite activation speed and energy absorbing capacity. Bench testing would be required to determine device characteristics over long time intervals under heavy usage.

Phase II: Further development and testing of prototype varistor arrestors. Optimal mechanical designs will also be pursued under this phase.

A90-337 TITLE: Fluoboric Acid Electrolyte Analysis by Ion Chromatography

CATEGORY: Exploratory Development

OBJECTIVE: To develop a method for the rapid analysis of fluoboric acid by ion chromatography.

DESCRIPTION: Liquid reserve batteries are used to supply electric power to many spin stabilized artillery delivered proximity fuzes. Fluoboric acid solution is used as the electrolyte in most of these liquid reserve batteries. HDL drawing 10974339 requires chemical analyses be done on the electrolyte to determine fluoboric acid (as tetrafluoborate), boric acid, and sulfate contents. The prescribed analytical procedures involve long and tedious wet chemical methods, some of which must be done at 1 degrees F to minimize side reactions that will introduce errors. Since they are manual operations and involve visual observation of titrametric end points, these procedures are prone to human error. For each shipping container of electrolyte, up to three days of alaboratory work are needed in order to quantify the three components. Further, the present wet chemical analyses identify only specific components of the acid. Therefore, the acid may pass all the wet chemical method tests but still have undesirable contaminations. For example, one common way that the power supply producer may lower an excessive sulfate content is to add lead fluoborate. This has the effect of reducing available active electrolyte, since it puts a preliminary bias in the cell reaction equilibrium. The current tests do no show excessive lead ion content, and hence cannot be used to monitor this undesirable action of the contractor.

Phase I: The problems associated with the wet chemical method may be overcome by using Ion Chromatography (IC). Previous studies in our laboratory have shown that fluoboric acid may be analyzed in about 30 minutes using a potassium hydrogen phthalate solution as eluant, a Wescan Anion/R column, and a Wescan 213 conductivity detector. It has also been shown that IC can be used to find contaminants in the acid that the wet methods do not detect, such as bromide, sulfate, or lead. We anticipate that other equipment, columns, techniques, etc. would also be effective. We expect that total labor time for the analysis of a single shipping container of electrolyte involving testing of replicates will be reduced from approximately 24 man hours to about 2 man hours. Approximately three to five shipping containers would be analyzed per week on a specific production program. Use of an autosampler will lead to additional labor savings, reducing the average analysis time to about 1 man hour. This phase includes the development of the process and the delivery of all hardware (including analytical instruments) and software.

A90-338 TITLE: Weather Sealed, RF Shielded External Entry Vault

CATEGORY: Engineering Development

OBJECTIVE: To reach Phase III, the objective is to construct and test a weather sealed, RF shielded entry vault (EV) unit capable of being mounted on the exterior of a van or shelter. The completed EV shall be weather proof (in accordance with NEMA 4R requirements) and provide an RF shielding performance goal of 80 dB (radiated), as tested by a MIL-STD-285 type test.

DESCRIPTION: A modular EV unit constructed mainly of commercially available components which provides both weather protection and RF shielding to electrical components is desirable for protection of tactical/strategic mobil/transportable DoD systems. Currently, weather proof externally mounted EVs are unavailable commercially. Electrical boxes which provide weather protection (IAWNEMA 4R) are commercially available. It is believed to be feasible to have an EV developed which meets the DoD requirements. The EV shall be designed to hold a complement of filters and ESAs normally found inside of an EMP protective EV for single/multiphase power filtering/entry.

Phase I: Design and Fabrication. Phase I will include design and fabrication of the EV unit. An initial investigation of current NEMA 4R designs will be conducted. Since ruggedness and fabrication cost will be of importance in an ultimate application, comments on these items also shall be made in the proposal and at the conclusion of the first phase of the investigation.

Phase II: Test and Demonstration. The second phase shall consist of the field testing of the installed EV units on a preexisting test facility. During this phase, the EV shall demonstrate the ability to meet the stated performance goals.

A90-339 TITLE: Low Cost Angular Rate Sensor

CATEGORY: Advanced Development

OBJECTIVE: The availability of a low cost angular rate sensor with accuracy suitable for use in autonomous navigation applications, would enhance the utility of combat information processing equipment by allowing a much more timely (and accurate) update of information on locations and of movement of equipment, units and even individual soldiers on the battlefield. The objective of this SBIR effort would be to develop a low cost sensor capable of operating in the battlefield environment so enough of them can be fielded to provide locations and movement of battlefield operations. Such a device would enhance the effectiveness of each unit because of the certainty of the relative locations of units within the battlefield.

DESCRIPTION: Currently available low cost angular rate sensors do not have suitable accuracy and stability to be applied to the task of a navigation aid for either vehicles or individuals. Currently available autonomous navigation aids are far too expensive to be widely enough applied to make a significant impact on the location of soldiers and units on the battlefield. For units in continual movement, GPS is not suitable because of uncertainties of satellite acquisition from behind foliage and terrain. GPS would be useful in obtaining starting locations and updates, but for realtime movement on the battlefield, giving consideration to the mobility required, it would be unsuitable.

Phase I: The most critical component of the Navigation Aid is the angular rate sensor in that it must measure turning rate and will govern the accuracy of the heading obtained by the navigation computer. Current experience involves a fluidic angular rate sensor but candidate sensors could be based on a vibrating quartz device, the fiber optic gyro or possibly a microscale gyro. The results of Phase I will be to select a sensor form a list of candidates. Typical sensing range of this device must be ± 100 deg/sec with a resolution of 0.002 deg/sec. Bandwidth of the sensor need to be no higher than 10 Hz and it must have a scale factor calibration of at least 0.5% of value. An operating temperature range of -55 degrees C to +100 degrees C is also required.

Phase II: Once a sensor has been selected from Phase I, a representative sample will be procured for testing and evaluation. Testing of the device, particularly with respect to the effects of temperature, will be utmost importance since some form of temperature compensation or thermal heating may be required. Evaluations will be made with respect to stability of performance characteristics, expected useful life and performance when integrated with the navigation CPU.

A90-340 TITLE: Application of New Generation Computer Technologies to Coupling/Scattering

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is the development of new hardware and software approaches to the numerical solution of Maxwell equations in the presence of dielectric and conductive objects. The approach will take advantage of new computer hardware development (e.g. parallel processing) and mathematical and software development (e.g. AI, fractals, numeric algorithms).

DESCRIPTION: Existing numerical approaches to the solution of the Maxwell equations take a brute force approach to obtain results. A need exists for the development or refinement of Maxwell solvers which take advantage of recent advances in computer hardware, software and applied mathematics. Time domain approaches, which can accommodate non-linearities, are of greatest interest. Frequency domain approaches are also sought.

Phase I: Recent advances in computer hardware and software and in applied mathematics will be surveyed to determine their relevance to the formulation of new Maxwell equation solvers. At least three combinations of approaches will be evaluated. The evaluation will be done through analysis, emulation, and/or direct application. Phase I will end with at least one specific approach.

Phase II: The approach or approaches identified from Phase I will be implemented in software and hardware. Canonical problems will be solved and the results compared to theory and brute force methods. The advantages and disadvantages of the approaches will be delineated. Phase II will end with the full documentation of the approach or approaches selected. Phase III is anticipated to be the development of a commercially available hardware/software Maxwell solver.

A90-341 TITLE: Microwave Absorptive Materials

CATEGORY: Exploratory Development

OBJECTIVE: Low cost microwave materials are required to protect components/devices and equipment from high-power microwaves (HPM). The objectives are to identify, characterize and evaluate sample absorptive materials under Phase I. These materials should be applicable for printed circuit board coatings, coaxial/waveguide low-pass/high-pass and pass-band filters, radomes and antennas coatings/covers. The materials should have greater than 20 dB out-of-band absorption, less than 0.5 dB in-band insertion loss, an absorption versus frequency profile which increases rapidly with frequency, and low cost design. Composite materials of ferromagnetic and polymers should be investigated to achieve the degree of absorption and frequency selectivity.

DESCRIPTION: Significant progress has been made over the past decade in developing radar absorbing materials (RAM). This project is aimed at improving RAM by providing both a transmission window with low-isnertion loss and high out-of-band absorption. The techniques and materials developed should be capable of being tailored for various frequencies and bandwidths through the microwave spectrum (300 MHz – 300 GHz). The DOD has a critical need for these new, low cost absorptive materials to negate the HPM hostile environments both existing and projected.

Phase I: Identification and characterization of candidate materials. Phase I will include a survey and establishment of a database of microwave absorptive materials. Sample materials will be tested and evaluated to determine absorption effectiveness and figure-of-merit.

Phase II: Develop engineering prototype microwave absorptive materials. If suitable candidate materials are identified under Phase I, tests and evaluations will be performed on selected materials, and low-cost techniques and designs developed for specific applications. Phase II will include a hardware demonstration package.

A90-342 TITLE: Electro Magnetic Pulse (EMP) Coupling to Cables

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop a complete solution to the problem of a right cylindrical conductor (cable) over a conductive dielectric half space (ground). The solution must accommodate all ranges of 2/a and 2/h where 2 is the wavelength of the incident radiation (plane wave), (a) is the diameter of the conductor and (h) is the height of the cable (conductor) over the "ground" plane. All polarizations and angles of incidence must be included. All practical conductivities and dielectric constants are to be addressed. The logical Phase III goal would be integration of the results into a generalized coupling/scattering code or methodology.

DESCRIPTION: Current electromagnetic coupling-to-cable codes and prediction methodologies are limited in their capabilities. Transmission line approaches generally ignore the multiple ground scatter and suffer inaccuracies when 2/h and/or 2/a are close to or less than 1. Finite difference approaches are limited by computer memory and computer cost. Greater accuracy and more efficient methods are required for the calculation of coupling to long cables over the real earth.

Phase I: The numerical and/or analytic model(s) will be formulated. The model(s) will be applied to simple problems (e.g., perfect conductor over a perfect ground plane) to establish initial validity.

Phase II: The model(s) will be verified by comparison to specific solutions in the technical literature and by test. (HDL facilities and equipment will be made available for such experiments). The model(s) will then be formatted into a user friendly code or methodology.

A90-343 TITLE: Non-Linear Effects Produced by Electro Magnetic Environments

CATEGORY: Basic Research

OBJECTIVE: To reach Phase III, the objective is to develop a self-consistent theory of air breakdown in apertures illuminated by an Electromagnetic Pulse. The theory is to be subjected to an experimental verification, and used to predict the amount and character of the energy that leaks past the aperture.

DESCRIPTION: Develop a theory of air breakdown (arcing) in apertures illuminated by Electromagnetic Radiation with characteristics similar to that found in the Electromagnetic Pulse. The calculation of the electric field in the aperture may be decoupled from the plasma dynamics, however the solution of the diffusion equation should be self consistent. The quantity of the assumptions/approximations employed and the regions of applicability should be addressed. The effect of the aperture geometry, the parameters of the incident radiation, and any air/gas environment parameters that can effect the initiation of arcing should be identified. Comparisons with experimental data should be made and experiments should be performed to verify that air breakdown occurs as predicted.

Phase I: Addresses the theoretical analysis of the topic. It is expected that numerical/computational models will be required for the investigation. Emphasis should be placed on providing an understanding of the physics of arc breakdown. The results of the latest studies involving leader formation in lightning and new information on air chemistry must be taken into account.

Phase II: The basic theory developed in Phase I will be applied to a simple canonical model. It is expected that an experiment will be designed to verify the basic theory and provide feedback to refine and modify the initial theory to obtain more accurate results. The results of this investigation should lead to identification of configurations for which arcing is likely to occur, and recommendations for design practices to protect against unwanted arcing.

A90-344 TITLE: Fast-Risetime, Direct Connect and Magnetically Coupled Cable Driver System

CATEGORY: Exploratory Development

OBJECTIVE: A cable driver system delivering a fast-risetime current pulse into an arbitrary impedance multi-conductor cable is required to supplement free-field HEMP illumination of Army tactical systems.

DESCRIPTION: A cable driver system delivering a fast rise-time current pulse into an arbitrary impedance multi-conductor cable is required to supplement free-field HEMP illumination of Army tactical systems. Required current injector specifications are as follows:

Peak Amplitude: 200 A. – 10 kA.

Risetime (10-90%): ≤ 10 ns. (goal ≤ 1 ns.)

Pulse Shape: Double exponential

First Zero Crossing: 100 ns.

Undershoot: ‹ 10%

Output Impedance: 50 ohms

The cable driver system should have the capability to supply a load pulse as described in the above technical specifications through either direct connection or via magnetic coupling to the cable in question. Response characteristics of ferro-magnetic materials at high-frequencies (›1 GHz) may impose severe limitations on the design and fabrication of the magnetically coupled injector. Present technologies for supplying a fast-risetime pulse to a load (cable) rely upon "direct-connect" techniques due to the frequency limited materials response of the ferro-magnetic couplers. Proposals which identify methods for overcoming the known deficiencies of these types of materials are solicited.

Phase I: Develops candidate conceptual designs for a magnetically coupled current injector which meets the aforementioned technical specifications. This injector design shall also possess the capability to quickly and easily be converted into a direct-connect geometry exhibiting identical performance characteristics to those discussed above. Analytical analyses and scale model testing of prototype materials/designs will be included in the Phase I design effort.

Phase II: Consists of the fabrication, checkout and acceptance testing of a complete current injection system (direct-connect and magnetically coupled) which demonstrates the ability to meet the above performance goals.

A90-345 TITLE: Wideband Electric Magnetic Field Sensors

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop, test and fabricate miniature wideband passive groundplane electric and magnetic field sensors that operate with a flat frequency response from 10k to 1.5G Hz. Each sensor will output a voltage directly proportional to the measured field and will work into 50 ohms.

DESCRIPTION: Because of the small wavelengths associated with measuring fields in the GHz regime, it is imperative to minimize sensor size. This limitation prohibits the use of present sensor designs which incorporate active impedance matching networks and an accompanying battery pack. It is advantageous for each sensor to have a flat response over the entire frequency range although two sensors may be used as long as each sensor covers at least four frequency decades. The target sensitivity of the electric field sensor should be 500 volt/meter/volt (ratio of applied field to sensor output voltage). Target sensitivity for the magnetic field sensor should be 50 Amps/meter/volt. Each sensor would be mounted to a metallic ground plane with a thickness of no more than 0.5 inches.

Phase I: Identify optimum sensor and passive loading circuitry design. Demonstrate recommended sensor design either through tested theoretical modeling or bench testing.

Phase II: Fabrication and testing of prototype sensors along with calibration data.

A90-346 TITLE: Dyadic Green's Function for Anisotropic Substrates

CATEGORY: Basic Research

OBJECTIVE: To reach Phase III, the objective is to develop an analytically efficient asymptotic closed form Dyadic Green's function for anisotropic layered substrates. The analytical form will be implemented numerically in standard FORTRAN coding for application to electromagnetic problems.

DESCRIPTION: The formal representation of the Dyadic Green's functions for anisotropic, and isotropic substrates, contain infinite double spectrum (or Sommerfeld type) integrals that must be calculated numerically. Recently, a closed form asymptotic representation for single and double layered Green's functions have been presented in the literature, which remain accurate for lateral separations of the source and observation points as small as a few tenths of a free space wavelength. These asymptotic representations have been proven to be an essential tool for development of highly efficient computer codes for analysis of various integrated circuit structures, as well as microstrip finite phase arrays, involved ins ingle and double layered isotropic media. It is of interest to pursue the same route of function-theoretic and asymptotic analysis used for the isotropic case, to develop an efficient asymptotic closed form version of the Dyadic Green's function for anisotropic substrates. The closed asymptotic form of such a Dyadic Green's will be valuable in the numerical analysis involving anisotropic and composite materials, as well as understanding the physics of such structures.

Phase I: Proof of principal study to determine if the isotropic formulation can be extended to the anisotropic substrate case without losing the desirable analytic properties. Comparison with canonical special solutions to establish accuracy and reliability as a function of the dominant parameters such as frequency spectrum, source substrate separation, and media parameters.

Phase II: Develop the numerical models and algorithms and implement the FORTRAN coding. Test the computer code on a simplified integrated circuit configuration such as a microstrip phased array. Document the codes and all results. Investigate community interest in marketing the algorithms as a set of design tools to complement existing high frequency (millimeter to optical) integrated circuit design tools on platforms such as the microcomputer and the minicomputer.

A90-347 TITLE: Composite Materials for Communication Shelters

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop and test composite materials to absorb electromagnetic radiation and yet, are structurally strong to withstand battlefield stress.

DESCRIPTION: Current communication shelters are made of sheet metals. Therefore they have very distinctive laser and radar signatures and become easy targets for present and future smart weapons. Existing technology for the stealth bomber can be researched for applicability to communication shelter construction with the purpose of minimizing the shelter signatures, shielding against nuclear electromagnetic pulse and withstanding battlefield stress.

Phase I: Investigation of candidate materials. Phase I will include the survey, identification and collection of samples of candidate materials. Where possible engineering and spectral properties will be determined from existing literature.

Phase II: Development and Testing. If suitable candidate materials were identified during Phase I, additional testing and development of techniques for improving their mechanical and multispectral properties will be conductedif

considered essential for battlefield application. Phase II will include prototype shelter construction and testing and analytical analysis with respect to shielding, signature and stress.

A90-348 TITLE: Reforming Radio Frequency Interference Door Gaskets

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop, test, and fabricate a practical low cost reforming RF door gasket and pressurizing mechanism. The gasket must easily accommodate existing door designs while providing a minimum of 60 dB shielding (at 150 kHz) to magnetic fields for a period of 2 years.

DESCRIPTION: Presently a wire mesh gasket with a solid silicon core is used to minimize the lectrical discontinuities present between an entry door and enclosure body. A major disadvantage to this gasket design is its ease of use and low cost. A major drawback though, is the gasket's inability to maintain a reasonable RF shielding value for more than several months. A major cause for this shielding degradation can be linked to the inability of the silicon core to expand to its original shape after extended use (referred to as "gasket set"). A possible solution to this problem would be to replace the solid gasket core with a hollow core and then add pressure to the gasket each time the door is opened to expand the gasket to its original shape. By assisting the gasket in expanding to its original shape, shielding degradation could be minimized. Pressurizing mechanism should not require power.

Phase I: Phase I would include the survey and identification of candidate gasket and pressurizing mechanisms in relation to the Army's more commonly used gasket mating surfaces. Prototype tests will be necessary to demonstrate feasibility.

Phase II: Additional testing and development to improve reliability and practicality. Working prototypes will be used to monitor shielding degradation as a function of time.

A90-349 TITLE: Low Cost Liquid Crystal with Touch Pads

CATEGORY: Advanced Development

OBJECTIVE: Most military systems today contain computers and require user input while providing some output which the soldier must visually see to utilize the system in his mission. The objective of this effort would be to provide a low cost military Liquid Crystal Display (LCD) with graphic/alphanumeric capability, a size of about 64 x 240 pixels and would include touch areas to allow for software programmable computer input.

DESCRIPTION: Any system which has a computer has a power budget and costs can usually be reduced by keeping component count down. The LCD has been a widely used device commercially since it has low power requirement and is relatively inexpensive. However, the device has not been widely used in military because its viewability has not always been acceptable both from viewing angle as well as over temperature range. The capability of including software programmable touch areas to the LCD adds to its utility since the user then has just one component, a low power display and an exceptionally versatile keyboard. The cost of such a device when military specifications are a requirement can become prohibitive. Viewability over the mil spec temperature range would allow the inclusion of such an input device in a wide range of system applications where low power low component count would have advantages. A particular application would be the Navigation Aid (NAVAID) developed at HDL. For an application like the NAVAID the LCD/tough device should cost no more than $500 in quantities of about 5000.

Phase I: This phase would survey existing LCD technology with particular emphasis on cost reduction techniques and performance over mil spec temperature range. A design will be produced which would be suitable for application to the NAVAID including programmable touch areas.

Phase II: Fabrication of prototype mil spec LCD/tough displays for use with NAVAID. These devices will be suitable for fielding with prototype NAVAID units which are currently in use in fielded applications.

A90-350 TITLE: Low Maintenance Door Closure

CATEGORY: Exploratory Development

OBJECTIVE: To reach phase III, the objective is to demonstrate a method of providing an RF seal for screen room type doors using electromagnetic methods. The completed prototype will have a performance goal of 60 dB shielding effectiveness to magnetic fields (at 150 kHz), as tested by a MIL-STD-285 type test.

DESCRIPTION: A method of providing an RF seal for screen room type doors using electromagnetic methods is sought. Current door designs rely upon fingerstrock wire mesh gasketing to provide an RF seal. As these seals age, the become degraded due to oxidation, pressure setting, physical damage and general wear. It is desirable to find and demonstrate methods which will reduce the DoD's reliance on such mechanical methods for obtaining RF seals. The use of an electromagnetic seal is expected to greatly enhance the longevity of RF seals, while reducing the maintenance burdens.

Phase I: Preliminary Design. The first phase will consist of an investigation of a specific type of an electromagnetic door seal. The investigation will include analysis and/or experiments that result in a preliminary design, an estimate of how well the design will achieve the performance goals of 80 dB shielding effectiveness, and the fabrication and testing of a small prototype (as measured using modified MIL-STD-285 techniques). Since ruggedness and fabrication cost will be of importance in an ultimate application, comments on these items also shall be made in the proposal and at the conclusion of the first phase of the investigation.

Phase II: Fabrication and Test. The second phase shall consist of the fabrication and test of a full size door that demonstrates the ability to meet the above performance goals. This door will be installed and field tested in a preexisting test bed.

A90-351 TITLE: Electron Collision Cross Sections in Air

CATEGORY: Basic Research

OBJECTIVE: Apply advanced pulse power techniques to dramatically reduce the risetime of the radiation pulse produced by the AURORA Simulator.

DESCRIPTION: An order of magnitude reduction of the radiation pulse risetime is of interest for gamma-ray simulation. This pulse sharpening would provide higher performance than is presently available by complementing existing electron beam/gas transport systems or by replacing the need for them. Novel approaches to pulse power systems that would modify or be added to the AURORA machine are desired. This simulator presently produces pulses of up to 12 MV on each of 4 output transmission lines. The pulse power risetime of the present system can be ~ 50 ns. Techniques that might provide the sharper rising pulse should make effective e use of existing hardware. Such techniques must be compatible with existing space constraints and the operational requirements imposed by simulation methodology.

Phase I: The results of this effort should prove the feasibility of the concept through calculations, modeling, designs, and preliminary experiments. The basic scaling laws for the hardware should be compiled, and a plan to test the scaling in Phase II should be formulated.

Phase II: A scaled prototype should be designed, fabricated, tested, and evaluated. The basic scaling laws should be validated. The results should be extrapolated to a preliminary design of hardware that could be installed and tested on AURORA in Phase III.

Phase III: Further development and a final design should be performed. Hardware should be fabricated, installed, and tested on the AURORA machine.

A90-352 TITLE: Pulse Sharpening for the AURORA Flash Gamma Ray Simulator

CATEGORY: Basic Research

OBJECTIVE: Apply advanced pulse power techniques to dramatically reduce the risetime of the radiation pulse produced by the AURORA Simulator.

DESCRIPTION: An order of magnitude reduction of the radiation pulse risetime is of interest for gamma-ray simulation. This pulse sharpening would provide higher performance than is presently available by complementing existing electron beam/gas transport systems or by replacing the need for them. Novel approaches to pulse power systems the would modify or be added to the AURORA machine are desired. The simulator presently produces pulses of up to 12 MV on each 4 output transmission lines. The pulse power risetime of the present system can be ~ 50 ns. Techniques that might provide the sharper rising pulse should make effective use of existing hardware. Such techniques must be compatible with existing space constraints and the operational requirements imposed by simulation methodology.

Phase I: The results of this effort should prove the feasibility of the concept through calculations, modeling, designs, and preliminary experiments. The basic scaling laws for hardware should be compiled, and a plan to test the scaling in Phase II should be formulated.

Phase II: A scaled prototype should be designed, fabricated, tested, and evaluated. The basic scaling laws should be validated. The results should be extrapolated to a preliminary design of hardware that could be installed and tested on AURORA in Phase III.

Phase III: Further development and a final design should be performed. Hardware should be fabricated, installed, and tested on the AURORA machine.

A90-353 TITLE: Vortex Shedding Mitigation Methods

CATEGORY: Engineering Development

OBJECTIVE: To reach Phase III, the objective is to characterize and mitigate the mechanical stress effects on fiberglass reinforced plastic structure tubing due to vortex shedding.

DESCRIPTION: In areas such as high frequency antenna test sites and support structures, it is imperative to minimize the perturbation the structural building members have on the electromagnetic field being generated. Because of its electromagnetic characteristics, these sites commonly use fiber reinforced plastic (FRP) structural tubing as supports. The use of structural tubing, though, has resulted in an inherently flexible structure. The long unsupported length, moment of inertia of the sections and Young's modulus of the FRP columns result in a relatively low natural frequency in lateral vibration in flexure of the uniform columns. If the frequency of an existing force coincides with one of the natural frequencies of the structure or isolated member(s) in the structure, the structure could be set into vibration. A steady state wind passing around a structural member such as a cylindrical support column, could create a system of Karman vortices in the wake of the member and produce this exciting force.

Phase I: Consists of an assessment of vibration severity for both short and long term intervals and an investigation of typical methods used to mitigate this effect in the design of large flexible structures.

Phase II: Consists of further development and scale model testing of the approved design.

A90-354 TITLE: Alternate Electromagnetic Pulse (EMP) Simulation

CATEGORY: Exploratory Development

OBJECTIVE: To reach Phase III, the objective is to develop, evaluate the fidelity of and establish use methodology for EMP simulators which will have minimum environmental impact. Environmental concerns surrounding the use of "free-field" EMP simulators have resulted in a shut down of Army EMP simulator operations; new high fidelity low-environmental-impact simulation methods and hardware are solicited.

DESCRIPTION: Current free-field simulation methods and some direct drive approaches to EMP simulation are of a concern from personnel and environmental impact issues. New methods are sought. These new methods must be high fidelity simulations and must be practical to implement from hardware, software, personnel, and organizational standpoints.

Phase I: Candidate approaches will be identified. The features of each approach will be detailed. In particular the fidelity and practicality of use will be estimated. Analytic and numeric evaluations will be used to support candidate approaches. Environmental Impact will be estimated.

Phase II: Candidate approaches will be implemented and the fidelity of each will be evaluated by test and analysis. Parameters of the methods which may affect personnel or the environment will be monitored. Phase II will conclude with a recommended alternate EMP simulation approach (or approaches) for the Army.

A90-355 TITLE: AURORA High Power Microwave Testing

CATEGORY: Basic Research

OBJECTIVE: Develop innovative devices for microwave transmission elements, or major components to enhance the capability for high power microwave (HPM) testing performed at the AURORA Facility.

DESCRIPTION: HPM research, development, and simulation testing is performed on the AURORA machine at frequencies $\leq$ 3 GHz. AURORA is a pulse power generator that can deliver 12 MV pulses at power level approximating 3.6 TW on each of 4 output lines. Advances are sought in the generation of microwave pulses, the transmission of these pulses to a test area, and key subsystems and components.

Phase I: The results of this effort should prove the feasibility through calculations, simulations, designs, and preliminary experiments.

Phase II: The Phase II effort will include additional theoretical or computational evaluation, as well as the detailed design, fabrication, and testing of a working prototype device that is powered by or used with the AURORA machine. The results should provide a demonstration of the principal features of the device or subsystem that are to be optimized in Phase III.

Phase III: The hardware should be optimized and developed to the stage where it can be routinely used for HPM generation at AURORA/government and industry facilities.

A90-356 TITLE: Photonics Packaging

CATEGORY: Exploratory Development

OBJECTIVE: Design and development of novel packaging approaches and techniques (manual and automated) for use in design and manufacture of systems consisting almost entirely or completely of photonic/optical components and parts. These packaging techniques will provide reduced cost and size as well as higher reliability and quality, make these kinds of systems practical to build and manufacture easily, and apply to military and commercial needs.

DESCRIPTION: The scope of this project is to attack the problem of cost-effective, reliable manufacture and assembly of photonic systems for optical computing, signal processing, etc. using bulk optics, integrated optics, fiber optics or electro-optic components and devices. The advent of light for signals instead of electrical signals in

copper, provides unique challenges and opportunities for system packaging design and manufacture. Systems using on technology only as well as hybrids of two or more technologies should be investigated.

Phase I: Development of manufacturing, packaging, and assembly concepts (manual and automated). Complete study short of prototype fabrication.

Phase II: Demonstrate concepts from Phase I by fabrication and test of working prototypes consisting of one photonic technology and one or more hybrid assemblies using two or more technologies.

Human Engineering Laboratory

A90-357 TITLE: Fire Support Applications of Global Positioning System Transponders

CATEGORY: Exploratory Development

OBJECTIVE: To design an expendable GPS transponder system which can be used by the fire support community in applications ranging from registration rounds to radiosondes.

DESCRIPTION: The fire support community needs a small, lightweight GPS transponder which uses very little power that can provide precise positioning information for fuzes, radiosondes, dropsondes and remote target acquisition devices. The cost of these transponders must be low enough ($300 per unit) to allow them to be expendable.

Phase I: Design and fabricate a GPS transponder (including all electronics, antennas and power supply) that will fit into a 10 cubic inch volume. This sytem must operate for five minutes on its internal power supply and must have sufficient transmitter power to reliably relay (on "S" band) the GPS signals to a ground station 25 kilometers away.

Phase II: Design and fabricate a GPS transponder (including all electronics, antennas, and power supply) that will fit into an artillery round fuze. This system must survive the firing shock of 30,000 G's and operate for five minutes on its internal power supply, and must have sufficient transmitter power to reliably relay (on "S" band) the GPS signals to a ground station 25 kilometers away.

A90-358 TITLE: Two Position Combat Vehicle Crewman Seat

CATEGORY: Exploratory Development

OBJECTIVE: Design and demonstrate a two position CVC crew station seat which can be elevated hydraulically or electrical through a vertical range of 24 inches.

DESCRIPTION: Crewman control combat vehicles form two positions: (1) open hatch (or open protected), and (2) closed hatch. The transition from open to closed may be made when the vehicle is under fire or encounters toxic agents. The transition from the outside "real" world to the internal "virtual" work must be swift and continuous with a minimum of disorientation or readjustment. The optimum system would feature the crewman seated in his station performing his duties with armrest controls and possibly a lap-type console. His open-hatch seat height is adjustable so that he has adequate vision and sufficient clearance from the overhead hatch. What the time comes to "button-up," he activates one switch which (1) returns his station to the longitudinal axis, (2) drops his entire control station to it internal position, (3) closes and seals the hatch, and (4) starts the ventilation/filtration unit. His hands never leave the systems controls, and the major transition is visual from real-world to virtual displays which are right in front of him now at eye level. Transition to open-hatch operation and emergency egress are just the opposite: (1) the hatches open, (2) the seats rise to a pre-set height, and (3) the crewman continues to operate or commences egress.

Phase I: Design and fabricate dynamics mock-ups which demonstrate the required mechanical interlocks, drive mechanisms, and manual back-up features.

Phase II: Incorporate armrest controls and demonstrate continuity of operation over the full range of seat motion. Install system in test-bed vehicle.

A90-359 TITLE: Intelligent Document Retrieval

CATEGORY: Exploratory Development

OBJECTIVE: The goal of this effort is to develop advanced computer system technology that uses new and emerging AI technologies relating to textual retrieval to allow for rapid location, extracting, and assembly of text into meaningful information structures. Information, once stored in the system, must be capable of being assembled in a form which allows for perusal by computer naïve nonsubject matter experts using natural language techniques. The system should likewise promote the productivity of the computer proficient subject matter expert (SME) research. Phase III of the system integration of technology prototyped in Phase II would produce a commercially viable product.

DESCRIPTION: The ability to store, retrieve, and manipulate information represented as discrete, numerically based data structures has been the basis of most modern computer technology. Information that is financial, statistical, or hierarchically ordered lends itself well to this technology. Today's Data Base Management System (DBMS) methodologies provide a rather complete suite of tools for the access and query of relatively homogeneous and structured information.

Unfortunately, only a small portion of the information needed by HEL is in this form. Most information generated, utilized, and stored today is in textual format; and very little of that information lends itself to current DBMS technology. That part which is not consistent with DBMS methodologies must be reorganized, distilled, categorized, and reformatted by SMEs before it can be used, stored, and retrieved electronically. This textual information tends to be unstructured – often intermixed with numeric, graphical, or image data – and is characterized by heterogeneity in organization, format, and content. Textual databases are usually very large collections of information that frequently exceed the sizes handled by a DBMS.

The recent development of affordable CD-ROM technology, fast computer processors, and reliable optical scanners has highlighted the scarcity of effective automated text retrieval technologies. The hardware side of this problem has been partially solved with off-the-shelf commercially available products. What remains is selection and/or modification of appropriate products and integration of these products into a seamless, integrated system that is compatible with advanced intelligent retrieval software. Software techniques which allow this hardware to perform in a manner which imitates the abilities of an expert human document researcher are being developed in academia and private industry. Both classical statistical and cognitive-based retrieval methodologies which mimic the way the human mind solves the text retrieval problem offer the best promise of effectively employing the power of today's computer hardware in the pursuit of this problem. Examples of areas of high interest to HEL for textual retrieval research include but are not limited to:

- Natural language processing
- Vector and probabilistic modeling
- Linear associative retrieval
- Automatic classification
- Phrase structure grammars
- Automatic thesaurus construction
- Transformational grammars
- Criterion phrases
- Boolean and p-norm models
- Word stemming
- Fuzzy logic

Phase I: Technology Area Review/Analysis. Phase I will include a review/analysis of technology employing AI and/or other classical methods listed above that are being researched as well as those that are being used within academia and industry to address the automatic text retrieval problem. The results/utility of previous and ongoing

government program should also be included. The overall objective of this review/analysis effort is to identify technologies which could be leveraged/adopted to form a potential state-of-the-art prototype system for demonstration in Phase II. In preparation for Phase II, Phase I should develop black and data flow diagrams describing applicable technology algorithms identified and include discussion of the potential algorithm/software technology shortfalls associated with adaptation/integration and potential work-arounds. A requisite for this Phase I effort would be the adoption of a sound method to evaluate the effectiveness/applicability of each technology review to the overall text retrieval problem.

Phase II: Proof-of-Principle/Demonstration. The Phase II effort will take the technologies identified in Phase I; employ off-the-shelf hardware/software, and, where possible, demonstrate the AI-based technologies'/algorithms' utility in forming a state-of-the-art automated text retrieval system prototype. As a minimum, the leveraged/adapted technology demonstrator must be able to handle free-form, natural language inquiries and automatically search and retrieve relevant text from a database of previously scanned and stored technical documents. Usability by computer-naïve users as well as aid to computer-proficient users will also be demonstrated.

A90-360 TITLE: Intelligent Interface for Artificial Intelligence Planning Applications

CATEGORY: Exploratory/Advanced Development

OBJECTIVE: Exploratory and advanced development efforts in the construction of direct manipulation and graphic interfaces. The objective is to develop a construction kit and interface design environment for knowledge-based planning applications in tactical logistics planning, scheduling, and maintenance.

DESCRIPTION: The Human Engineering Lab is prototyping AI based decision support systems to enhance the prediction of resupply requirements, plan the allocation of transportation assets, rapidly generate and evaluate alternative logistics support plans, and schedule vehicle and equipment maintenance activities. Interfaces for these systems have been developed under UNIX, the X Window System and Motif, to run on a Sun 4/260 workstation. The objective of this effort is to develop a general purpose, direct manipulation interface "construction kit" and interface design environment based on UNIX, the X Window System and Motif standards. Specific areas of interest are:

a. INPUT INTERFACES: The interface developer would use this environment to lay out and edit interface objects (windows, scroll boards, buttons, menus, icons, etc.) and give them specific attributes (color, size, position, etc). These objects would have methods to handle display, highlighting, resizing and other appropriate behaviors based on the X library and Motif. The interface design environment would also assist in the linking of functional code to the generated interface code.
b. OUTPUT INTERFACES: Objects for the display of project planning output are required. Minimum requirements are the standard activity network type technical planning, tracking and monitoring structures, such as CPM, PERT, and WBS, for the display of the knowledge-based planners output. Desired features for the interface design environment include support for the generation of charts, histograms, comparison reports, project calendars, and what-if analysis to assist in customizing the planner output interfaces to the logistics domain.

Phase I: Emphasis should be on application and extension of existing interface building tools which are fully compatible with UNIX, the X Window System and Motif standards. The work should include a serious effort at prototype development (bidders must have their own computing facility).

Phase II: Emphasis should be on development and field evaluation of fully operational prototype demonstrating the increased effectiveness and added capabilities made possible by the technology.

A90-361 TITLE: Combat Vehicle Automatic Sighting System

CATEGORY: Advanced Development

OBJECTIVE: Design and demonstrate a CRT-based sighting system which will lock-on to a designated target using image contrast, and track the target while both the target and the sighting vehicle are in motion.

DESCRIPTION: Gunners in future Combat Vehicles will be using electro-optic sensors to acquire, track, and engage the opponent. Imagery will be presented to him on high resolution color CRT monitors. Using a hand controller, he should be bale to designate a target by centering a sight symbol and pressing a button. Using pixel contrast, the target could be discriminated from the background, and a feedback circuit used to keep the sensor trained and locked-on. The target image would flash when the sensor was locked and tracking. Actuation of a second button would slew the main weapon into alignment with the sensor, and weapon lock-on would be indicated on the sight picture. Another button on the hand controller would actuate the laser range find, and when the range was determined and the weapon elevated and ready, the sight picture would actuate the laser range find, and when the range was determined and the weapon elevated and ready, the sight picture would change again to indicate "ready to fire." A trigger switch on the controller would fire the weapon. Another area on the periphery of the sight would show type of round loaded, number of rounds remaining, and other weapon system information.

Phase I: Design and build a working test-bench system with all of the components, logic, and circuitry. The sensor in this version could be a standard television camera feeding a standard monitor. The hand controller could be either GFE or custom designed.

Phase II: Install the system on a research vehicle and incorporate into the existing gunner's crewstation. Provide circuitry and logic to align the sensor and main weapon. Demonstrate lock-on and control while both target and sighting vehicle are in motion.

A90-362 TITLE: Development of a Digital Auditory/Speech Processor

CATEGORY: Advanced Development

OBJECTIVE: The need currently exists for an ear-level assistive listening device which digitally processes auditory signals to include speech.

DESCRIPTION: The device should be able to process signals using in three different listening conditions: moderate to high background noise, impulse noise, and a quiet listening condition. In all cases the desired signal should be enhanced while limiting the overall sound pressure to the ear. The device should be small with output at ear-level. The device must be programmable with dip switches which will allow variation in: duty cycle, chopping rate, attack time, release time, frequency selectivity, compression, and knee. The unit must also be capable of providing narrow band masking at low levels.

Phase I: The first year should be limited to the assembling of four prototype devices with at least the above capabilities. A pilot study should also be completed which looks at the feasibility of processing a signal imbedded in noise (negative signal to noise ratio) and establishes parameters which must be under operator control.

Phase II: This will require the final development of a digital signal processor which implements the findings of Phase I and is capable of extracting a signal with a negative signal to noise ratio.

A90-363 TITLE: Computer-Assisted Low Data Rate Driving for Military Applications

CATEGORY: Exploratory Development

OBJECTIVE: Design and develop a methodology to permit rapid deployment (at speeds of up to 20 kilometers-per-hour) of robotic vehicles, platforms and mission modules at distances of up to 4 kilometers using a low datarate (16 kilobits-per-second or fewer) video and communications link. Phase II system will permit the military operator to perform path planning, path designation, and execution of commands to the remote robotic system to traverse the chosen path.

DESCRIPTION: Currently, full-time operator-in-the-loop control is required for deployment of remote robotic vehicles. Remote driving of these vehicles can be automated through the use of computer-controlled path planning and execution programs. An additional complication is the requirement for use of a low datarate bandwidth to ensure secure communications and command and control on the battlefield. Current secure video links require that the operator attempt to drive using a very degraded image (the result of applying image compression techniques to reduce required bandwidth), resulting in very slow and inaccurate deployment. A technique is needed to allow an operator to view a remote scene (using the vehicle's on-board video), select a path to the next waypoint and command the vehicle to traverse terrain to that waypoint without requiring full-time intervention.

Phase I: Design and develop a technique for computer-assisted path selection, perform preliminary engineering studies and provide an engineering specification to implement it on an existing robotic vehicle or platform. Candidates include the HMMWV currently in use on the Army's Tech-Based Enhancement for Autonomous Machines (TEAM) program or other robotic platforms in use at the US Army Human Engineering Laboratory.

Phase II: Implement the final design onto two engineering prototype systems. The first implementation will use a small test platform (the size of a golf-cart or smaller) which can be used for controlled studies to test alternative soldier-machine interface designs for the command and control of military robotic vehicles, platforms and mission modules with the automated driving technique. The second prototype will use a full-size military vehicle or robotic platform and will be implemented using the Real-Time Control System (RCS) robotics programming methodology developed by the National Institute of Standards and Technology (NIST). The second prototype will be used for field testing of the command and control design.

A90-364 TITLE: High Dexterity Telerobotic End Effector

CATEGORY: Exploratory Development

OBJECTIVE: Development of a multi digit (three or more fingers) sensor equipped, telerobotic and effector testbed. The testbed will be used to develop control software necessary for the effective introduction of telerobotic manipulation in a variety of Army applications e.g. munitions handling, maintenance and recovery operations.

DESCRIPTION: The effectiveness of robot manipulators designed to perform hazardous or labor intense functions is substantially reduced by available and effector technology. While flexible multi-finger grippers have been designed for use in research environments their lack of mechanical robustness, low payload etc. precludes their use in research using real military workpieces. The objective of the proposed effort is to develop a robust, multi-digit, sensor equipped and effector incorporating computer control and man machine interfaces. This will permit use of the testbed in teleoperated and autonomous control regimes for selected gripping tasks. The emphasis of the SBIR effort is the development of a flexible testbed suitable for follow on research on tactile sensing, grasping strategies etc.

Phase I: Will review the requirement and prior relevant work yielding a preliminary design concept for the end effector, its computer controller, sensors (tactile, proximity, etc.) and man-machine interface. Interface specifications to government owned robot manipulators and robot control systems will be developed.

Phase II: Will complete the design and develop a working testebed equipped with a body of control software which in conjunction with the man machine interface will provide an effective force reflecting mode of teleoperator performance. While software (other than that necessary for test) for real time autonomous control of the end effector will not be developed in the second phase, the sensors, interface, processors and development environment to facilitate this as follow on research will be provided as part of the Phase II deliverable.

Materials Technology Laboratory

A90-365 TITLE: New Hybrid Materials for Ballistic/Laser Protection

CATEGORY: Exploratory Development

OBJECTIVE: To develop improved laser and ballistic resistant transparent materials. Potential Phase III applications for these new materials include helicopter/aircraft canopies, ground/tactical vehicle windscreens and direct view optics.

DESCRIPTION: Conventional polycarbonate panels/structures provide adequate ballistic protection but afford no eye protection against incoming laser irradiation. Incorporation of dyes and/or reflective filters provides adequate laser protection but only against a limited number of specific wavelengths in the visible region. Innovative hybrid passive or active transparent optical systems incorporating new materials and technologies are needed. Proposals addressing either one of the following approaches will be considered:

1. Hybrid laser/ballistic resistance material systems effective against mid to high energy out of band lasers with ballistic protection comparable to or greater than polycarbonate.
2. Hybrid passive or active laser resistance/ballistic protection system for broadband low energy laser protection in the 400-1200 mm region with at least 50% photopic transmission and optical density greater than 4 when laser irradiation is present, and ballistic protection comparable to or greater than polycarbonate.

Phase I: Develop one or more hybrid transparent materials concepts and demonstrate feasibility.

Phase II: Optimize and scale-up the most promising hybrid materials system demonstrated in Phase I. Develop a full scale prototype system for specific Army application and demonstrate effectiveness against laser and ballistic threats or provide end item for government test and evaluation.

A90-366 TITLE: Fiber Optic Lay-up in Composite Structures for Imbedded Sensors

CATEGORY: Exploratory Development

OBJECTIVE: Determine potential and compatibility of fiber optics as signal carriers in composite structures, such as airframes, wings or combat vehicles. Develop models for incorporation of optical fibers into composite structures and evaluation of the effects of processing on the integrity of the optical fiber. Potential applications include Nondestructive Evaluation (NDE) of structures with imbedded sensors.

DESCRIPTION: Various structural components of military equipment are subject to extreme stress and fatigue during operation. Many of these components are made of composite materials. Various nondestructive methods are used for periodic examination of the integrity of structural components such as aircraft wings, among them acoustic emission and ultrasonics. If imbedded sensors could be used to have a continuous feedback of information from numerous key stress points on the integrity of the structure, equipment failure could be more accurately predicted and avoided. Piezo-electric sensors, which change optical properties in response to strain or other environmental factors related to structural integrity, are viable. Transmission of this response through light pipes, optical fibers, to a remote on-board analytic device is proposed. The optical fiber, as well as the sensor, must be imbedded in the composite structure. Compatibility of imbedding the optical fiber within the composite structure during processing should address degradation of the optical fiber components subjected to the pressure, temperature and chemical environment present.

Phase I: Develop a model for incorporation of optical fibers into composite structures for several processing methods used in military applications. Develop a model for evaluation of the stress, temperature, and chemical impact on the optical fiber during processing.

Phase II: Demonstrate the validity of the model obtained in Phase I by fabricating sample composite structure incorporating optical fibers for one or more processing methods and evaluating the optical and mechanical integrity of the optical fibers. Sample structures and fabrication methods should be typical of Phase III Army applications cited in the Objective above.

A90-367 TITLE: Engineered Ceramic Reinforced Ceramic Matrix Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop engineered ceramic matrix composites to desired properties and structural shapes. The inherent brittleness and low impact resistance of monolithic ceramics makes their incorporation into components very difficult. Clever design approaches to components should be combined with equally clever engineering of the material itself to increase the amount of abuse that the component can function with prior to failure. Potential Phase III applications are heat engine components, wear surfaces and armor.

DESCRIPTION: Monolithic ceramics currently can be manufactured to low porosity, near net shaped components. Processing refinements have led to an increase in reliability of these components though in-service abuse often has a terminal effect on the component. Innovative engineering of the material is required to improve the resistance of fracture from wear and impact damage.

Phase I: Develop engineered ceramic matrix composites; particulate, whisker, fiber, woven; into a 2D or 3D structure. The matrix and reinforcement can be a boride, carbide, or nitride based ceramics. The deliverable will be three separate compositions of two tiles 50 x 50 x 10 mm in size for property evaluation.

Phase II: During Phase II, the most promising composite combination will be scaled-up to produce 150 x 150 x 50 mm tiles and to show complex shape capabilities.

A90-368 TITLE: Unique Tungsten Based Composites and Heavy Alloys

CATEGORY: Exploratory Development

OBJECTIVE: Develop tungsten based composite or heavy alloys with unique alloy combinations in order to provide unusual mechanical or physical properties.

DESCRIPTION: It has been long known that pure tungsten, in the unworked condition, is brittle. It can be made ductile through extensive mechanical working or by alloying. The alloying efforts have generally concentrated on the class of alloys known as tungsten heavy alloys (generally W-Ni-Fe). Among other uses for the tungsten heavy alloys is kinetic energy penetrators, used for the defeat of armors. But, it is generally known that in most cases the heavy alloys are inferior to penetrators made from depleted uranium (DU) alloys. It is desirable at this time to investigate the development of a tungsten based composite or heavy alloy that is not based on the current heavy alloy system. Rather, the composite or alloy developed should take advantage of the high density and strength of tungsten but provide other mechanical or physical property advantages characteristic of the composite addition that would make a successful kinetic energy penetrator.

Phase I: The Phase I effort will define the composite, identify the contents of the various components, and demonstrate its fabrication. A preliminary effort should be made to show an improvement in themechanical properties, particularly the high strain rate properties (e.g. by hopkinson bar or other acceptable method of testing) of the composite over the current penetrator technology.

Phase II: The Phase II effort should optimize the composite composition and processing. An extensive property and microstructural characterization should be planned. Also, subscale ballistic test specimens should be produced in quantities sufficient to determine the ballistic properties of the comoposite.

A90-369 TITLE: High Temperature Oxygen Index Apparatus

CATEGORY: Exploratory Development

OBJECTIVE: Development of an apparatus capable of providing oxygen index (flammability/ignition) data at sustained temperatures from ambient to 800 degrees Centigrade on samples of polymer and composite materials.

DESCRIPTION: Organic polymers and composites are currently used as components of several military systems (ACAP, Bradley, CIFV). Increased usage in military applications is inevitable as they become more fire resistant and their cost-effective characteristics are better defined. Determination of the oxygen index (OI) or minimum concentration of oxygen in a flowing oxygen-nitrogen mixture required to sustain equilibrium combustion (ASTM D2863-77), provides a mean of ranking organic polymers and fiber-reinforced composites in terms of "ease of ignition," one measure of fire resistance. Research conducted, to date, clearly indicates that the ranking observed at ambient temperature seldom holds at elevated temperatures and that there is no known way in which ignition behavior between ambient temperature and the upper limit of measurement can be reliably predicted.

Phase I: Phase I should investigate the feasibility of an instrument operating at temperatures in the range 400-800 degrees Centigrade. The ability to actually measure OI values at these thermal levels, temperature stability under operating conditions, durability of instrument components, etc. should be demonstrated in this phase.

Phase II: Phase II should consist of the construction of an appropriate instrument for test and evaluation. Any modifications required after initial operation should be made during this phase of the program. Final result should be a completely operational instrument.

A90-370 TITLE: Low Cost Phased-Array Antennas

CATEGORY: Exploratory Development

OBJECTIVE: Successful development would make available low cost phase-array antennas for employment into communications/surveillance equipment for Army systems. This would offer users a versatile tool much as low cost microprocessors did to users of closed loop control systems.

DESCRIPTION: Phased-array antennas offer agility and high directionality at high cost due to manufacturing techniques and assembly costs. Multilayer thin film technology offers substantial cost reduction at some potential cost in agility and power handling capability. Material processing techniques exist which promise adequate performance for non-critical equipment. Emphasis of this work is to broaden the use of the technology by substantial cost reduction.

Phase I: Consists of determining suitable fabrication techniques and methods which will allow low cost manufacture of suitably designed microwave phased-array antennas.

Phase II: Consists of actual manufacture of an operating phased-array antenna based on the design developed in Phase I and the full engineering studies and data packages which demonstrate the low per item cost when scaled up to production runs.

A90-371 TITLE: Improved Thermographic Techniques for Composites

CATEGORY: Exploratory Development

OBJECTIVE: To develop optimal thermographic NDE techniques for field inspection of large scale composite structures. Potential Phase III applications for this new NDE technique include helicopter rotorblades and panels, primary aircraft structures, rocket motor cases, bridging components, bore evacuators, future combat vehicles, as well as commercial areas such as fixed wing aircraft, helicopters, and automotive.

DESCRIPTION: Numerous contact and noncontact thermographic NDE techniques have been developed over the last twenty years. Recent improvements in thermal imaging systems have resulted in renewed interest in real time thermography as a viable NDE technique for composites. However, practical experimental techniques employing these thermal imaging systems have not been optimized for practical inspection of large composite structures in the field. Proposed thermographic inspection system must be environmentally safe and not affect structural performance of the composite. Proposals addressing one or more of the following techniques would e considered:

1. Low cost, preferably reusable, contact liquid crystal or other temperature sensitive materials or coatings.
2. Optimized contact or non-contact passive thermographic technique incorporating a field portable uniform high intensity heat source and thermal imaging system.
3. Optimized contact or non-contact active thermographic technique incorporating field portable vibrothermographic system.

Phase I: Review and evaluate state-of-the-art thermographic methods for quality control and NDE of composites. Develop and demonstrate feasibility (analytically or experimentally) of improved integrated, thermographic techniques for inspecting large composite structures.

Phase II: Select one or more of the most promising techniques address in Phase I and optimize. Develop complete integrated prototype field portable inspection system and demonstrate application on full scale composite structures used in Army systems.

A90-372 TITLE: Nondestructive Evaluation Method for Moisture in Composites

CATEGORY: Exploratory Development

OBJECTIVE: Development of a novel automated NDE system capable of rapidly determining amount and location of moisture in fiber reinforced organic matrix resin prepregs and composite structures. Potential Phase III military and civilian applications for this new NDE system includes inspection of primary and secondary structures for aircraft and ground vehicles.

DESCRIPTION: Fiber reinforced organic matrix composites are being used or proposed as primary and secondary structures for numerous military and commercial applications. The structural behavior of these advanced materials is known to be affected by in-service environmental conditions (humidity, temperature, etc.). Absorbed moisture causes the matrix to swell, lowers the glass transition temperature of the resin (plasticization), induces residual stresses and microcracking in the composite, and can irreversibly degrade the fiber/matrix interface. In addition, moisture in prepregs (cause by improper storage) can change the curing behavior and degrade the physical and mechanical properties of the fabricated composite. Because of the deleterious effect of moisture on the mechanical properties of organic matrix composites, there is a need to develop an automated, one sided NDE system for rapid determination of the amount and location of moisture in these materials. Technique proposed/developed must be practical and suitable for operation in a manufacturing environment or dept/repair facility and, preferably, in the field.

Phase I: Review state-of-the-art in NDE techniques for detection of moisture and its effect on physical/mechanical degradation of composites. Develop and demonstrate feasibility of a laboratory technique for detecting moisture in a variety of composite materials and structures.

Phase II: Develop optimized, automated, ruggedized prototype system addressed in Phase I. Demonstrate capability of the prototype NDE system to detect amount and location of moisture in composite prepregs and composite structures of interest to the U.S. Army.

A90-373 TITLE: Mixed Microstructure Enhancement of Fracture Toughness in Sintered Silicon Nitride

CATEGORY: Exploratory Development

OBJECTIVE: Development of a starting material which, upon sintering, would yield a controllable, uniform, fully dense material made up of a mixture elongate (acicular) and equiaxed grains. Phase III applications for this material are in the area of high-toughness engine ceramics.

DESCRIPTION: Starting powders and sol/gels commonly used in silicon nitride ceramic production normally result in either a uniform grain morphology, or in uncontrolled mixtures of morphologies in which defects and weak phases limit material toughness. Microstructures incorporating both equiaxed and elongate grains provide enhanced

toughness, but non-uniform distribution of the different morphologies results in property degradation. Mixing precursors of different morphologies is difficult, and post-mixing segregation often occurs. To produce reliable, cost-efficient silicon nitride engine ceramics it is desirable to develop a starting material which does not require mixing, will not segregate during handling, will produce a uniform microstructure with controllable amounts of acicular grains, and will not result in defects or weak phase (e.g., due to dopant accumulation).

Phase I: Explore methods which can produce a mixed-microstructure end-product as described above. Demonstrate enhanced fracture toughness.

Phase II: Successful approaches identified in Phase I will be optimized on the bases of end-product quality (fracture toughness, uniformity, reliability of method), cost, and simplicity.

A90-374 TITLE: Intermetallic Aluminide Powders for Injection Molding

CATEGORY: Exploratory Development

OBJECTIVE: Develop an inexpensive process for the production of pre-alloyed, ultrafine intermetallic aluminide powders for particle injection molding applications.

DESCRIPTION: Powders used for particle injection molding are desired, on one hand, to have low mechanical friction and high packing density so higher particle loading can be achieved; these are characteristics of a coarse powder. On the other hand, it is desirable that the injected powder be fine enough to fill the molding die very well so the molding of fine detail and complex shapes is achieved. Additionally, uniformly sized particles helps attain isotropic dimensional shrinkage. Solid state sintering of aluminides is difficult when using coarse powders due to the low diffusion rate in the ordered lattice and powder as fine as practicable is needed.

The goal of this work is the production of pre-alloyed intermetallic alluminide powder with particle sizes finer than 20 microns. It is also a goal of this work that the process be inexpensive compared to current processes when large production quantities are considered. The technique must produce a high yield of powder in the desired size. The particle injection process also requires that the powder particles be approximately spherical to allow the removal of the binder so the processing technique should create powder of an appropriate shape.

Phase I: The Phase I effort will develop and define the powder production technique and demonstrate that the technique is capable of producing powder of the desired characteristics. An initial effort must be made to show an economic advantage to the process (i.e., high powder yield at low material and energy cost and low capital cost compared to the life of the equipment).

Phase II: Phase II should scale-up laboratory sized equipment to a production level and demonstrate the production of high volumes of powder. A full engineering economic analysis must be performed showing that the process is cost competitive.

A90-375 TITLE: Innovative Life Cycle Management Systems for Composites

CATEGORY: Exploratory Development

OBJECTIVE: To develop an integrated, interactive Bar Code and database system for composite life cycle management. Potential Phase III applications include adaptation of this system to address other composite (and non-metallic) manufacturing programs at DoD installations and commercial facilities.

DESCRIPTION: Presently, no easy way exists to monitor and track materials through all the processes required to fabricate them into composite specimens and structures. An inventory of materials and their specifications must be available in order to assure shelf life and safety as well as processability. This computerized system must be easily accessible to all who choose to use it and be in a familiar format. Proposals should address development of an automated, interactive bar code and database management system that could be applied to composites tracking,

characterization, fabrication, and testing. Proposed system must be practical, readily adaptable, user friendly, menu driven and cost effective.

Phase I: Develop a viable concept for an integrated life cycle composite materials and structures management system. Describe advantages and cost effectiveness of this technology.

Phase II: Develop complete, automated, interactive life cycle management system (hardware and software) designed in Phase I. Fully implement and demonstrate this system on important Army Composite Programs to be identified during Phase I by the contracting agency.

Vulnerability Assessment Laboratory

A90-376 TITLE: Diagnostic Tool for High Power Microwave (HPM)

CATEGORY: Exploratory and Advanced Development

OBJECTIVE: To develop electric field sensor(s) which can measure the intensity and pulse shape of a HPM field without perturbing the field.

DESCRIPTION: The U.S. Army has extensive program for electronic warfare vulnerability assessments (EWVA) designed to stress development, developmental and next generation weapon/communication-electronic (CE) system to existing and postulated EW environments. One of the EW environment involves HPM. The effects of HPM on weapon/CE systems are being investigated. There is a need for an electric field sensor which can measure the intensity and pulse shape of a HPM field without acting as a perturbing influence on the field. The sensor developed should be capable of measuring field strengths of 10 to 1000 watts/sq. cm. and should operate over the frequency band from 100 megahertz to at least 10 gigahertz. The sensor should have no metallic components to perturb the electric field.

Phase I: Feasibility study to determine the technical viability and merit of the concept.

Phase II: Tangible results such as software, prototypes, etc. shall be developed to prove the feasibility of the proposed design. Proof of principle demonstration of the developed prototype shall be made.

A90-377 TITLE: Large Duty Cycle Pulsed Semiconductor Diode Lasers

CATEGORY: Exploratory and Advanced Development

OBJECTIVE: To develop pulsed semiconductor diode lasers with duty cycles greater than 0.4%.

DESCRIPTION: There is a need to research methods of constructing pulsed semiconductor diode lasers with duty cycles greater than 0.4%. Present day pulsed semiconductor diode lasers have 0.014% duty cycles within the emission wavelengths of 800 to 1100 nanometers. Typical pulse lengths and repetition rates are 100 nanoseconds and 1 kilohertz, respectively. The required pulsed semiconductor diode lasers with the larger duty cycle will be used in the construction of rail jammers for field and laboratory work. A typical rail jammer might have a pulse length of 10 to 100 nanoseconds and a repetition rate of 50 to 100 kilohertz. Although present day diode lasers are small and rugged, their pulse lengths and repetition rates (i.e., duty cycles) are too slow to meet the requirements of a rail jammer.

Phase I: Theoretical study to determine feasibility of developing a pulsed semiconductor diode laser with large duty cycles.

Phase II: This effort will result in the prototype development of a pulsed semiconductor diode laser with large duty cycle compatible for use with rail jammers.

A90-378 TITLE: Dynamic Scene Generator

CATEGORY: Exploratory and Advanced Development

OBJECTIVE: To design, develop and demonstrate the feasibility of dynamic multi-band scene generator.

DESCRIPTION: A dynamic scene generator is required which will create an image of at least 512 pixel scene to be used for testing a variety of sensor systems. The scene generator shall operate, not simultaneously, in two bands: long wavelength IR (8 to 12 microns) and mid IR (3 to 5 microns). It shall have a variable field of view (3 degrees to 20 degrees in 1 degree increments) and a dynamic temperature range of at least 20 db from a background ambient temperature of around 20 C. It shall have a writer/eraser capability that will allow viewing at least 30 frames/second preferred. It shall have a 0.1 C resolution using an 8 bit digitized input to represent the temperature of each pixel. The feasibility of projecting a scene can be viewed by a sensor system while meeting the aforementioned specifications shall be demonstrated. In addition, it is required that the scene generator be capable of projecting a scene in the UV (0.2 to 0.2 micron) and mmw (35 gigahertz ½ GHZ) bands. The requirements for the dynamic scene generator will be set by the technological limits imposed by operating in the two bands (longwave IR and mid IR) and generating a 512 by 412 pixel scene.

Phase I: Study to determine the feasibility of a dynamic scene generator meeting the specification stated above.

Phase II: Prototype of the required dynamic scene generator shall be developed. Proof-of-principle demonstration shall be made.

Aviation System Command

A90-379 TITLE: Avionics Combat Maintenance/Battle Damage Repair (CM/BDR)

CATEGORY: Exploratory Development

OBJECTIVE: Development of damage criteria for avionics due to conventional, nuclear, biological, chemical and directed energy environments. Investigation of repair requirements, concepts and techniques. Development of avionic Cm/BDR guidelines. Phase III is the actual implementation/demonstration of the guidelines.

DESCRIPTION: Deficiencies exist in developing BDR procedure for complex electronic equipment in Army helicopters. Today's helicopter avionic systems are more sophisticated than ever before and will continue to be complete in the future. With the advent of advanced integrated avionic architectures and dependence on AI/knowledge-based expert systems to handle more aircraft functions, more and more complicated electronic equipment will be installed on the modern helicopter. Indeed, electronics will enable Army forces to respond rapidly to the intense battle tempo future conflicts. Unfortunately the same electronics equipment that provides this force multiplier is very sensitive and highly vulnerable to damage.

Phase I: Problem Definition:

- Analysis of problem severity with respect to conventional, nuclear, biological, chemical and directed energy environments.
- Survey and evaluation of repair requirements, concept and techniques.
- Recommend BDR guidelines for development.

Phase II: Guidelines Development:

- Identification of maintenance repair requirements with respect to combat resilient designs, support equipment/tools, Army maintenance management structure and logistic support.
- Development of avionic Cm/BDR guidelines/specficiations.

A90-380 TITLE: Spatial and Temporal Registration of Dissimilar Sensors

CATEGORY: Exploratory Development

OBJECTIVE: Develop a capability for spatial and temporal registration of dissimilar target acquisition sensors.

DESCRIPTION: Target acquisition systems are moving away from single to multiple sensor fusion systems. With this new technology comes several challenges, including the difficulty of spatially associating/correlating target reports from several sensor, and associated processor, sources while operating in an airborne platform. A further complication includes the temporal variation in target reports. For example, a radar scans the temporal variation in target reports. For example, a radar scans differently and more quickly than a FLIR, thereby generating target reports at different times. Determining the correct correlation on target reports from the two sensors is a complicated task, and multiple sensors is even more complex. Uncertainty regions, order of association, and determination of the final target position are all affected by the method of correlation. This effort is to look at the problem of spatially and temporally associating target reports from a FLIR, TV and Millimeter Wave Radar.

Phase I: The result of Phase I should be a defined approach for associated target reports, and a description of the required sensor performance, output parameters and processor requirements. This approach supported by analysis.

Phase II: Further development in Phase II, if warranted, should include a testing of the correlation approach using test data available from a previous multiple sensor fusion field tests. The Phase II proposal should include a description of sensor parameters and target location and time of collection information required to fully test the approach to association.

A90-381 TITLE: Turboshaft Engine Surge Control

CATEGORY: Exploratory Development

OBJECTIVE: To design a system capable of avoiding an impending surge or smoothly recovering from an active surge on a turboshaft engine.

DESCRIPTION: Digital electronic engine controls are rapidly expanding the role of control systems in the normal operation of helicopter turboshaft engines. Controls are no longer limited to scheduling fuel flow versus a few environmental and engine conditions, but can now also be concerned with fuel economy at steady state conditions, torque, temperature and speed governing, and anticipation of transients in engine torque requirements. One area that requires increased investigation is the detection, recovery from an avoidance of surge. Aided by improved sensing devices which respond faster to transients in pressure and temperature, new control methods may be developed which will allow the engine variable geometry, thus circumventing the surge altogether. Also, in the unfortunate case that the engine actually undergoes a surge, a ;method to smoothly recover from it would be necessary. The engine system this surge control is to be design for will be decided at a later date with the stipulationthat it must be a turboshaft engine currently used by helicopters in the Army inventory or presently under development for use in Army helicopters. Any sensors earmarked for use by the control must already be developed, although not necessarily available on existing systems. The goal of this program is to develop a control system which will alow the engine to operate at the maximum possible level of performance, while actively detecting and avoiding impending surges, or in the case of an actual surge, to smoothly recover and transition back into normal operation. Once developed, the control will need to be evaluated through simulation and on engine performance testing.

Phase I: Will generate a formal report which will include designs for a system that will satisfy the objective of surge control and a tradeoff analysis which shows how engine performance is affected by varying degrees of surge protection.

Phase II: Will consist of fabrication of the surge control system complete with all necessary software and hardware (in breadboard form). System performance will be verified through engine simulation and on-engine testing. Phase II will generate a final report which will include all results of the performance tests.

A90-382 TITLE: Knowledge Base Development for Rotorcraft System Status

CATEGORY: Advanced Development

OBJECTIVE: Develop a knowledge base for a portion of the System Status for the Day/Night Adverse Weather Pilotage System (D/NAPS).

DESCRIPTION: The major objective of the D/NAPS program is to flight-demonstrate enhanced mission of effectiveness and survivability for day/night adverse weather operations through innovative integration of advance technology to include sensors, computing methods, and controls/displays. The D/NAPS program will demonstrate a representative set of capabilities which will enhance pilotage tasks (vehicle operation, communication, defensive system operation, crew/team coordination, navigation, and mission/tactical planning) during day/night adverse weather operations. The D/NAPS mission entails low-level, contour, and nap-of-the-earth flight to a destination within hostile territory while avoiding and/or surviving threats within a pre-specified arrival time window, and return to a friendly base with a specified probability of survival. The subject SBIR effort will augment the D/NAPS program as indicated below:

Phase I: The Phase I effort shall culminate in a description of the knowledge base for a portion of the D/NAPS System Status, a software development plan, a D/NAPS interface description, and a test and evaluation plan.

Phase II: The results of Phase II shall be verified software with a demonstrated capability in a software engineering environment to perform a portion of the D/NAPS System Status functions described as follows: The SS expert system shall be responsible for overall aircraft system resource configuration and shall reconfigure or change operation mode where applicable in the even of critical (mission affecting) equipment failures. The SS function shall maintain status information on aircraft sensors, processors and subsystems, performing fault diagnoses with built-in continuous self tests and developing plans for the diagnosis and prediction of critical failures. The SS function shall include sensor, processor and subsystem diagnosis and reconfiguration. It shall determine revised operational limitations based on system faults, failures, and malfunctions due directly or indirectly to combat damage and inherent failure. It shall determine revised operational limitations based on remaining expendable resources (fuel, flares, chaff, etc.). It shall present pilot caution/warning advisory and procedure information in event of an emergency, but shall execute automatic reconfiguration functions without the need of pilot intervention.

A90-383 TITLE: Magnetic Bearings for Gas Turbine Engines

CATEGORY: Basic Research

OBJECTIVE: Develop magnetic bearings which will replace conventional rolling element bearings in a two-spool gas turbine engine.

DESCRIPTION: Performance requirements on future gas turbine engines will place stringent demands on mechanical components; in particular, bearings and lube requirements. Magnetic bearings offer great potential for aerospace and industrial applications where high temperatures (850°F-1500°F) and pressures restrict wet lubricant (e.g., MIL-L-23699 or MIL-L-7808) and dry lubricant (e.g., powdered MOS2) use. A need exists to improve the magnetic materials used in magnetic bearings. The magnetic strength of the magnetic material determines the bearing/s dynamic and static load bearing capability. Materials to be considered should have high potential for Phase II development/producibility such as rare-earth samarium-cobalts or iron-boron combinations. The bearing dynamic load capacity will be greater than 10,000 pounds, with static load capacity greater than 18,000 pounds.

Phase I: Phase I effort will involve selection of baseline turboshaft gas turbine engine and ball bearing performance parameters. A preliminary design will be executed to include the magnetic bearings, magnet material power requirements, microprocessor/controller, packaging, and software. Critical areas requiring future development will be identified for Task II.

Phase II: Development of magnet material, fabrication of the magnet bearings, and final bench testing will include two bearings (each having four axis of control) suspending a rotating shaft.

A90-384 TITLE: Fast Activating Transparent/Opaque Device

CATEGORY: Exploratory Development

OBJECTIVE: To develop a dynamic laser eye protection window which is capable of activation from a transparent state to an eye safe state fast enough to preclude eye damage. The system must protect eyes from low energy laser hazards across the entire visible and near infrared spectrum.

DESCRIPTION: Currently laser eye protection for Army aviators is provided with dye absorbers or holograms embedded in helmet mounted visors. These static systems only protect against a limited number of fixed wavelengths, require a full time luminous transmissivity loss and add weight and complexity to the helmet. There are several DoD research efforts underway to provide eye protection against frequency agile low energy laser threat in the visible and near infrared spectrum. However, to avoid burdening the aviators with cumbersome eyewear, research efforts are required to develop a dynamic laser eye protection window concept which will provide inherent protection from frequency agile lasers. Dynamic filters are desirable, but have been limited by slow activation times. Innovative approaches are required to decrease the reaction times of laser protective devices to preclude eye damage.

Phase I: The desired result is a preliminary design for the fast activating transparent/opaque device. The actual device to trigger activation of the protection system will be developed under separate effort. Analytical and experimental efforts to assist in development and verification of the design will be required.

Phase II: This phase will encompass fabrication and performance evaluation testing of a fast activating laser protection system. Electrical signals can be utilized to trigger activation for demonstration and test purposes.

A90-385 TITLE: Long Life Catalytic Air Filter

CATEGORY: Exploratory Development

OBJECTIVE: To develop a catalytic conversion air filtration system for NBC protection of Army helicopters.

DESCRIPTION: There is currently a deficiency in the Army aviation arena of nuclear, biological, chemical (NBC) qualified aircraft. Rotary-wing aircraft must be able to operate and conduct missions in an NBC environment. The NBC threat exists and it is imperative that the Army be equipped to operate in this threat. Sufficient technology exists to filter contaminated air using carbon-based filters; however, numerous problems associated with the use of carbon filters still exist. Carbon dusting, unpleasant odor, and premature failure are just a few of the problems. However, the most significant drawback to these filters is the logistical supply burden they impose. Technology is mature enough today to develop catalytic conversion filters that will alleviate the majority of the aforementioned filter problems. Reducing these problems will allow for an aircraft qualified NBC filtration system. NBC air filtration systems designed for helicopter application must be small, lightweight, durable and logistically supportable. Catalytic conversion systems could be promising if they can be shown to provide adequate protection for extended periods of time.

Phase I: The desired result is a trade study offering a description of an optimal material/configuration for the long life catalytic air filter concept.

Phase II: Development of a prototype system and testing with applicable chemical agent stimulants.

A90-386 TITLE: Digital Terrain Database Resolution and Accuracy Analysis

CATEGORY: Exploratory Development

OBJECTIVE: Perform a tradeoff analysis using various Digital Map Agency (DMA) products and prototype and prototype products to determine the best combination of resolution and accuracy required for Army Aviation target acquisition purposes.

DESCRIPTION: Several existing and prototype DMA products offer digital terrain elevation data of varying levels of resolution and accuracy. Resolution refers to the grid spacing between sample points or posts and accuracy relates to the quality of the elevation information at that post. Projections indicate future Army Aviation assets will employ digital terrain elevation data within their associated target acquisition systems for passive ranging purposes. This effort is required to understand the effect of different combinations of resolution and accuracy have on passive ranging performance. Consideration shall be given to the effects associated with overall target acquisition system errors (from the lock-on target reticle of the targeting display to sensor boresight), co-located sensor spacing, airborne drift (from registration within the digital map), and aircraft height about the terrain (low grazing angles versus high downlook angles).

Phase I: Data required to perform this analysis will be provided by the Government. This would include any known DMA products and prototypes, operational pop-up heights and typical aircraft target acquisition system accuracies. The Contractor shall be responsible for writing the analysis software, performing the analysis, and subsequently writing a report. The analysis software shall be deliverable under the contract.

Phase II: A follow-on effort is not anticipated at this time.

A90-387 TITLE: Advanced Fastener System for Composite Structures

CATEGORY: Exploratory Development

OBJECTIVE: To develop a fastener system to optimize joining systems composite structures.

DESCRIPTION: Fasteners currently being utilized on composite structures are an outgrowth of the Sheet Metal Era. They do not interface well with composite materials. Advanced composites can be delicate materials to fasten. Ordinary fasteners can damage the fibrous composite panels when installed. Creating a hole in fibrous composite materials can cause delaminations to the back or blind side of the panel, whereas metal materials tend to deform slightly without seriously diminishing their load carrying capabilities. This could result in fastener pull through in the composite. The pressure required during installation can cause buckling or delamination, and the problems that occur during use include edge delamination, crushing, or pull through. Most metals are not compatible with the carbon fibers so common in advanced composites, and therefore run the risk of galvanic corrosion. Metal fasteners must be made of titanium alloys, austenitic stainless steels, or Inconel, metals that are the most compatible with advanced composite materials. Not only is there a problem about what fasteners can do to composites, there is also a problem of what composites can do to fasteners. Abrasive fibers damage unprotected fasteners during repeated installation and removal cycles. Other problems with the current fastener systems on composite structure are: corrosion from the non-composite fastener, fastener mechanical failures, non-standardization of fastener sizes and lack of lightning strike ground capabilities. Developing a viable fastener system which will reduce the large number of fasteners and be compatible with composites, will save weight and money on the Army's future aircraft.

Phase I: The desired results of the Phase I effort are to make a field evaluation and literature survey of current production fasteners and evaluate materials for the design of a new fastener system to interface with composite structure. Candidate fastener design materials will be evaluated and tested for interface requirements with advanced composite materials. Coupon test with the proposed fastener material will be conducted.

Phase II: The end result for this R&D program will include design, fabrication and test of an advanced application fastener system for composite aircraft structure. The selected system will represent an improvement over existing fastener systems in terms of acquisition and support costs and weight. The fastener system will be designed,

fabricated and full-scale tested. The new fastener system will be tested with composite airframe structures for high and low cycle fatigue, environmental conditions to include temperature and humidity effects, and for static strength properties.

A90-388 TITLE: High Performance Fuel Injectors for Small Gas Turbine Engines

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate advances in fuel injection, atomization, and dispersion using JP-8.

DESCRIPTION: Fuel atomization and droplet dispersion techniques significantly affect the overall performance of turboshaft engines. In addition, they effectively dictate the engine starting and high altitude relight capabilities. However, this program is exacerbated by the Army-wide conversion from JP-4 fuel to the more viscous and less volatile JP-8 fuel. A need exists for developing improved techniques for fuel injection, atomization, and dispersion of the fuel droplets for use in the Army's small high temperature rise turboshaft engines. The proposed design should provide excellent fuel atomization at light-off conditions, as well as full-power conditions. The successful design will be directly applicable to near and/or far term designs of Army turboshaft engines. The primary benefits of this program will be improved atomization and mixing. Secondary benefits would be pattern factor enhancement and the resultant turbine nozzle durability improvements.

Phase I: A Phase I program should result in a concept demonstration. This could take the form of a small-scale experiment or a sound numerical analysis that demonstrate the potential for significantly enhancing the fuel atomization and the droplet dispersion.

Phase II: A successful Phase II effort would demonstrate the concept at full scale, illustrating the utility of the concept for applications of interest to the Army.

A90-389 TITLE: Aviation Target Simulation

CATEGORY: Exploratory Development

OBJECTIVE: Determine the feasibility and potential methods of developing a comprehensive target simulation capability that will support aviation target acquisition development programs.

DESCRIPTION: Current multispectral target acquisition development efforts require simultaneous field data collection under realistic terrain and climatic conditions of all sensors being considered in the system. This is not only costly but sometimes impossible to orchestrate. The ability to simulate target signatures in appropriate background conditions for sensors such as visible and near infrared television, forward looking mid and longwave infrared, millimeter wave radar, radar, acoustic, etc. would be significant advantage in multisensor fusion development. The simulation needs to be adaptable to variations in sensor capability and must not only model representative target signatures but the clutter environment in which the signatures will be placed.

Phase I: The result of Phase I should be a review of existing modeling and simulation techniques for aviation targeting sensors, new approaches currently in development, and technically supported position on the feasibility of developing an integrated capability to represent target signatures and clutter in various spectrums.

Phase II: Further development in Phase II, if warranted, should result in a specific approach and program plan to develop such a facility. Detailed specifications of processing, hardware, space, power, and staffing requirements would be laid out. Technical substantiation of the proposed development methodology will be required.

A90-390 TITLE: Temperature Effects and Compensation Techniques for Amplitude Modulated Fiber Optic Sensors and Components

CATEGORY: Exploratory Development

OBJECTIVE: This project shall conduct experiments to define the temperature dependence of optical fibers and connectors on the amplitude of light passing through them. It shall use this information to develop and test a methodology to compensate for temperature effects on an amplitude modulated (AM) optical signal.

DESCRIPTION: Amplitude modulated fiber optic sensors have been shown to be affected by large temperature variations such as those occurring in the Army aviation environment (-55 C to 135 C). The dual wavelength technique was shown to be inadequate in compensating for such large temperature variations since temperature affects the propagation of each wavelength differently.

Phase I: The Phase I effort shall perform any experimentation required to define the temperature dependency of optical fibers and connectors as a function of wavelength. This information shall be used to develop a preliminary design for a technique which will compensate for large temperature fluctuations as well as fiber aging and other signal degradation phenomenon.

Phase II: The Phase II effort shall develop the compensation techniques proposed during the Phase I effort. A prototype model will be constructed and tested over temperatures ranging from -55 C to 135 C. The prototype shall be capable of being used with any fiber optic sensor using an AM output signal. It shall also be capable of withstanding the harsh military environment.

A90-391 TITLE: Knowledge Base Development for Rotorcraft Mission Planner (MP)

CATEGORY: Advanced Development

OBJECTIVE: Develop a knowledge base for a portion of the Mission Planner for the Day/Night Adverse Weather Pilotage Systems (D/NAPS).

DESCRIPTION: The major objective of the D/NAPS program is to flight-demonstrate enhanced mission effectiveness and survivability for day/night adverse weather operations through innovative, integration of advanced technology to include sensors, computing methods, and controls/displays. The D/NAPS program will demonstrate a representative set of capabilities which will enhance pilotage tasks (vehicle operation, communication, defensive system operation, crew/team coordination, navigation, and mission/tactical planning) during day/night adverse weather operations. The D/NAPS mission entails low-level, contour, and nap-of-the-earth flight to a destination within hostile territory while avoiding and/or surviving threats within a pre-specified arrival time window, and return to a friendly base with a specified probability of survival. The subject SBIR effort will augment the D/NAPS program is indicated below:

Phase I: The Phase I effort shall culminate in a description of the knowledge base for a portion of the D/NAPS Mission Planner, a software development plan, a D/NAPS interface description, and a test and evaluation plan.

Phase II: The results of Phase II shall be verified software with a demonstrated capability in a software engineering environment to perform a portion of the D/NAPS Mission Planner functions described as follows: The MP expert function shall be based on the availability of preflight up-loaded, stored mission plans. The MP function shall provide a mission re-planning capability in response to unanticipated conditions or pilot commands. The MP functions shall provide rapid path planning within mission constraints. A combination of heuristic and algorithmic methods is acceptable to provide good (though not necessarily optimum), quick options to the pilot. Both two-dimensional and three-dimensional path planning shall be considered and implemented. The MP function shall utilize aspects of both temporal and spatial reasoning. The MP function of resources as determined by the System Status.

A90-392 TITLE: Effectiveness of Active vs. Passive Countermeasures

CATEGORY: Exploratory Development

OBJECTIVE: Develop an analytic code which defines optimum mix of active and passive countermeasures for rotorcraft given specific threat laydowns.

DESCRIPTION: If rotorcraft signatures are significantly reduced, the power required by on-board jammers can also be reduced. Performance, weight and cost are all factors in determining the selection of survivability enhancement features for rotorcraft such as the LHX. It is imperative that active CM Requirements be closely integrated with achievable, passive reduction levels. There does not exist currently, in industry or the Government, a code for this prediction. One has been needed for the LHX development and the LHX COEA. This project will develop an analytic code which considers given RCS combinations of signature/CM on survivability and mission effectiveness. The code will also optimize the required mix for a given scenario by adjusting signature and active CM parameters.

Phase I: Will provide a user friendly analytic code to predict probability of survival and mission completion for three specified scenarios. Deliverables will include a report on analysis results, documentation for the code, and a copy of the software.

Phase II: Will develop an optimization of the code to indicate CM requirements given signatures, and to indicate signature requirements give CM characteristics, for a wide range of possible scenarios. Deliverables will include documentation for the code, report on analysis results for several test cases, and a copy of the optimization code software.

A90-393 TITLE: Helicopter Obstacle Proximity Sensing System

CATEGORY: Exploratory Development

OBJECTIVE: To use existing collision avoidance technology to develop an obstacle sensor for Army helicopters.

DESCRIPTION: Current Army doctrine calls for nap of the earth flying with hover and pop-up/pop-down, or hover with elevated sensors and sights (AHIP). Pilots, while hover, tend to unconsciously pull up and back into the trees behind them. There currently exist numerous collision-avoidance systems; however, none currently exist for Army helicopters. The purpose of this program is to demonstrate the feasibility of a simple, compact, inexpensive ranging system suitable for helicopter collision-avoidance application.

Phase I: The proposer would examine existing ranging systems and either select one or modify one for use on Army helicopter. The system must be capable of working in a 360 degree environment and be able to detect obstacle (trees, rocks, bushes, wires, etc.) encountered during a typical mission. The system must be capable of working with a variety of different blade lengths, from twenty –thirty feet and still maintain a discrete sensing range 5-10 feet with a one to three foot resolution. The system should be eye safe and cause no increase in aircraft detectability.

Phase II: The proposer shall take the ranging system and perform verification testing at both a system and subsystem level. This would include verification of subsystem feasibility before system integration and complete system testing for each range to verify linearity, resolution, and minimum/maximum range capability. The evaluation of the technical feasibility of the ranging system will be based upon factors such as performance, complexity, weight, and cost.

A90-394 TITLE: Embedded Fiber Optic Sensors in Composite Aircraft

CATEGORY: Exploratory Development

OBJECTIVE: To provide built-in inspection method for high performance composite structures.

DESCRIPTION: Current research in the area of bearingless main rotor hub technology on military helicopters shows promising benefits for using composites to improve structural life, cost and damage tolerance assessments. Many of the bearingless hub concepts use a composite flexbeam as the primary load transfer member between the rotor blade and the main rotor hub. These flexbeam structures have complex bending, axial and torsional loads imposed by the rotating hub and often they are enclosed in a pitch case which prevents easy visual inspection. The requirement exists for a ground-based structural diagnostic tool to test the structural integrity of such a structural component without having to remove the pitch case. Embedded fiber optic sensors have the potential for meeting this requirement by placing a fiber optic sensor in a structure during the fabrication process. These fiber optic sensors can then be utilized to improve damage tolerance detection as well as aid in the detection of impending structural weakness, permitting the structure to be repaired or removed before failure. Technical issues which require investigation include material and strain compatibility between the embedded fiber optic sensor and the host composite structure; the stresses that the structure experiences during the fabrication process; the accuracy, reliability, and life of the sensor device and sensor activation techniques. Testing of highly stressed laminated composite structures with embedded fiber optic sensors need to be conducted to correlate signal response to a number of laminate properties and verify that interference with the signal does not occur.

Phase I: Investigate the type of fiber optic sensors available for the application of embedding the sensor in highly stressed composite components. Identify and select the processes which will be used to embed the sensor in the composite component. Define application range and identify problems which may occur during the fabrication process. The methods for embedding these devices need to be developed so that a structure can be produced in a timely and cost effective manner with minimal effect on structural integrity of the component.

Phase II: Fabricate composite components with embedded fiber optic sensors. Conduct preliminary static and dynamic tests of components and monitor the performance of the fiber optic sensor. Develop techniques to assure that the devices and their associated input/output components are placed in the proper location without damage to the sensor. Provide a detail design of final product and list manufacturing steps and procedures. Calculate structural effects of a variety of embedding techniques in relation to the fabrication and manufacturing process. Conduct tests to correlate with analytical calculations. Develop a database detailing the effects of embedded fiber optic sensors on the structural integrity of the laminates.

A90-395 TITLE: Advanced Computational Fluid Dynamic (CFD)

CATEGORY: Exploratory Development

OBJECTIVE: To further develop and validate an advanced (preferably 3D fully viscous) CFD code for analysis of highly loaded, high mach number centrifugal compressors.

DESCRIPTION: Advanced CFD codes are a key to the development of high performance gas turbine engine compressors and turbine blading. This program is intended to take advantage of recent advances in CFD code development by converting such an advanced code to be able to readily perform the modeling or analysis of highly loaded, high mach number centrifugal compressors and accompanying diffuser systems which have a very complex internal flow. This code would then be used to analyze two previously designed and tested high performance centrifugal compressors and their code signed diffuser systems. The data for these compressors, which is necessary for their analysis, would be provide by the preparing activity listed below.

Phase I: Phase I work performed shall involve the conversion of an advanced (preferably 3D fully viscous) code, including boundary conditions set up to be able to analyze highly loaded, high mach number centrifugal compressors.

Phase II: Phase II work will entail the analysis of two previously tested centrifugal compressors mentioned above. This analysis will be performed in order to validate the advanced code and to further understand the flow fields of these compressors. This effort would also include some effort to analyze and recommend possible design changes for increased performance which are derived from the use of the developed advance code.

A90-396 TITLE: Knowledge Base Development for Rotorcraft Pilot-Vehicle Interface (PVI)

CATEGORY: Advanced Development

OBJECTIVE: Develop a knowledge base for a portion of the Pilot-Vehicle Interface for the Day/Night Adverse Weather Pilotage System (D/NAPS).

DESCRIPTION: The major objective of the D/NAPS program is to flight-demonstrate enhanced mission effectiveness and survivability for day/night adverse weather operations through innovative integration of advanced technology to include sensors, computing methods, and controls/displays. The D/NAPS program will demonstrate a representative set of capabilities which will enhance pilotage tasks (vehicle operation, communication, defensive system operation, crew/team coordination, navigation and mission/tactical planning) during day/night adverse weather operations. The D/NAPS mission entails low-level, contours, and nap-of-the-earth flight to a destination within hostile territory while avoiding and/or surviving threats within a pre-specified arrival time window, and return to a friendly base with a specified probability of survival. The subject SBIR effort will augment the D/NAPS program as indicated below:

Phase I: The Phase I effort shall culminate in a description of the knowledge base for a portion of the D/NAPS Pilot-Vehicle Interface, a software development plan, a D/NAPS interface description, and a test and evaluation plan.

Phase II: The results of Phase II shall be verified software with a demonstrated capability in a software engineering environment to performa portion of the D/NAPS Pilot Vehicle Interface functions described as follows: The PVI shall reduce pilot cognitive workload. The PVI shall adapt to changing cockpit conditions so as to be unobtrusive during low stress conditions and to provide maximum assistance in high stress situations. The PVI shall aid the pilot in an adaptive manner by monitoring pilot performance, comparing observed performance against expected performance, modifying pilot tasks as necessary to easy accomplishment, managing cockpit displays or format to present only essential information at critical times, and performing automatically those functions required for mission success or survival. The PVI shall use advanced control and display technology which is available at the time of detailed system design. Pilot interactions with the system shall be as simple as possible and reconfigurable. The PVI shall provide for pilot challenge and system explanation of D/NAPS generation recommendations.

A90-397 TITLE: Lightweight Crash Resistant Fuel Tank Material

CATEGORY: Exploratory Development

OBJECTIVE: To reduce the weight of current fuel tank materials by 20% and still maintain the crashworthiness and self sealing capabilities required by the mil-spec.

DESCRIPTION: Current fuel tank materials which make up the fuel tanks used by the Army weigh approximately 0.9 lb/ft. These materials were developed in the late 60's and have been used by the Army since that time. The intent of this effort is to investigate new and improved lightweight materials which may be applicable to fuel tankmaterials which could reduce this weight.

Phase I: To identify possible materials to be used in the design and fabrication of fuel tank material. The materials selected will be based on their relative weight and strength properties as compared to the current materials used. A proposed lighter fuel tank material will be identified.

Phase II: To design, fabricate, and conduct tests on the fuel tank material design selected in Phase I against selected tests of the fuel tank mil-spec.

A90-398 TITLE: Portable Self-Powered Heating Tool

CATEGORY: Exploratory Development

OBJECTIVE: Develop a lightweight, portable, self-contained explosion-proof heating device for use on fueled aircraft to cure repair adhesives, composite materials and heat-shrink material (i.e. HTS hydraulic line repair fitting).

DESCRIPTION: In the future battlefield, battle damage repair will have to be performed in the field away from any air or power source. A lightweight, portable unit with its own power source that can deliver heated air (approx. 350 degrees F) is needed to cure adhesives and shrink heat shrinkable material on fueled aircraft. Such a tool could be incorporated into the Army's aircraft battle damage repair kits to give maintainers flexibility in the types of repairs that can be performed. Without such a tool, the types of repair that a repairer can perform is limited by whether air or power is available and the time required to complete repairs are affected by availability of air/power sources.

Phase I: Design/Develop, fabricate and test a prototype tool that will meet the requirements for: portability, capacity (power and operating cycles/time), explosion-proof potential and cost.

Phase II: Engineering development of the tool to include: qualification testing, field testing, R&M testing, producibility, engineering, and specification drawings.

A90-399 TITLE: Lightweight Electric Lube and Scavenge Pump

CATEGORY: Exploratory Development

OBJECTIVE: Design, fabricate, and test a compact, lightweight reliable, electrically driven lube and scavenge pump assembly for use in gas turbine helicopter engines.

DESCRIPTION: Current gas turbine helicopter engine lube and scavenge pumps are driven by the engine through an accessory gearbox. This system contributes a large percentage to the weight of the engine, restricts flexibility for placement of accessories, and makes the speed at which accessories are driven dependent on the gas generator speed. The use of electrically driven accessories powered by an electric starter/generator is being investigated as a means of reducing accessory drive system weight, increasing flexibility of placement of accessories, and permitting operation of accessories at their optimum speeds for different conditions. However, most of the work has concentrated on the starter/generator portion of the system and very little has been done on accessories. In order to make the electric accessories approach feasible, compact, lightweight electrically driven accessories such as the lightweight electric lube and scavenge pump will need to be developed.

Phase I: Phase I of this project shall determine the requirements for the lube system for a gas turbine helicopter engine with electric accessories. Preliminary design of a self-contained pump assembly consisting of an electric motor and supply and scavenge elements shall be performed. The assembly shall utilize advanced materials and technology to minimize weight and volume. The effort shall include an investigation of the advantages and disadvantages of designing the unit to operate on 270 Vdc as compared to 28 Vdc. The assembly should be designed to operate under the environmental conditions specified by Mil-Spec-85734. Demonstration of a prototype electrically driven pump assembly is desired in Phase I.

Phase II: Detail design, fabrication, and testing of a pump assembly shall take place during Phase II. Testing shall demonstrate durability and debris damage tolerance of the pump assembly.

A90-400 TITLE: Modular Optical Delay Assembly for Digital Position Transducer

CATEGORY: Advanced Development

OBJECTIVE: To design and develop a fiber optic digital delay line and read ahead module for use within one inch meter digital optical linear and rotary position transducers.

DESCRIPTION: A complete fly-by-light (FBL) flight control system has been developed and flight tested by the Army on a UH-60 helicopter under the Advanced Digital Optical Flight Control System (ADOCS) Program. The technology critical to FBL consists of basic fiber optic technology (critical to communicating control signals

throughout the aircraft) and sensor technology (crucial to generating control signals). Government and industry have made substantial investments in basic fiber optic technology which has matured and is considered to be funded development programs, just recently matured to where producibility issues can be addressed. Current digital linear and rotary position sensors demonstrated in ADOCS are expensive to produce because hands-on labor intensive techniques, required to ensure adequate tension control of the fiber winds, are required to wind hair thin optical fibers around a mandrel (delay line assembly), which fits into the sensor body. Improper tension has a negative effect on sensor performance by producing excessive light loss in the fibers. This also increases the sensors sensitivity to temperature, since the fiber's tension varies as the mandrel expands and contracts with temperature. The current labor intensive manufacturing techniques are economically inefficient and cannot support production of the large quantity of sensors necessary for FBL control systems. Thus, this program will try to solve these problems as described in Phase I and II below.

Phase I: Design and develop a low cost, modular integrated fiber optic delay line assembly and transducer read ahead, for a twelve bit digital optical linear position transducer. The design must be easy and relatively cheap to manufacture.

Phase II: Fabricate and performance test module prototypes; integrate them into a position transducer, and conduct system performance and life cycle tests.

A90-401 TITLE: Multimission Launcher Concept Development

CATEGORY: Exploratory Development

OBJECTIVE: The intent of this program is to develop a breadboard multimission launcher which is capable of firing all currently fielded U.S. Army Aviation missiles and to define associated logistical and technical advantages.

DESCRIPTION: Three missiles are currently fielded and operational within Army Aviation. These are the Tub-launched Optically-tracked wire-guided (TWO) and HELLFIRE air-to-ground antitank missiles and the Stinger air-to-air missile. Each missile has its dedicated launcher, interface electronics, and controls. Therefore, substantial logistical and operational benefits may be derived by developing a single launcher capable of firing all missiles. The intent of this program is to develop a missile launching system capable of firing and controlling HELLFIRE and Stinger only.

Phase I: The desired results of the Phase II are to assemble and test a breadboard Multimission Launcher in a laboratory environment using missile emulator hardware for function verification.

Phase II: The desired results of Phase II are to assemble and test a breadboard Multimission Launcher in a laboratory environment using missile emulator hardware for functional verification.

A90-402 TITLE: Integrated Fire and Flight Control (IFFC) Implementation Assessment

CATEGORY: Exploratory Development

OBJECTIVE: Perform a preliminary qualitative feasibility assessment of the utility and implementation of Integrated Fire and Flight Control.

DESCRIPTION: To maximize the combat effectiveness of air-to-air rotorcraft, the control laws require specific tailoring to suit the mission. The new, emerging air-to-air requirement imposes demands on the rotorcraft and crew that exceed conventional design and handling qualities criteria. The purpose of this work is to explore the potential impact IFFC could bring to mission performance and to recommend integration methods/schemes/approaches to most effectively employ the IFFC concept in the modern attack helicopter.

Phase I: The contractor shall perform a qualitative assessment of the implementation of an IFFC system/concept. The contractor shall further recommend integration methods/schemes/approaches to most effectively employ the IFFC concept in the modern attack helicopter.

Phase II: The contractor shall define preliminary mission task tailored integrated fire and flight control law architecture for improved flight path precision for aerial gunnery. These mission "tuned" and fire control integrated flight control laws shall be structured to alleviate or mitigate fire control inaccuracy contributions from weapon firing-induced aircraft deviations or flexures during the gunnery task. The Contractor shall compose math models to quantify IFFC measures of effectiveness in simulation.

Construction Engineering Research Laboratory

A90-403 TITLE: Large Space Structure Design Parameters

CATEGORY: Basic Research (Engineering)

OBJECTIVE: To provide research solutions that identify the efforts of design related parameters on the stiffness and stability of large space structures in low earth orbit.

DESCRIPTION: Potential utilization of large space structures (assembled or deployed on orbit) by the Army as reverence platforms/supporting structures for arrays of sensors and their ancillary equipment will emphasize stiffness and shape stability in the space environment. Methods of design and analysis are needed to maximize these features while minimizing mass. The full interaction of structural configuration, materials and controllers will be considered.

Phase I: The results of this phase will be a report which describes in detail design/analysis techniques, effects of material properties and control systems needed for stiffness and shape stability in low earth or geosynchronous orbits.

Phase II: Based on predictions of Phase I, this phase will develop a design model, create a hypothetical space platform that demonstrates high stiffness and shape stability, analyze/refine the model and produce a prototype large space structure of one-quarter scale or larger, for delivery to the monitor of the studies.

A90-404 TITLE: Lead Immobilization Coating/Treatment

CATEGORY: Basic Research

OBJECTIVE: To develop a potable water compatible chemical complexing agent which will selectively coat the residue from lead soldier joints in drinking water plumbing, without physical removal of the pipes/soldered joints.

DESCRIPTION: The latest amendments to the Safe Drinking Water Act propose major reductions in allowable lead concentrations. The principal source of lead is solder in building plumbing systems. Although the use of lead solder has recently been banned, it is expensive to remove soldered joints from existing buildings. If a method to selectively coat and immobilize the lead in soldered joints were available which did not adversely affect the water quality, it would be a great benefit for lead control at existing buildings.

Phase I: Investigate the ability of chemical coatings compatible with potable water quality guidelines to immobilize lead from lead soldered joints in a plumbing system. The most desirable methods would be chemicals which could be added directly to water. A second alternative would be a treatment applied while the system is temporarily taken out of service, followed by a flushing period after which the lines would be usable for potable water.

Phase II: Develop and pilot test a Lead Mobilization Coating/Treatment System on a variety of existing buildings which exhibit high lead concentrations.

A90-405 TITLE: Development of an Improved Rapid Seismic Analysis Procedure (RSAP)

CATEGORY: Exploratory Development

OBJECTIVE: Modify the existing RSAP to take advantage of recent advances in earthquake engineering and computer technology.

DESCRIPTION: A first generation Rapid Seismic Analysis Procedure (RSAP) is now outlined in the Tri-Service manual, Army TM 5-809-10-2, Seismic Design Guidelines for Upgrading Existing Buildings. This method is used to estimate potential earthquake damage to buildings. It is extremely limited in its ability to provide accurate and detailed results, and does not incorporate many of the lessons learned from recent earthquakes or recent developments in micro-computer hardware and software capabilities. With these recent developments and lessons learned, more detailed, accurate, and efficient methods of evaluating the earthquake resistances of structural systems of buildings are now possible. An improved Rapid Seismic Analysis Procedure should be produced based on these technical developments. Using this improved method RSAP, the vulnerabilities of military facilities to earthquakes may be more accurately and rapidly assessed without additional cost.

Phase I: An algorithmic approach and basic concept for in improved RSAP shall be developed. This procedure shall incorporate the latest advances in earthquake engineering and computer systems engineering to assess the earthquake resistance provided by a building structural system. The procedure shall permit the analyst to examine a variety of construction materials and structural configurations, representative of conventional military construction, and shall permit the input of ground motion data as outlined in TM 5-809-10-2.

Phase II: A micro-computer version of the improved RSAP shall be provided which allows engineers to rapidly and accurately assess the earthquake resistance of building structures. The RSAP software shall be verified through field application at a variety of military installations to be chosen by USACERL. The installations will reflect different building types and seismic inputs.

Cold Region Research and Engineering Laboratory

A90-406 TITLE: Total Pressure Measurements in Freezing and Thawing Soils

CATEGORY: Exploratory Development

OBJECTIVE: To provide research and development resources sufficient for a small business contractor to develop to a marketable degree an instrumentation system for manually or continuously and automatically measuring and recording vertical and/or horizontal pressure beneath the surface of freezing and thawing soils.

DESCRIPTION: Currently available instruments are large and average the applied pressure over a large area. The devices were developed for use in large embankments such as dams or high retaining walls. In this instance it is desirable to develop a much smaller instrument which can be used beneath a road or airport pavement to determine the pressure at a selected “point.”

The currently available instruments are generally very “stiff” or very “compliant” and tend to concentrate or more widely disburse loadings causing inaccurate data to be obtained. Matching the modulus of the gage to that of the soil is necessary to minimize these problems, but in seasonal frost areas the modulus varies substantially depending upon whether the soil is frozen, thawing, thawed and not reconsolidated or thawed reconsolidated. The modulus of fine-grained soil may easily change three orders of magnitude during various stages of freezing and thawing.

The ideal gage will be small, perhaps two inches in diameter by less than an inch thick, insensitive to temperature changes in the range of 0 F to 80 F, capable of measuring pressures in the range of 0.5 to 100.0 psiwith a resoluation of 0.1 psi and an accuracy of + or – 0.2 psi over the lower quarter or one-half of the pressure range and not more than + or – 0.5 psi over the upper one-half of the range.

The instruments would be imbedded into soils ranging from granular base courses to silt and clay subgrades. The environment may range from saturated to very low degrees of saturation (20% to 30%) and road salts or other chemicals may be present occasionally or continuously in the soil. The most important environment change will be freezing and thawing, however.

Phase I:

a. Determine feasibility of instrumentation to meet the above standards.
b. Develop a working "breadboard model" of instrumentation which will meet the requirements listed above.
c. Conduct laboratory tests to verify the proper performance of the "breadboard model" instrument.

Phase II: The contractor will design and fabricate a prototype of the equipment evaluated in Phase I. The end product will be a validated and calibrated prototype instrument which will be used in field experiments to demonstrate the potential applications in its intended environment.

A90-407 TITLE: Development of a Portable Instrumentation-Video Interface

CATEGORY: Exploratory Development

OBJECTIVE: To provide research and development resources sufficient for a small business contractor to develop and successively market instrumentation ranging from a portable battery operated instrumentation interface system to an instrument with a minimum of four external sensors and overlay the results of that instrumentation on a video signal.

DESCRIPTION: Current technology allows for computer data to be overlayed one standard NSTC composite video signal. However, with the increased use of portable batter operated video recorders there is presently no technique to place data such as temperatures, wind speed, wind direction, etc. on the video recording. Many cameras have hand operated character generators built into the cameras for time/data and titles, but this does not input other instrumented signals on a real-time basis.

The instrumentation/interface should be small enough to be carried while operating a portable video system. The self contained battery should operate the instrumentation and generate the combined composite video signal for a minimum time of 2 hours when the ambient temperature reaches -40C. The video input should be capable of accepting standard 10 pin, 12 pin, and 14 pin connections used by video manufacturers such as Sony, Panasonic, and JVC. The instrumentation input should be programmable to accept a diverse range of inputs, such as thermocouples, thermistors, wind speed, wind direction, strain gage load cell outputs, and other voltage or resistance type sensors. The programming can be comparable to an EPROM.

The interface should be capable of changing the color, contrast, and location of the four channels of sensor output on the composite video signal.

Phase I:

a) Determine the feasibility of instrumentation to meet the above standards.
b) Develop a working model of the instrumentation/interface.

Phase II: The contractor shall design and fabricate the equipment evaluated in Phase I. The end product will be a validated prototype instrument to be used in field documentation of ice problems on rivers.

Engineer Topographic Laboratory

A90-408 TITLE: Dynamic Tactical Decision Aids (TDA)

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to develop new and innovative Dynamic Tactical Decisions Aids using advanced technology adapted to the needs of the non-technical military user.

DESCRIPTION: Past demonstrations of Tactical Decision Aids (TDA) during military exercises have demonstrated the need for more effective means of training a Geographic Information Systems (GIS) user to successfully generate and manipulate these TDAs. Frequently, the soldier has little or no experience in terrain analysis or computer methodology when he is assigned to a terrain unit and must be rapidly trained to perform this job. TDAs are created by a laborious process and procedure a static output that cannot be manipulated by the user.

Phase I: The first phase will research new and innovative tools, hardware and/or software, to determine how these impact the creation and manipulation of TDAs. The tools could be incorporated within a GIS or applied within an independent frontend. Possible candidates for research would be touch screens, voice recognition devices, natural language or expert system interfaces, and hypercard/supercard technology. The result of Phase I will be a report itemizing the recommendations along with the system(s) (Macintosh, SUN, UNIX, S-Windows, etc.) to which the technology is adaptable.

Phase II: The second phase will demonstrate the usefulness of selected tools recommended under Phase I. The contractor will purchase the necessary hardware/software items, install them on a hardware system and GIS, prepare a formal demonstration, test the effectiveness of the project, and document the results.

A90-409 TITLE: Urban Warfare Digital Data Base

CATEGORY: Exploratory Development

OBJECTIVE: To develop an innovative concept and technique for generating topographic data bases.

DESCRIPTION: Historically, by doctrine, the Army has avoided military operations over urban terrain. The past decade has clearly shown that not only is that approach not reasonably, but any high probability low intensity conflict will involve considerable fighting in urban areas. The recent fighting in the Philippines, Romania and Panama clearly show the tendency for urban areas to become the battleground of the future. The ability to create a topographic database for high resolution aerial photography over urban areas is very limited and largely a manual process. Those automated procedures that do exist, to extract evaluations to provide a topographic database, in a crisis response time frame, is badly needed. At a minimum, a wire frame model, over which high resolution aerial photography could be draped is required. More sophisticated data bases showing the position of roads, buildings, and associated descriptions would be highly desirable.

Phase I: Provide a conceptual design and ETL laboratory demonstration of a methodology to generate an urban area topographic data base from high resolution aerial photography using a crisis scenario. The methodology is to be clearly documented including all relevant mathematics. Software is to demonstrate any high risk procedures. A wire-frame model over as a minimum. More sophisticated databases showing the location of roads, buildings, associated descriptions would be highly desirable.

Phase II: Develop and delivery to the Government a developmental model with appropriate documentation for evaluation using live data. The entire process from photogrammetric source to a digital topographic data base (consisting at a minimum elevations but preferably feature data as well) will be evaluated. Follow-on work will be required in two areas. One will be to make the software more robust. The second would be to convert what is essentially a research piece of software to a prototype system which could be demonstrated with troops during field exercises.

A90-410 TITLE: Brigade Level Hardcopy Device

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to successfully develop a hardcopy printing device, used with a man-portable computer, to produce terrain analysis graphics in the field.

DESCRIPTION: The U.S. Army Engineer Topographic Laboratories is currently investigating the use of a small man-portable computer for use in preparation of terrain analysis products in the field, at brigade level and below. The computer is equipped with a single color plasma display, 8.5 by 6 inches in size. This is used to display various graphic products, but a hard copy printer capable of producing map overlays from the screen image would greatly increase the utility of the system. At present, there are no known hard copy imaging devices wholly suitable for this use. Such a device should be man-portable, capable of printing to transparency materials with a format at least as large as the display screen, use non-smearing links, and be rugged enough for field use.

Phase I: The first phase of this project shall consist of: (1) a determination of the functional requirements for a Brigade Level Hardcopy Device, (2) an assessment of the applicable state-of-the-art within government and industry, and (3) an implementation plan acquiring or developing the device.

Phase II: A candidate printer will be procured and modified, or developed. It will be interfaced to and tested with the portable computer system.

A90-411 TITLE: Sensors and Technology for Minefield Detection from Space

CATEGORY: Basic Research

OBJECTIVE: Objective is to identify sensors and technology(s) that have the potential to be employed to remotely detect landmines from space. Parametric analysis would be performed to evaluate the potential for use of current and future sensors and technology(s) by the Army to detect landmines from space.

DESCRIPTION: Remote landmine detection is essential to minimize losses of Army personnel and equipment and facilitate rapid movement. This analysis would identify the kind and type of sensors and technology that could be employed from space to remotely detect landmines. This analysis would consider all sources of remote landmine detection including from personnel on the ground, ground vehicle mounted (manned or unmanned) and from manned and unmanned aircraft. The utilization of a space-based detection capability would be a compliment to those capabilities and not be a replacement, unless a space-based capability were far superior to other detection sources.

Phase I: Identification of performance parameters required for remote landmine detection from all possible detection sources (ground, air, and space).

Identification of current sensors, technology(s) and/or a system(s) that are capable of detecting landmines from space. Identification of high payoff, future sensors, technology(s) and/or system(s) that require further development to accurately detect landmines from space.

Conduct a parametric analysis of the current sensors, technology(s) and system(s), high payoff, future technology(s) and system(s), and performance parameters required with the objective of identifying the contribution that space-based landmine detection can make to landmine detection from all possible detection sources.

Recommendations for development program(s) to mature high payoff, future sensors and technology(s), if current technology inadequate, to accurately detect landmines from space.

Phase II: Conduct either an exploratory development of technology demonstration program to mature and demonstrate the high payoff sensors and technology(s) identified during Phase I above.

A90-412 TITLE: Development of a Statistical Method for Three-Dimensional Terrain Elevation Error Analysis

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to develop a set of measurements of the accuracy of Digital Terrain Elevation Data (DTED), a method for deriving the measurements, and a technique for evaluating the reliability of products derived from the data.

DESCRIPTION: Little is known about DTED accuracy, and consequently its reliability, yet DTED is essential for making most of terrain analysis products employed by the field commander to make informed tactical decisions. A statistical method must be developed for measuring DTED accuracy in all three spatial dimensions.

Phase I: Phase I will establish a rectangular array of highly accurate field elevations of positions contained in an existing DTED cell. With the field data as an experimental control, a mathematical method for analyzing DTED accuracy in three dimensions will be developed. A graphic display capability will be developed to visually demonstrate discrepancies found between DTED and the control data.

Phase II: Phase II will demonstrate the methodology on DTED representing different types of topography. The tests will be used to validate the applicability of the measurements and the ability of Army users to apply the proposed evaluation techniques.

A90-413 TITLE: Development of Models for Terrain Features on Digital Radar Imagery for Automated Feature Extraction and Change Detection

CATEGORY: Basic Research

OBJECTIVE: The objective is to develop models in support of the automated extraction and change detection of significant military terrain features from digital radar imagery. Develop quantitative characteristics of the features, techniques for the separation of features from backgrounds, and strategies for effective and efficient automated feature extraction and change detection.

DESCRIPTION: Feature extraction and change detection from radar imagery cannot be accomplished timely and efficiently because it is performed manually by image analysts. This deficiency can be removed by automation. Radar signatures of terrain features very significantly with respect to the radar system parameters, imaging geometry and geographic locations. Hence, a feature may produce many different radar signatures. This fact presents technical barriers to automated feature extraction which may be resolved by the introduction of symbolic features and their radar signatures similar to the way that human analysis image signatures to specific features. The classification of the work will be SECRET. The developed software must be demonstrated on an ETL SUN or an equivalent work station using the C programming language and the UNIX operating system.

Phase I: Detailed description of approach and methodology for symbolic model development and extraction demonstration for at least one feature from different radar images.

Phase II: Symbolic models for relevant military terrain features, algorithms and software, and demonstrations of feature extraction and change detection on an ETL SUN or an equivalent work station.

A90-414 TITLE: Impacts of Climate Change

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to cull the current research related to global climate change, assess the forecasted impacts of climate change on the military and its activities (with special focus on the Corps of Engineers),

and develop a plan of action and sets of recommendations to allow the military to effectively cope with and plan for these anticipated negative effects.

DESCRIPTION: The subject of climatic change is currently an extremely topical issue. A great deal of scientific activity is currently underway which focuses on such concerns as global warming, the Greenhouse effect, changing weather patterns, ozone depletion, etc. Various government and private agency experts have come forth with scientific prognostications concerning both short and long term climatic changes and effects. However, the experts are not of one mind, as extremely conflicting and diametrically opposite points of view surface almost daily.

With regard to the military, any major change(s) in the world's climate could have significant impacts. For example, changes in precipitation patterns, frequency of droughts, and the migration of major agricultural regions could generate new military alliances and may create new areas of potential military conflict. On its Civil Works side, the Corps of Engineers (COE) could be faced with increased shoreline erosion, inadequate dams, aqueducts, levees, piers, canals, etc. To adequately prepare for such events, the military requires a knowledge base of current scientific climatic change information with associated impacts.

Phase I: Phase I will consist of a thorough and comprehensive literature survey of the most scientific climate change information and thinking. This survey will include detailed descriptions of models, algorithms and techniques, as well as summaries of findings to include type of change, magnitude, and projected time scale of events. Potential impacts on the military and its activities shall be correlated to these findings in a general fashion.

Phase II: Phase II will expand upon the aspects of climate change as it relates to the military, with particular emphasis on the Civil Works arena of the Corps of Engineers (COE). Possible impacts on existing and planned COE structures, activities and procedures shall be examined in detail. When possible, cost estimates of these potential impacts shall be put forth. Potential solutions and planning guidance shall be recommended.

Waterways Experiment Station

A90-415 TITLE: Penetrating Sealants

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop a penetrating sealant that when applied to concrete will penetrate at least to a depth of 18 in., restoring the integrity of unsound or deteriorated concrete and preventing additional deterioration. This is the typical depth of many concrete slabs for pavements and, where the concrete is often limited to the near-surface 18 in. of concrete. The development of the sealant may also require development in application procedures to ensure good, even penetration of the sealant into the concrete.

DESCRIPTION: Current sealants are only surface-type sealants, have limited penetration ability, and generally do not have the ability to reduce the migration of water in the concrete except at the near-surface region where they are applied. The new sealant should have good penetrating power, thus reducing the water permeability of the overall concrete to some depth approaching 18 in.

Phase I: Develop candidate materials.

Phase II: Develop candidate application procedures and test overall system.

A90-416 TITLE: In-Situ Test Device to Determine Lateral Earth Pressures

CATEGORY: Engineering Development

OBJECTIVE: Geotechnical investigations required for the design of structures and foundations for military operations, ground shock calculations, or studies of the mobility of wheeled and tracked vehicles, require a knowledge of in-situ stresses for initializing the computations. The technology to measure these stresses does not

exist. Although vertical stresses can be estimated with reasonably accuracy from a knowledge of the unit weight of the soil, horizontal stresses must be estimated from the product of an assumed value or values for the coefficient of lateral earth pressure and the estimated values of vertical stress. Consequently, there is an inherent degree of uncertainty in these analyses. The Department of Defense has a critical need to develop the technology to determine horizontal stresses in situ. Successful implementation of this technology will have a direct application to the measurement of vertical stresses in-situ.

Phase I: The proposed research should include a literature search and an assessment of existing technology, preparation of conceptual design alternatives, development of an analytical model to assess design alternatives, an instrumentation requirements, and a summary evaluation of preliminary design criteria and instrumentation requirements, and a summary evaluation of the overall feasibility of the proposed project.

Phase II: The proposed research should include the design, fabrication, assembly and calibration of the test apparatus, laboratory or field in situ validation tests of the apparatus in cohesive and cohesionless soils, and a final report documenting the study.

Medical Research Acquisition Activity

A90-417 TITLE: Cross Sectional Imaging System Using Phosphor Transducers

CATEGORY: Exploratory Development

OBJECTIVE: Develop a volumetric medical diagnostic imaging device using photosensitive phosphor plate technology as a transducer. Conventional image processing algorithms (e.g. filtered back projection) should be used to render an image in digital format.

DESCRIPTION: The military medical services are interested in applying volumetric imaging techniques to combat casualty care. Phosphor plate technology may prove to be a reliable image transducing media to convert patient-attenuated x-ray photons into a diagnostically useful image.

Phase I: Explore design features, develop a proposed design with related engineering/physics data to support the technical approach.

Phase II: Develop a prototype breadboard device.

A90-418 TITLE: Purification of Native and Recombinant Flavivirus Proteins for Use in Vaccine Development

CATEGORY: Exploratory Development

OBJECTIVE: To purify native flavivirus proteins (E and NS1) for comparison with expressed protein vaccine candidates.

DESCRIPTION: The incumbent will grow large quantities of dengue and Japanese encephalitis viruses in tissue culture and purify native and recombinant proteins by the least denurating techniques available. The purity of preparations will be at least 95% as demonstrated by polyacrylamide gels electrophoresis. The identity of proteins will be established using hyper immune ascetic fluids and monocional antibodies provided by Walter Reed Army Institute of Research (WRAIR). Gram quantities of proteins will be provided to WRAIR investigators for use as controls in mouse protection experiments.

Phase I: Bulk quantities of viruses will be prepared. Methods for purification will be developed using dengue-2. The envelope and the non-structural protein (NS-1) will be purified and characterized and their identity certified at WRAIR.

Phase II: Following determination of techniques, 50 gram quantities of each of the E and NS1 proteins of dengue-1 through dengue-4 and Japanese encephalitis virus will be produced and provided to WRAIR.

A90-419 TITLE: Development of Small Animal Infection/Protection Model for Dengue-3 Virus

CATEGORY: Exploratory Development

OBJECTIVE: Development of a small animal infection model for dengue-3 virus to assess the protective capacity of dengue-3 sub-unit and whole virus candidate vaccines.

DESCRIPTION: A reliable protection model to assess the protective capacity of dengue-3 virus antigens is currently unavailable. Dengue-3 viruses, members of the family FLaviviridae, are major public health threats in the tropics, causing epidemic and endemic disease. Candidate vaccines being developed include live attenuated virus strains, sub-unit preparations using protein antigens prepared by recombinant methods, or synthetically prepared polypeptides. The development of protective candidate vaccines would be enhanced by early evaluation in immunologically competent small animals. Small animal infection models already exist for other dengue viruses (dengue-1, 2, and 4) in weanling and young adult mice. No dengue-3 virus strains have been devolved which can infect mice older than about 12 days.

Phase I: Develop dengue-3 virus strains which can reliably infect young adult mice or a similar small animal model. Mouse neurotropic dengue-3 virus (for suckling mice) will be provided by the Government. Other strains will be provided if necessary. This work will be performed in close coordination with in house investigators at the Walter Reed Army Institute of Research.

Phase II: Develop protection assay to assess the immunological potential of selected dengue-3 antigens (provided by the Government) using the infection model developed in Phase I. The contractor will assess the protective capacity of the selected antigens and report on their immunological potential.

A90-420 TITLE: The Molecular Biology of the Mechanisms of Antiparasite Drug Action and Resistance

CATEGORY: Basic Research

OBJECTIVE: The project objective is to gain an understanding of the molecular basis of drug resistance in parasites. These data will be used to evaluate and develop novel chemical agents for combating drug resistant parasites.

DESCRIPTION: The utility of current chemotherapeutic drugs for the treatment of malaria, leishmaniasis and schistosomiasis is becoming less effective due to drug resistant parasites. In order to develop or adapt drugs whose efficacy is not compromised by this resistance, the molecular biology of drug resistance needs to be full elucidated. Data have suggested that multi-drug resistant protein, p-glycoprotein 170 (pgp 170), may facilitate drug efflux. Additional data is needed on the structure of transport protein(s), the mechanism of drug efflux, and the identification and characterization of the gene(s) involved.

Phase I: The identification and characterization of multi-drug transport protein(s) and gene(s).

Phase II: The development of drugs that will modulate the multi-drug resistance phenotype and the use of Phase I data to empirically ascertain the phenotype of drug-resistant parasites.

A90-421 TITLE: Development of Diagnostic Probes for the Detection and Surveillance of Drug Resistant Parasitic Infections

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop probe(s) that will provide rapid identification of drug resistant Plasmodium falciparum malaria and Leishmania species.

DESCRIPTION: The phenomenon of resistance to drugs by prokaryotic pathogens is a matter of great practical concern. The prevalence of multidrug resistant strains of P. falciparum and the unresponsiveness of cutaneous and visceral leishmaniasis to antimonial therapy is a serious clinical problem that represents an important threat to the management of these diseases. There is a growing demand for the development of a rapid diagnostic test that will allow a complete direct identification of drug-resistant parasites in easily obtainable patient samples. The probes would call for a single reading of results by semi-skilled technical staff. The probes should be specific, sensitive and inexpensive. The quantities required for in vetro and field testing of each prove submitted is about 100 and 1000 reactions respectively.

Phase I: Submission of potential probe(s) in the appropriate quantity and quality for in vitro testing against reference drug resistant and sensitive parent clones of the parasites.

Phase II: Submission of additional quantities of specific probe(s) for field testing and evaluation.

A90-422 TITLE: Development of Novel Methodologies for Diagnosing and Evaluating Acute Schistosome Infections

CATEGORY: Basic Research

OBJECTIVE: The objective is to design a rapid, simple, specific methodology for detecting the early acute (Katayama-like) syndrome in individuals infected with Schistosoma mansoni.

DESCRIPTION: The acute phase of Schistosoma mansoni infection is gaining increased recognition as a debilitating disease syndrome. This Katayama-like syndrome is clinically non-specific and must be differentially diagnosed from other fever producing diseases. This is of particular concern relative to immunologically naïve individuals who are returning from S. mansoni endemic areas, and who are presenting with these acute symptoms. Primary health care personnel need, therefore, a rapid, simple and specific diagnostic test which can be applied in the field to identify this early syndrome prior to the classical presentation of schistosome infection.

Phase I: Submission of measurable parameter that is unique to the early, acute schistosomiasis syndrome.

Phase II: Submission of a simple deployable diagnostic test system for the measurement of the unique parameter determined in Phase I.

A90-423 TITLE: Multipurpose Centrifuge

CATEGORY: Advanced Development

OBJECTIVE: Develop a small, lightweight, multi-powered centrifuge for all combat casualty care relevant fluids.

DESCRIPTION: A centrifuge is needed to perform microhematocrit, urine sediment, fecal concentration, and plasma preparation procedures. Capability for use with QBC II hematology tubes is also desirable. Item must be small, lightweight, durable, and capable of being operated on batteries or AC (110/200V, 50-60 Hz).

Phase I: Develop a working prototype centrifuge that will perform all required procedures.

Phase II: Develop and test a production-level centrifuge that will perform all required procedures.

A90-424 TITLE: Cold Sterilizing Agent

CATEGORY: Exploratory Development

OBJECTIVE: Develop a stable powdered material which can be readily dissolved in water and used for the cold sterilization of dental instruments in the field.

DESCRIPTION: Currently available cold sterilizing materials are effective for certain applications but are all in solution form. The bulk and weight of these solutions present a logistical problem when considered for field use. A powdered material suitable packaged in waterproof packets and having an extended shelf life could be dissolved in water at the time of use. The resulting reduction in logistics requirements would be significant. The spectrum of activity of the material developed should be at least equal to available cold sterilizing liquids which in general have been demonstrated adequate for the sterilization of dental instruments.

Phase I: Demonstrate feasibility of producing a powdered cold sterilizing agent.

Phase II: Development of a powdered cold sterilizing agent which can be solubilized in cold water and provide effective sterilization of dental instruments.

A90-425 TITLE: Hand-held Locator for Radiotransparent Foreign Bodies

CATEGORY: Exploratory Development

OBJECTIVE: Development of a light-weight, hand-held device to easily detect small radiotransparent, foreign bodies such as plastic fragments. The device will be used in surgery in the same manner as metal detectors are currently used to locate metallic foreign bodies in the human.

DESCRIPTION: In a battlefield situation, many types of fragments can become embedded in a soldier's body. If this fragment is nonmetallic, it poses two problems: (1) it may be difficult to obtain an accurate picture of it using conventional x-ray technology, and (2) during surgery, it is impossible to know for sure when the surgeon is approaching the foreign body. A small, hand-held metal detector can be used to locate metallic fragments, but there is no existing instrument that can locate nonmetallic fragments.

Phase I: The Phase I effort will develop a viable technology to be used for such a foreign body locator. The technology should lend itself to the development of hand-held prototypes that are light-weight and easy to use in field medical treatment facilities.

Phase II: These prototypes should be used in pre-clinical trials that show that applicability of the technology developed in Phase I. It should also be shown that foreign body locators could be efficiently manufactured.

A90-426 TITLE: Development of A Lensless Phoroptor

CATEGORY: Exploratory Development

OBJECTIVE: Develop a Lenless Phoroptor using laser speckle pattern motion to gage refractive error.

DESCRIPTION: Currently, optometrists use a phoroptor containing a selection of lenses and a wall chart to measure visual acuity. Laser light which has been diffused by passing through a rotating cylinder will generate an interference pattern in space. If the eye is correctly focused, the pattern is stationary, the pattern will move at a rate and direction proportional to the amount of refractive error. A laser based phoroptor would not require the patient to make subjective judgements and could be more compact and easier to use than conventional equipment.

Phase I: Proof of the basic concept and breadboard phoroptor.

Phase II: Prototype equipment and evaluation with conventional phoroptors.

Strategic Defense Command

A90-427 TITLE: Electronics Materials for Anti-Satellite (ASAT) Application

CATEGORY: Basic Research

OBJECTIVE: The objective of this topic is to provide the necessary advances in electronic materials in order to improve the technology base for designing and developing lightweight, radiation hard, high performance electronic circuits for use in interceptors, active and passive sensors, and data/signal processing devices used in anti-satellite applications.

DESCRIPTION: Novel ideas which improve radiation hardness, performance, power requirements, capability and/or weight of integrated circuits, detectors, sensors and other electronic or electro-optical components are sought in areas such as: quantum-well/super-lattice structures which support "band gap engineering:, new organic and polymer materials with unique electronic/electro-optical properties, microstructure waveguides, solid state lasers, optical detectors exploitation of single crystal diamond electronic properties, high frequency transistors, superconducting concepts.

Phase I: This phase should demonstrate the feasibility and scientific or technical merit of the proposed idea in order to reduce risk incurred with Phase II effort. The demonstration should consist of an experiment or simulation that clearly shows the potential of the concept, ie., the fabrication and characterization of a light emitting diode using new materials, novel processing or new concepts.

Phase II: This phase should address critical issues and result in a well defined product or process ready for the commercial development of a specific application. For example: activities would consist of determining performance as a function of process variable and address the critical issues, which could include the integrated of, perhaps a transistor with the other elements of a logic circuit for a given application.

Phase III: This phase should consist of applying the technology developed in the previous phase to a specific application, such as, fabricating components which would be incorporated in a neural network system for data/signal processing in an ASAT interceptor or other commercial application.

A90-428 TITLE: Neural Network Software/Hardware for Directed and Kinetic Energy Anti-Satellite (ASAT) Weapons System

CATEGORY: Basic Research

OBJECTIVE: To develop new and innovative neural network algorithms and architectures that will aid in developing a real-time, economical and reliable kinetic and directed energy anti-satellite (ASAT) weapons system.

DESCRIPTION: Directed Energy (DE) and Kinetic Energy (KE) anti-satellite weapons systems is a vital candidate system to our nation's defense. This weapons system has a need for knowledge base systems that are economical and provide accurate information in real-time. A neural network is a computational structure modeled on biological processes. Some of the key features of the neural network are its trainability and speed. Neural networks are a powerful tool that can increase the power of DE and KE anti-satellite weapons knowledge base systems by helping the system learn faster and with less human programming. Approaches are sought to extend or improve present ASAT concepts, facilitate and reduce the cost of the concepts. Elements of the systems include, but are not limited to, weapons pointing, beam control, acquisition, tracking, sensor focal planes, signal and data processing, guidance and control algorithms, control of cryocoolers, array image processing and other ASAT system components.

Phase I: The first phase will conclude the feasibility of the concept through simulation and/or prototype and the applicability of the concept to ASAT weapons system. It will also show the merit of furthering the concept to a Phase II.

Phase II: The second phase will incorporate the principle developed in Phase I into a prototype or show proof of principle and feasibility for incorporation into the ASAT demonstration phase commercial applications will be considered.

Phase III: Results of Phase I and Phase II shall lead to a Phase III that will incorporate the developed principles into a specific ASAT test application and/or lead to specific commercial application.

A90-429 TITLE: Sensor Signal and Data Processing for ASAT Application

CATEGORY: Basic Research

OBJECTIVE: New and innovative approaches offering order-or-magnitude improvements to sensor signal and data processing performance, power, weight, size and cost are desired.

DESCRIPTION: Modern sensors produce vast amounts of electronic signal information which must be processed quickly and accurately to perform surveillance and target tracking functions. Signal processing of the sensor data is first performed to identify object detections. Data processing is then performed to handle target tracking and other high level functions. Advances are needed both in hardware architecture and in algorithms to handle nuclear effects mitigation, structured background removal, object dependent processing, and multiple target tracking.

Phase I: A Phase I effort will identify one or more specific functional elements of the signal and data processing chain and seek a sizeable and realizable improvement to the components. This will include design and simulation of the improvement and proof of its technical merits.

Phase II: Phase II will develop the signal or data processing improvements from Phase I for a more detailed simulation/prototype demonstration of the advantages of the resulting hardware or algorithm.

Phase III: This Phase will involve the application of the processing innovation to real systems with possible industry or government cooperation. The product that emerges form Phase I or Phase II research shall be such that in Phase III either more research is required to finalize the development or it is ready to be introduced into the ASAT demonstration program and/or introduced into the private sector commercial market.

A90-430 TITLE: Optical Computing and Optical Signal Processing Technology for ASAT Application

CATEGORY: Basic Research

OBJECTIVE: Develop innovative optical materials, devices, components, architectures, and algorithms that will advance the technology. The innovative concept shall lead to a product that will increase performance for a specific function and/or reduce the power, weight, size, etc., of a component required by the ASAT system. This can be in any aspect of BM/C3, surveillance, acquisition, tracking or kill assessment, etc.

DESCRIPTION: Orders of magnitude advancement in performance is needed in hybrid opto-electronic and in all computing and signal processing systems. This requires new and significantly enhanced nonlinear materials and photonic devices, acousto and electro-optic components, optically and electronically addressed SLMs and array processors, holographic techniques, reconfigurable interconnects, methods of massive fan-in/fan-out, and parallel algorithms and architectures. Applications include optical neural-network processors as well as general-purpose optical analog and digital computers and special-purpose optical co-processors and accelerators.

Phase I: The results of this effort will provide proof-of-concept feasibility by means of preliminary design, simulation, and laboratory experimentation. The product should be directly linked to some subsystem of the ASAT program and have potential commercial application.

Phase II: The results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working, but not necessarily optimized, breadboard model. Consideration must be given to, and direct application shown, for improvement to some element of the ASAT program. Phase II must provide insights into the Phase II program which can be further government funded development (a procurement) or private sector commercialization.

Phase III: This effort will be the commercialization, as well as military application in missile interceptors and satellites, of high-density performance optical signal and data processing systems or subsystem.

A90-431 TITLE: Robotics and Artificial Intelligence (AI) for Anti-Satellite (ASAT) Application

CATEGORY: Basic Research

OBJECTIVE: The objective of this research is to explore innovative, novel decision aid concepts and robotic technology for ASAT applications including the BM/C3 functions.

DESCRIPTION: Innovative ideas for research designed to enhance an ASAT system decision making capability under severe environment are sought. Genetic algorithms and other self-adapting concepts which both reduce the time required to reach a decision and improve the decisions made are of particular interest. Also, innovative concepts for robotic techniques which will either aid in the maintenance of a deployed ASAT system or in the manufacture of components for an ASAT program are requested.

Phase I: During this phase, an innovative concept will be investigated and feasibility established via mathematics, computer simulation, prototyping or a combination of these. The concept must be shown to lead a product that can go into a Phase II and have a potential for a Phase III.

Phase II: A robotic technique or AI concept must be developed towards a clearly identified ASAT requirement. It must further be shown to have the potential for commercialization for either or both the government not the private sector. A robotic manufacturing demonstration, or a demonstrated expert decision system for the BM/C3 function are examples of a Phase II program.

Phase III: The results of Phase I and Phase II will be integrated within an ASAT system that will be used in an actual ASAT demonstration and validation experiment and/or lead to a specific commercial application.

A90-432 TITLE: Computer Architecture, Algorithms, and Languages for Anti-Satellite (ASAT) Application

CATEGORY: Basic Research

OBJECTIVE: Demonstrate novel or innovative approaches for ground and space computer architecture, algorithms, and language support target acquisition, tracking, classification/discrimination, kill assessment, and battle management/command, control, and communication (BM/C3).

DESCRIPTION: The ASAT program is pursuing the development of both a kinetic energy, and directed energy anti-satellite concept. This ASAT program is to demonstrate current technology and will initiate product improvements as new technology becomes available. In support of this program, the following areas of interest are identified.

Computer architecture to improve processing speed, be parallel or distributed in layout, be more secure, with increased fault-tolerant capabilities, and have higher reliability are being sought. Innovative algorithms to increase

data processing performance, include fault tolerance, and implement novel numerical techniques are requested. Languages to optimize operating systems for computer architectures, demonstrate improved man-machine interfaces, and allow for easy software updates and system testing are also of interest.

Phase I: To investigate and analyze the various approaches toward solving a particular problem area and recommend a single defined method. The method should be based on innovative concepts that will provide benefits to the ASAT program.

Phase II: To determine the Phase I method through a design, fabrication and/or encoding, and testing. During demonstration, the procedures to implement the method, schedules, resources requirements, and testing are documented and evaluated. Periodic testing provides a means of assuring that method can be successfully implemented.

Phase III: This phase shall lead to components or systems that can be integrated into the ASAT prototype or demonstration program. Also, this phase should provide new products for civilian markets based on the technology transfer.

A90-433 TITLE: Laser Communications for ASAT Application

CATEGORY: Basic Research

OBJECTIVE: Research technologies which will enhance the feasibility of a laser communications network for elements of the ASAT program.

DESCRIPTION: A critical element of the ASAT program is a communications network. Highly desirable characteristics of a communications network are: high date rate, high resistance to jamming, rapid acquisition and tracking, switchable links, wide field of view, and secure links. This program is structured to explore the relevant innovative technologies which support laser communications links. These support technology areas include, but are not limited to: lasers, laser beam steering/control; modulation techniques/systems; receiver techniques/systems; and networking concepts.

Phase I: New and innovative concepts are sought which will enhance the feasibility of laser communications links/networks. The Phase I effort should be structured to determine the feasibility of the proposed concept by the end of the Phase I performance period.

Phase II: After the feasibility of the proposed concepts has been established in Phase I, the evolution of the concept will be continued during the Phase II effort. The concepts will be implemented in software/hardware to demonstrate the engineering feasibility of the concept and any critical engineering bottlenecks will be addressed and solved.

Phase III: Following a successful Phase II effort, proposed concepts should have evolved to the point that full scale engineering development can being to incorporate the concepts into a firm design as a component or major subsystem of a laser communications link/network.

A90-434 TITLE: Propulsion and Propellants for Anti-Satellite (ASAT)

CATEGORY: Basic Research

OBJECTIVE: Develop innovative propulsion materials, devices and components to provide substantial performance improvement and weight/volume reductions for kinetic energy weapons that utilize solid propellant rockets or hybrid liquid-solid energies.

DESCRIPTION: Order of magnitude advancement in performance is needed in advanced rocket propellant materials, motor cases and nozzles, and processing technology. This requires new and significantly enhanced energetic polymers and novel oxidizers; high strength to weight materials for rocket motors and nozzles;

miniaturized devices and components; and improvement in automation science for chemical processes that contribute to safe mixing, handling and processing of highly toxic and energetic propellant ingredients.

Phase I: The results of this effort will provide proof of concept feasibility by means of preliminary design, simulation, and laboratory experimentations.

Phase II: The results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working preliminary breadboard model.

Phase III: The hardware should be developed to the stage where it can be demonstrated in a flight test.

A90-435 TITLE: Sensors, Detection, Tracking and Kill Assessment for Anti-Satellite (ASAT)

CATEGORY: Basic Research

OBJECTIVE: The objective of this program is to develop innovative sensors and related technologies for the ASAT program.

DESCRIPTION: The objective of this program is to develop innovative sensors and related technologies for the ASAT program. Sensors and their associated systems will function as the "eyes and ears" of an ASAT system providing target detection, target tracking and kill assessment. New and innovative approaches to these requirements using advanced concepts are encouraged across the electromagnetic spectrum, from radar to gamma-rays. Passive, active, and interactive techniques for acquiring and tracking targets against a variety of backgrounds are solicited. In addition to novel sensing concepts, sensor-related device technology is also needed, with the intended goal of producing either a specific product or process. Examples of some of the areas to be addressed are: advanced focal plane arrays with on-focal-place signal processing, range-doppler radar and radar, imaging (different wavelengths), improvement of detector efficiency and producibility, sensor fusion, gamma, x-ray and neutron detection, detection, agile lasers, radiation sources, and countermeasures to sensor are sought. Entirely new concepts as well as significant improvements are solicited.

Phase I: The results of this effort will provide proof of concept by means of preliminary design, simulation, and/or laboratory experimentation.

Phase II: The results of this effort will include hardware or components developed to a state where they can be demonstrated in a flight experiment.

A90-436 TITLE: Structural Materials and Space Structures for Anti-Satellite (ASAT)

CATEGORY: Basic Research

OBJECTIVE: The development of advanced structural materials and advanced space structures for prime power systems, antennas, tracking and pointing systems, pressure vessels, solar collectors, lightweight large optics and other key ASAT subsystems.

DESCRIPTION: ASAT System requirements emphasize major improvements in material properties: stiffness, impact resistance, high temperature capability, etc. Other goal include advances in oxidation resistance and damage tolerance of composites, enhanced toughness of ceramic composites, and creation of fatigue-resistant metal composites with significant improvements in passive vibrational damping. Also sought are tribology innovative techniques, low density alloys, and methods to minimize fiber matrix reactions in composites exposed to high operating temperatures. Advances in passive and active control of structural dynamic responses to environmental and operational excitations are needed. These diverse needs will benefit from the development and incorporation of advanced material technology into all aspects of the ASAT program, including ground support, surveillance, and terminal kill.

Phase I: The results of this effort will provide proof of concept by means of preliminary design, simulation, and/or laboratory experimentation.

Phase II: The results of this effort will include detailed design, fabrication, evaluation of a working but not necessarily optimized, breadboard or brassboard model.

Phase III: The results of this effort will include hardware or components developed to a state where they can be demonstrated in a flight experiment.

A90-437 TITLE: Directed Energy for Anti-Satellite (ASAT)

CATEGORY: Basic Research

OBJECTIVE: Develop innovative concepts for materials, components, design or architectures that will enhance the state of technologies for directed energy.

DESCRIPTION: Orders of magnitude advancement in energy on target, propagation beam control, target interaction and kill assessment are needed. Advancements in the areas of high-energy lasers, particle beams, microwaves or other directed energy devices are needed. Major enhancements in component technology such as: ion sources, beam control devices, accelerators, neutralizers, optics, amplifiers, lasing materials, and plasmas are requested.

Phase I: The results of this effort should prove feasibility through calculations, simulations, designs and preliminary experiments.

Phase II: The results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working preliminary breadboard model.

Phase III: The hardware should be developed to the stage where it can be demonstrated in a flight test.

A90-438 TITLE: Surveillance and Early Detection for Anti-Satellite (ASAT)

CATEGORY: Basic Research

OBJECTIVE: Develop innovative surveillance and early detection sensors, devices, materials, components and architectures to advance the technology.

DESCRIPTION: Advances in surveillance and detection platforms, sensors, components, materials and architectures are needed. Significant evolutionary or revolutionary improvements in concepts or technology are required. Examples of areas to be explored are active and passive sensors, staring arrays with on-focal-plane signal processing, advanced radar concepts, surveillance platform concepts, advanced optics, detector materials, cryocoolers, platform stabilization and sensor pointing.

Phase I: The results of this effort will provide evidence of concept feasibility through preliminary design, calculations, modeling and preliminary experiments.

Phase II: The results of this effort will include detailed design, fabrication, demonstration and testing of a working, but not necessarily optimized breadboard model.

Phase III: Hardware or component should be developed to a state where it could be demonstrated in a flight experiment.

A90-439 TITLE: Kinetic Energy Concepts and Technology

CATEGORY: Basic Research

OBJECTIVE: Defense against satellites requires a highly efficient interceptor system. The goal of this research is to investigate and exploit concepts for advancing the state-of-the-art in kinetic energy technologies.

DESCRIPTION: This program will focus on developments in all technologies, systems, and subsystems which may be utilized in ground, air, and space-based satellite interceptors. Propulsion, airframe and materials, guidance, control, and warheads/lethality are the principal subtechnologies of prime interest.

Phase I: The Phase I effort will provide proof of principle reasonability by means of preliminary design, simulations, and/or laboratory experimentation.

Phase II: The Phase II effort will build upon the feasibility of the Phase I results to provide demonstration through design, fabrication and testing of a breadboard/brassboard model.

Phase III: Hardware or component will be developed to the flight demonstration state.

A90-440 TITLE: Development of a Modern Standard Atmosphere Model for the Kwajalein Atoll Environs

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic is to develop a modern standard atmosphere model for the Kawjalein Atoll and to validate this model using available data.

DESCRIPTION: There are currently several different “Standard Atmosphere” models for the Kawjalein Atoll. These include the Kwajalein Standard Atmosphere and the Blood-Kwan Atmosphere among others. These models are fairly old and relatively crude in that they do not accurately characterize the atmosphere on any given day. These models are used to correct radar measurements real time and post mission for atmospheric effects in the troposphere.

Phase I: Develop a prototype atmospheric model based upon a database of Meteorological Sound System (MSS) sonde measurements takin in recent years and other modern measurement techniques including satellite observations and MMW space-averaged surface measurements available at Kwajalein. This effort will consider data accuracy and granularity and their effects on the potential for model development.

Phase II: This effort will continue the model development and the validation of the model using available data. Also, this phase II will be to develop recommendations for additional measurements or instrumentation as appropriate.

Phase III: A Phase III could be developed for applying, maintaining and upgrading the model.

A90-441 TITLE: Splash Detection and Surveillance Radar

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic is to investigate innovative, low costs radars for splash detection of reentry objects and safety surveillance.

DESCRIPTION: There is a current need for a highly reliable, low cost radar system to observe the splash down of reentry objects and to provide quick look or real time scoring. This radar system should also provide safety surveillance of aircreaft and boats.

Phase I: A low-cost, reliable radar concept should be defined and shown to the feasibility to meet the above objective.

Phase II: The radar concept is to be further developed to show with simulations and/or prototype demonstrations that it will meet the KMR needs.

Phase III: TBD.

A90-442 TITLE: AN/FPQ Radar Upgrade

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic is to develop innovative, low costs concepts to enhance the beacon tracking capability of the AN/FPQ.

DESCRIPTION: Currently the AN/FPQ Radar located in Kwajalein Island has a 50 MHz operational bandwidth. It is desired to upgrade this to a 500 MHz operational bandwidth. This capability is needed to enhance the ability of the FPQ radar in beacon tracking.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: Further develop the concept to a fully demonstrate that the concept can meet the KMR requirement if installed in the FPQ radar.

Phase III: TBD.

A90-443 TITLE: Trajectory Estimation

CATEGORY: Exploratory Development

OBJECTIVE: Using data available from on or off-board sensors, determine maximum lift and drag forces acting on a reentry vehicle as a function of altitude. Use that information in the determination of the best estimate trajectory for the vehicle or at least to establish limits on the deviation from a ballistic trajectory which will be permitted in the fitting process.

DESCRIPTION: To obtain a very accurate trajectory for test vehicles flow to Kwajalein a Best Estimate Trajectory (BET) is formed by fitting a single trajectory through all the sensor date. Various schemes are used to determine and remove fixed biases, and weight the data by its measured quality and a prior knowledge of the various sensors' accuracies. In exoatmospheric flight, Keplerian motion is force, but in reentry where atmospheric forces affect the trajectory, few physical constraints are imposed on the motion. The results, particularly where the body is crossing gaps in the coverage between two sensors, are poor and show maneuvers which are not physically realizable. A more realistic assessment of the aerodynamic forces on the vehicle and the effects of those forces must be included in the BET process.

Phase I: Innovative concepts are being sought that have the potential to meet the objective. The Phase I effort should show the feasibility of the concept.

Phase II: Further development, testing, and validation of the concept to demonstrate the utility of the concept to meet the KMR requirement.

Phase III: TBD.

A90-444 TITLE: Radio Frequency Hazard Monitoring – USAKA

CATEGORY: Exploratory Development

OBJECTIVE: To provide sensors and procedures which will allow efficient and rapid mapping of the RF power density at a large number of ground stations surrounding the USAKA sensors as a function of antenna pointing and transmitter power.

DESCRIPTION: USAKA has a number of high power radars which can generate unacceptable radiation levels on the ground if their pointing is not carefully controlled. RF surveys are conducted to determine the operational limits which must be imposed. Whenever antenna or transmitter changes are made, which is quite frequently, the surveys must be repeated. With the present equipment, the task is both time consuming and error prone. Ideas are sought for equipment and procedures which will allow more rapid and accurate surveys.

Phase I: Innovative concepts for meeting the above objective are to be shown feasible in this phase.

Phase II: Further development of this concept to fully demonstrate its capability to meet the KMR needs.

Phase III: Could be the installation on KMR.

A90-445 TITLE: Radio Frequency Hazard Monitoring – Kwajalein

CATEGORY: Exploratory Development

OBJECTIVE: Sensors are needed to provide a continuous record of RF field strength at various locations on Kwajalein. They should integrate over a time period consistent with that specified by (ANSI) C95.1-1982, and should be low enough in cost that many stations can be monitored.

DESCRIPTION: The safety of personnel on Kwajalein is guaranteed by imposing limits on where and when the many high powered radars can radiate. Particularly with electronically steered antennas a system which provided a continuous record of the actual fields created is imported to be certain that established limits are no inadvertently exceeded. Novel low cost approaches which could be widely deployed are sought.

Phase I: Innovative concepts for improving the safety of KMR personnel is to be defined. Sensor(s) capability and system concept is to be shown feasible.

Phase II: System concept, sensors, instrumentation and complete program is to be developed to fully demonstrate this idea and prove its utility if installed at KMR.

Phase III: Could lead to installation at KMR.

A90-446 TITLE: Developmet of Enhancement to the Data Collection Capabilities of Kwajalein Missile Range Systems

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic is the development of innovative concepts for enhancing the data collection capabilities of the Kwajalein based systems.

DESCRIPTION: Currently the Millimeter Wave Instrumentation Radar (MMWIR) is capable of collecting data on one target at a time. In order to collect data on other targets, it must be manually switched with a resulting loss of valuable and limited data collection time. This radar is located on Roi Namuir Island in the Kwajalein Atoll.

Phase I: Innovative concepts for improving this radar's data collection capability are being sought. During this phase, the concept should be defined well enough to show the feasibility of the innovation and how it enhances the data collection capability.

Phase II: The innovative concept should be further developed and demonstrated via an experiment and/or simulation that the concept is technically sound and can significantly enhance the data collection capability of the MMWIR.

Phase III: A Phase III could be the installation and testing of the concept on Roi Namuir.

A90-447 TITLE: Trajectory Fitting

CATEGORY: Exploratory Development

OBJECTIVE: To determine the source of and correct for error in present trajectory fitting and modeling processes.

DESCRIPTION: In its flight from the west coast to Kwajalein, a ballistic missile is observed by three sets of sensors, those in the launch and impact areas, and another set in Hawaii. When data from all the sensors is combined from a Best Estimate Trajectory (BET), a good fit to all the date cannot be obtained. The data from all the sensors within a set are consistent. A good fit can be obtained to any two sets of sensors, but not all three. It is believed that the mid-trajectory data is at fault, and two possible explanations are offered. The first is that the coordinates of the Hawaiian sensors are not accurately known. The second and more likely explanation is that the actual gravity anomalies affecting the trajectory are not adequately modeled by the earth model (WSG-84) currently in use.

Phase I: Innovative concepts are sought that have the potential to meet the objective. Phase I should show the feasibility of the proposed concept.

Phase II: Further development and testing of the Phase I concept.

Phase III: TBD.

A90-448 TITLE: Statistical Data for Orbital Debris

CATEGORY: Exploratory Development

OBJECTIVE: To develop innovative concept for modifying the Millimeter Wave Instrumentation Radar (MMWIR) to collect data on orbital debris.

DESCRIPTION: Man-made space debris or orbit debris remains in orbit during its lifetime and is not transient through the space around the earth. Information about the current debris environment is extremely limited by the inability to effectively track small objects. It is of interest to see innovative techniques, i.e. waveforms, adaptive processing, etc., that would allow the MMWIR to track small objects for cataloging and to develop a statistical characterization of the debris population in earth orbit.

Phase I: Investigate the ability of MMWIR to be modified to allow the tracking of small orbital debris. Also, define the size of the smallest object possible for tracking.

Phase II: Develop the modification idea and show through simulation, analysis, or other sound engineering principles that the concept will meet the objective.

Phase III: TBD.

A90-449 TITLE: Signal Processing Enhancement for GBR-X Radar

CATEGORY: Exploratory Development

OBJECTIVE: To develop innovative signal processing methods and signal processors to enhance the planned GBR-X radar capability.

DESCRIPTION: The planned GBR-X radar will have a capability dictated by current state-of-the-art hardware and software. Therefore, innovative algorithms and/or hardware concepts are sought that have the potential to significantly improve the planned capability. This could include optical signal processors and related components.

Phase I: Develop and show the feasibility of an innovative signal processing concept.

Phase II: Demonstrate through simulation, experimentation, and/or prototyping that the concept has the capability to significantly enhance the performance of the GBR-X.

Phase III: TBD.

A90-450 TITLE: Development of a Display Gallery for USAKA Mission Data

CATEGORY: Exploratory Development

OBJECTIVE: To develop a design for a display gallery on Kwajalein Island to display extensive data from the GBR-X and KREMS in a cost effective way.

DESCRIPTION: Current mechanical radars at USAKA generally handle only one object at a time and hence display needs have been limited. The phased array GBR-X, in contrast, can handle a few dozen objects simultaneously and thus a desire exists for an extensive display capability. It happens that the rapid progress which is occurring in the small computer area offers the potential for providing very numerous displays at a moderate cost. These displays as a minimum should display a range doppler image and a summary of body motion information on each of the twelve objects.

Phase I: Develop a top level display design in sufficient depth to show feasibility and cost effectiveness.

Phase II: Develop a preliminary design for a display gallery defining interfaces and practical issues in sufficient depth to define a low-risk program for building the display gallery.

Phase III: TBD.

Army Research Institute for Behavioral and Social Sciences

A90-451 TITLE: Skill Retention as a Function of Acquisition Training Variables

CATEGORY: Exploratory Development

OBJECTIVE: To develop task performance prediction models as a function of: task type and skill acquisition training strategies (e.g., performing a task to criterion once vs. X number of times, spacing practice over hours, days or weeks; providing frequent performance feedback vs. withholding feedback until performance exceeds a specified error bound).

DESCRIPTION: Currently, the U.S. Army schools typically provide training on skills to the level of novice capability rather than mastery, because of the time and expense that would be required to conduct more extensive training. The basic training strategy is to explain and show soldiers how to perform a task, and then have them perform it once or a few times before moving on to the next tasks; it is expected that soldiers will acquire skills at

the appropriate level of expertise by on-the-job-training. However, when soldiers arrive at units, they often fail to remember what they were taught at school, and supervisors have only very limited opportunities to provide refresher and mastery level training. Training theory and supporting data are needed to enable development of training strategies that optimize school and unit resources to produce soldiers who can perform their job tasks well, especially under the stress of combat.

Phase I: Select an appropriate taxonomy for soldier tasks, and modify as required. Prepare skill performance prediction models reflecting alternative training strategies. Prepare operational definitions for all criteria and predictor variables.

Phase II: Design and conduct a small-size validation effort for selected tasks categorized by the taxonomy.

A90-452 TITLE: Modeling the Master Tutor

CATEGORY: Exploratory Development

OBJECTIVE: There is a need to understand the processes, cues, algorithms, techniques, and knowledge about the learner that Master Tutors possess and use so that these functions can be emulated in Computer-Based Instruction (CBI). Although CBI has been developed and used in a variety of training settings during the last two decades, its promise as an "individualized" tutor has not been achieved. One reason is that most of the research to date has used the instructional interaction, the student, or the content as the focus.

DESCRIPTION: Over the past decades, there have been developed models of the learning process, models of the student's knowledge state, models of subject matter structure, instructional strategy decision models, etc. These models have arisen from a variety of theoretical positions. A similar model or set of models is needed to reflect the tutorial expertise that should be part of CBI.

Phase I: Phase I of this research requires the development of a comprehensive taxonomy of the knowledges, behaviors, cognitive and non-cognitive skills, methods, algorithms, etc. that are critical to a Master Tutor's effectiveness. Two or three domains (which have widely differing skills characteristics) shall be chosen for empirical data to be collected from protocols of Master Tutors at work. A revised model shall then be developed.

Phase II: Phase II of this SBIR program requires the validation of the taxonomic model developed in Phase I. Initially, the goal of this Phase will be to see if the characteristics of a Master Tutor derived from the model, can be transferred to other instructors. If so, the model's structure, rules, and other features shall be incorporated in a CBI program in one of the domains from which it was derived, and in one that was not used for protocols. A comparison shall be made of the effectiveness of the CBI programs with and without the tutorial model; and another comparison with direct instruction by the Master Tutor(s).

A90-453 TITLE: Measurement of Performance of Army Tactical Units

CATEGORY: Basic Research and Exploratory Development

OBJECTIVE: To establish methodology for improved measurement of performance of U.S. Army tactical units.

DESCRIPTION: The U.S. Army needs to be able to adequately measure the performance of its tactical units in order to estimate the Army's combat capability, diagnose training requirements, and determine the resources required to support training. Measurement is also essential for evaluating new weapons systems, tactics, and organizational designs. Measurement needs to address all levels from squad through battalion task force.

The U.S. Army traditionally has used mission/task analyses to establish the attributes of performance which should be trained and evaluated. While useful, by its very nature the analytic approach leads to emphasis of "fractional" parts of performance and often fails to capture the dynamic, emergent, interactive and tightly coupled aspects of unit performance. Additional approaches are needed which emphasize synthesis and more integrated, molar

performance indices, the nature of such molar indices may be suggested by the high level constructs contained in, for example, "combat fundamentals," "tenets of the airland battle," etc., described in military history and doctrine. Alternatively or complementarily, it may be useful to apply mathematical and modeling techniques to the problem of identifying and measuring molar aspects of unit performance.

Phase I: The objectives of this phase are to: (1) formulate hypotheses, theories, or models which identify molar aspects attributes of unit "performance" which should be observed and measurement operations and analytic techniques which permit their testing and validation; (2) establish measurement operations and analytical techniques which permit their testing and validation; (3) conduct analyses to demonstrate the feasibility and potential utility of the methodology. Data from the National Training Center (NTC) and Joint Readiness Training Center (JRTC) can be made available for these analyses. The final report will fully describe the process and result of this phase.

Phase II: The objectives of this phase are to validate and refine the methodology and measures. This will involve extensive application of the methodology to real data and comparison of the results with results from other methods of describing and assessing unit performance. The final report will fully describe the process and results from both phases.

A90-454 TITLE: Dimensions for Military Occupational Specialty

CATEGORY: Advanced Development

OBJECTIVE: To provide dimensions and associated methods which can be used to analyze the commonalities versus differences between job requirements (e.g., equipments, tasks, organizational location). The use of resulting data will provide information useful for evaluating alternative MOS and Career Management Field (CMF) restructuring possibilities in terms of manpower, personnel, and training impacts.

DESCRIPTION: Work is ongoing at ARI to develop decision tools to support the selection, design, and redesign of MOSs and CMFs to meet force modernization requirements. Attention is initially being focused on Signal and Military Intelligence (MI) MOSs and CMFs but it is intended that the tools will be expanded to deal with other combat, combat support, and combat service support branches. It is expected that, for each tool developed, the overall approach and procedure will be common to all branches. It is also expected, however, that some dimensions or considerations within some tools will be branch specific. For example, all the dimensions used to describe signal equipment so as to analyze commonalities and differences from the soldier's task performance standpoint are not expected to be necessary or sufficient to describe tank weapons.

Phase I: Initial work completed on the question of how to usefully describe Signal branch equipments and MI aptitude requirements will be critically reviewed and analyzed to understand the approaches and make recommendations. Subsequent Phase I and Phase Ii work in either of these two areas or in other areas (e.g., tasks, organization) will be coordinated with this work and is to be complementary. Drawing upon the Signal branch, MI branch, or other approaches, the major branch-specific characteristics of other combat, combat support, and combat service support branches are to be reviewed. Apparent differences in the selected area of analytic dimension development are to be identified and two or more branches selected for the Phase Ii effort. The selection is to support the goal of adding dimensions and procedures to the selected commonality analysis tool so that it is applicable to all the combat, combat support, and combat service support branches.

Phase II: The necessary and sufficient additional dimensions and procedures for analysis of selected area commonalities in the branches selected in Phase I are to be identified and developed. They are to complement and be integratable with other ongoing or completed work on the development of MOS and CMF restructuring analysis tools.

A90-455 TITLE: Officer Force Structure Planning Model

CATEGORY: Exploratory Development

OBJECTIVE: An Officer Force Structure Planning Model is required to provide users with manpower cost and force structure implications of changes in personnel policies, particularly those involving changes in current or future compensation. The model could be used to directly demonstrate the effect of manpower policies, such as changes in compensation or retirement programs, on the officer force structure.

DESCRIPTION: A series of recent efforts have been directed towards providing better retention and cost information that can be used to evaluate the cost and force structure implications of manpower policies on the enlisted force. Similar models would provide tools to evaluate manpower policies directed towards officers.

Phase I: Phase I of this research requires development of a theoretical framework of U.S. Army officer retention behavior, specifying an empirical model that can be estimated, consistent with the theoretical model, and estimating the retention models using ACOL-2 specifications (the Annualized Cost-of-Leaving models correcting for sample selection over time) for major occupational specialties. ARI's Office Panel Research Data Base would be available for estimating these models.

Phase II: Phase II of this SBIR program requires integrating the retention-behavior parameter estimates from Phase I, and officer manpower cost data from AMCOS, into a prototype Officer Force Structure Planning Model.

A90-456 TITLE: Measurement of Combat Performance

CATEGORY: Exploratory Development

OBJECTIVE: To identify tools for the measurement of combat performance.

DESCRIPTION: Typically, selection tests for the military are evaluated in terms of their empirical validity for predicting peacetime performance. Yet, the ultimate success of the military is evaluated in terms of wartime, not peacetime performance. Reliable and valid measures of individual performance in a combat environment are needed as criteria for predictor measures developed for selection and classification of enlisted soldiers.

Phase I: Phase I would involve a review of the relevant literature to determine if this literature provides a foundation for the development of preliminary combat performance measures for Army enlisted soldiers. The product of Phase I would be a plan for the development of these measures in Phase II.

Phase II: In Phase II the contractor, using the Phase I results supplemented by interviews with combat veterans as needed, would develop a preliminary set of measures of combat performance. These measures would be reviewed by subject matter experts and revised as necessary.

Armament Research Development and Engineering Center

A90-457 TITLE: Advanced Seekers for Smart Munitions

CATEGORY: Exploratory Development

OBJECTIVE: This work can be transitioned to a Phase III application when the contractor successfully demonstrate a new type of seeker system that has superior performance to ones currently used in STAFF or Search and Destroy Armor (SADARM).

DESCRIPTION: The U.S. Army Research, Development, and Engineering Center (ARDEC) has committed itself to developing an evolutionary family of both "shoot to kill" as well as "hit to kill" smart projectile munitions throughout the foreseeable future. Past examples of this thrust are seen in the Copperhead projectile, currently in production, as well as search and destroy armor (SADARM) now in full scale development. These munitions will rely on increasingly autonomous seekers capable of finding a variety of ground targets immersed in terrain situations. In some cases, the red and millimeter wave technologies form the conventional baseline approaches. Seekers are still in an evolutionary state and are limited in their performance against complex backgrounds, weather

adversities and countermeasures. It will be necessary to enhance the performance in future evolutions of this technology. Topics of special interest to ARDEC are hybrid semi-active (SAL)/infrared (IR) seekers, focal plane array/imaging IR seekers, strapdown seekers, advanced millimeter wave integrated circuit seekers, and dual-mode IR/MMW seekers.

Phase I: Perform a paper study and design on the proposed seeker system for an autonomous munition. This paper should include analytical the proof of concepts on the enhanced performance over a present day seeker. Also, a proposed hardware design that can operate under high G conditions including proposed signal processing methods to detect targets in real world clutter.

Phase II: Design and build the seeker from Phase I preliminary design to perform under captive flight test conditions and operate coherently with signal processing algorithms designed in accordance with the Phase I proposal. Through CFT the contractor shall prove the systems enhanced functionality and performance, with real world date (clutter) in an environment specified by ARDEC, over the present day seeker system discussed in the Phase I final report.

A90-458 TITLE: Advanced Adaptive Weapon Control Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate low cost high performance digital servo control technology for precision fire-on-the-move applications including armor, air defense and aircraft system applications.

DESCRIPTION: Recently progress has been made in demonstrating major accuracy improvements for both aircraft and combat vehicle weapon systems using advanced digital control design techniques and Linear Quadratic Gaussian Loop Transfer Recovery (LQG LTR) design approaches. Further improvements in gun accuracy are anticipated through the development of improved robust nonlinear and adaptive control laws and control laws that exploit recent advances in H infinity and e1 sensitivity mimization techniques. High speed, low cost micro computer technology now permits these techniques to be implemented in high bandwidth digital servo loops required for precision gun stabilization. This project will address the broad spectrum of issues associated with the development of design tools and methodology, modeling, simulation and real time hardware/software implementation.

Phase I: Develop methodology for design and implementation of high performance robust adaptive and nonlinear control laws for precision weapon stabilization and tracking. Formulate specific control laws for nominal two input, multi output nonlinear plant with friction, backlash, resonant modes, high impulse periodic disturbances nonlinear compliance and sensor noise. Determine performance and robustness characteristic with respect to the structural and unstructured plant perturbations and provide analysis of hardware/software implementation requirements.

Phase II: Develop a fully integrated design, test and prototyping environment for advanced nonlinear and adaptive multivariable control systems. Provide a real time programmable digital control module with online data analysis capability and I/0 capability necessary for laboratory test bed evaluation. Optimize module hardware/software and algorithm design based on test data and provide complete documentation of algorithms and hardware/software architecture.

A90-459 TITLE: Electro-Magnetic Interference (EMI)/Electro Magnetic Pulse (EMP)/High Power Microwave (HPM) Protection for Packaged Ammunition

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the feasibility of providing electromagnetic interference/electromagnetic pulse/high power microwave (EMI/EMP/HPM) protection for ammunition through packaging using cost-effective techniques.

DESCRIPTION: Recently the military has been concerned with the sensitivity of ammunition to EMI/EMP environments. With the incorporation of electronic fuzes and guidance system, and other sensitive hardware into todays ammunition, susceptibility is a major concern. In addition, there have been significant advances in the field of HPM. It is felt that HPM generators may create detonation and burnout problems for ammunition.

Currently, it is not known to what level protection is provided to ammunition by the use of metal, plastic and fiber ammunition containers. It is theorized that metal containers should attenuate most of the EPM/EMI/HPM field, but there is concern about transmission through the gasket (closure) area. Due to the inherent characteristics of plastic and fiber materials used, it is possible that current containers will provide little or no protection against these fields. It must be determined to what level protection is being provided by the use of these materials in all the generic container designs currently being manufactured. Once the attenuation levels are determined, cost effective ways of shielding can be analyzed, including container gasket shields, gasket additives and material additives/processing.

Phase I: To determine the level of protection of ammunition from EMI/EMP/HPM afforded by plastic, fiber or metal packaging containers. Provide theoretical analysis of the attenuation provided by generic container designs and the possible improvements that could be achieved through design modifications, processing techniques/materials and external or internal shields. Provide economic analysis levels of protection that could be achieved vs. cost.

Phase II: Test existing generic designs against EMI/EMP/HPM to determine actual levels of field attenuation through sides and gasket area. Analyze correlation of experimental results with theory. Develop improved shielding methods, incorporate into existing container designs and retest. Analyze correlation of experimental results with theory. Re-evaluate shielding levels obtained vs. cost.

A90-460 TITLE: Fire Control Battle Management and Decision Support System Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate advanced expert system decision aids for armor and/or artillery applications.

DESCRIPTION: The feasibility of developing high performance expert system decision aids for armor and artillery system applications has been demonstrated recently based on laboratory prototype tests. Further technology development is required, however, to address specific algorithmic issues associated with real time planning/replanning, sensor/information fusion, terrain analysis, as well as issues of knowledge engineering, man/machine interface, rapid prototyping and simulation environments for evaluating decision aids. Expert system decision aids which address one or more of the following requirements are of specific interest: (a) Identification Friend or Foe (IFF), (b) Fire Control (acquisition/tracking), (c) tactical planning/order preparation, (d) tactical situation assessment, (e) status/reports, (f) self defense of weapon platform, (g) sustainment, (h) command and control, (i) fire detection, (j) communications, (k) reconnaissance, selection and occupation of position and (l) embedded training.

Phase I: Develop methodology for design and implementation of distributed expert system decision aids for artillery and/or armor applications. Formulate and define conceptual designs for specific expert system modules including hardware implementation and software prototyping environment. Develop detailed functional specifications.

Phase II: Develop a full-up laboratory prototype decision support system with appropriate displays, simulation driven, development environment and run-time environment. Optimize hardware/software, algorithm and interface design based on laboratory test results and provide complete documentation of hardware/software, analysis and test results.

A90-461 TITLE: Advanced Signal Processing Methods for Smart Munitions Seekers

CATEGORY: Exploratory Development

OBJECTIVE: This work can be transitioned to a phase III application, when the contractor successfully demonstrates a new target detection, clutter rejection algorithm which provides superior probability of detection and lower false alarm rates than currently available for applications in Search and Destroy Armor (SADARM) or STAFF.

DESCRIPTION: This U.S. Army Research, Development, and Engineering Center (ARDEC) has committed itself to developing an evolutionary family of both "shoot to kill" as well as "hit to kill" smart projectile munitions throughout the foreseeable future. Past examples of this thrust are seen in the Copperhead projectile, currently in production, as well as search and destroy armor (SADARM) now in full scale development. Seekers and sensors in future munitions will be faced with increasingly complex decision making situations. The front-end hardware, infrared (IR), and millimeter wave (MMW) will provide a rapid, continual stream of serial and parallel analogue signals representing the world sensed by the seeker. Entire space-time maps at state-of-the-art reolution levels may be available in the IR bands, the millimeter wave bands, the acoustic bands, the active radar bands, and possible any combination of all of these. The pattern-recognition challenge is a substantial one. The goal of the seeker will be to detect, identify, classify, locate, and track at any instant the desired target(s) in an unpredictable, complex, frequently frustrated set of world data. Current and future hardware advances in large scale integrated circuits (LSIC), very high speed integrated circuits (VHSIC), optical computers and future parallel processing architectures must be tied together with current and future advances in software, advanced algorithms, and artificial intelligence disciplines to form a cohesive and believable structure of feasibility for future munitions. In brief, the challenge of advanced signal processing is to desire the "brain principles (software)" to service the "eyeball-ear principles (hardware)."

Phase I: Perform a paper study on the proposed new concept of a target detection algorithm with emphasis on high background clutter conditions and potentially suppressed target signatures. This should include proof of enhanced functionality and performance over current designs. All calculations and procedures should be included with detailed definitions.

Phase II: Software shall be written using Phase I final report guide lines. Proof of concept will be proven through testing of the algorithm. Final testing of the algorithm shall be performed by ARDEC with simulated and real world data in both high clutter and clutter free environments. The software shall have the capability of being tested by an independent group. It is preferred that the software can be eventually mapped onto very high speed integrated circuits which will go into a munition.

A90-462 TITLE: Optical Designs for Enhancing Laser Eye Protection

CATEGORY: Exploratory Development

OBJECTIVE: Designs for direct view optical sights which will enhance the operation of non-linear optical switches, sacrificial mirrors and other optical limiters placed in focal planes.

DESCRIPTION: To protect operators of a direct view optical sight from laser eye damage, optical limiters based on non-linear processes, plasma formation and sacrificial mirrors must be placed in a focal plane of the system. Present system are design with the primary goal of presenting an adequate image to the eye. The purpose of this program is to add the requirement of improving the concentration of energy in the focal plane of the system in order to trigger limiters at a lower threshold of input energy.

Phase I: An army optical sight will be analyzed to determine its efficiency in concentrating coherent radiation at its focal planes. A 10x, ±4 deg. field-of-view system will be designed with the goal of matching its performance and increasing the concentration of flux in the focal plane. The final report will contain the optical design and analysis.

Phase II: A device based on this Phase I design will be fabricated. Imaging performance will be measured and compared to that of a conventional system. Measurement of the point spread function in the system's focal plane will be measured.

A90-463 TITLE: Small Caliber Primer Automated Inspection System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a reliable, safe and cost effective method to perform 100% automated inspection of small caliber primers.

DESCRIPTION: Approximately 2.1 million 5.56mm primers and 7.62mm primers are produced and 100% visually inspected every day at Lake City Army Ammunition Plant (LCAAP). The current primer inspection operation is very labor intensive and the inspectors are constantly exposed to hazardous energetic material. Four to five operators are engaged in manually inspecting the primers in each charging wing. Each inspector manually dumps a box containing 1,416 primers into a tray and then orients the primers in one direction. After the primers have been oriented, the inspector looks for visual defects through a magnifying glass and culls the defective primers. Then the primer tray is covered and turned over, enabling the operator to inspected the other side of the primers. One box of primers is inspected in about three minutes. It is impossible to maintain a consistent standard of inspection since factors like operator skill, fatigue, emotional mood, and judgment influence the efficiency of this operation. Thus, there exists a lot of variation from inspector to inspector. Since there is no accurate way to determine that the proper amount of primer mix has been placed in the primer cup, it is up to each individual inspector to determine what constitutes a normal or light charge. The same is true with other defects: it is up to each inspector's judgment. Testing conducted to-date shows that the efficiency of each operator decreases throughout the day due to fatigue and the conditioning effect of repetitive tasks. While the cost of an individual primer ranges from a fraction of a penny to a few cents per primer (depending on type), a malfunctioning primer either causes the complete round of ammunition to be useless or, in the case of a hangfire, it could prove to be potentially dangerous to the user.

Thus, quality and safety are two factors of major concern in the manufacturing of primers. The current primer inspection operation at LCAAP is inadequate. The quantity of primers, the number of inspections per primer, and the size of the primers make the inspection operation difficult and inefficient. The inspection of small caliber ammunition is very subjective and highly dependent on the operators skills and experience. Some of the major and critical defects, i.e., too much shellac, light primer charge, are difficult if not impossible to consistently detect. As a result, defective primers may pass through the inspection operation undetected, later causing weapon and cartridge malfunctions.

Phase I: Determine feasibility of utilizing existing or modified automated machine inspection systems to perform the required small caliber primer visual inspections, and to determine if the proper amount of primer mix is present in the primer. The capability of a machine inspection system to detect each of the primer defects should be evaluated. Hardware and software specifications include camera type and resolution, microprocessor, speed, memory requirements, interfaces, support equipment, software type and modification. Also, recommendations on the type of primer handling system should be provided.

Phase II: Fabricate a primer inspection machine prototype and material handling system to automatically inspect primers at a rate in excess of 1500 primers per minute. Provide the necessary parameters (lighting condition, camera position, primers orientation, etc.) to optimize inspection operation. Evaluate the prototype capability in terms of reliability and repeatability, and make the necessary hardware and software modification to optimize the inspection equipment performance.

A90-464 TITLE: Rapid Solidification Processing of Tungsten Alloys

CATEGORY: Exploratory Development

OBJECTIVE: Develop the means of producing pilot plant quantities of rapidly solidified processed high tungsten content (›96%W) alloys for ballistic evaluation as kinetic energy penetrator rods.

DESCRIPTION: Attempts to rapidly solidify process tungsten alloys by jet ribbon methods have been partially successful with tungsten contents approaching 80 weight percent. Higher tungsten content alloys require higher temperature casts and these become more corrosive/erosive to the containment crucible and nozzle delivery system.

Most standard ceramic materials for the containment crucible and nozzle have not been effective. Standard atomization approaches would also need to consider proper containment of the melt and controlled delivery. Rotating electrode schemes although doing away with the container, would need to dedicate a great deal of effort in fabricating the precursor electrodes. Modified "skull casting" techniques adapted to a regulated dispensing of a molten stream may offer a potential solution. Innovative approaches are therefore sought to reliably exploit rapid solidification technology for high content (greater than 96 weight percent) tungsten alloys.

Phase I: Develop a methodology for rapid solidification processing of high tungsten alloys. Utilizing various alloy compositions evaluate process characteristics and establish key parameter values to enable the reproducible production of research quantities of processed tungsten alloy powders. Explore consolidation schemes to produce full density bulk stock for mechanical property evaluation.

Phase II: Scale-up processing equipment to provide batch yields of 1-5 kgm. Systematically examine the effects of various process parameters on the mechanical properties and microstructure of the final consolidated products and thereby define suitable processing for full scale application.

A90-465 TITLE: Intelligent Sensor Based Robotic Control Systems Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop a generic multi-adaptive robotic control module and development environment for mobile manipulator systems for ammunition handling, re-supply and logistics applications.

DESCRIPTION: Significant progress has been made recently in developing advanced sensor based servo control systems for high performance robotic manipulators. Specifically, a high speed 386 based multi-processor robotic control module and software development environment was developed which permits a broad range of adaptive and compliant motion control strategies to be implemented for arbitrary manipulator configurations. Extensions of this technology are required, however, to deal with fundamental problems of mobility and base motion effects, flexibility task level control, multi-sensor integration, dual arm coordination associated with fusing ammunition in a moving re-supply vehicle and loading ammunition in a moving platform environment. Technical issues of interest include robust and adaptive controls, compliant motion control, visual servo control, voice natural language interface for control, dual arm control strategies, world modeling design environment, real time, knowledge based task level control and control from moving base including path planning, navigation and obstacle detection/avoidance.

Phase I: Develop methodology and algorithmic approaches to intelligent sensor based robotic control systems for applications to material handling and loading. Perform preliminary modeling and simulation studies to determine performance/robustness characteristics of the control laws and provide control processor design and system hardware specifications.

Phase II: Develop controller hardware/software and development environment for interface with laboratory test bed manipulator systems. Develop test scenarios and scaled down mock-ups to demonstrate controller performance capabilities. Provide fully integrated prototype module with documentation source code and development environment and evaluate in laboratory tests.

A90-466 TITLE: Pre-Dyed Bullet Jackets

CATEGORY: Basic Research

OBJECTIVE: Develop a method of drying bullet cups before they are drawn into bullet jackets.

DESCRIPTION: At present, after the cartridges are finished being assembled they undergo a tip identification process which applies a paint to the cartridge tip to identify its function (Blank, Tracer, etc.). Basically, depending on the cartridge size the process for tip identification is slightly different, 5.56 mm are spray painted, 7.62 mm are dipped in paint. Either way tip identification is a separate process that adds time and therefore cost to the cartridges.

To cut cost and process time it would be advantageous to develop a method of dying the bullet before it is manufactured. More importantly by eliminating the lacquering process the emissions of hydrocarbons would be greatly reduced. This would be an important environmental asset.

Phase I: Develop methodology for dying the copper cups used to make bullet jackets. Formulate processing characteristics and examine the metallurgic properties and the consequences of dying the cups. Provide cost analysis for implementing the use of pre-colored cups.

Phase II: Build a prototype of the process needed to dye the cups. Fabricate a sufficient amount of cups to be drawn and processed into bullets. Load cases with these bullets. Provide a performance analysis to determine if the dye process had any effect on bullet performance. Also, determine the effect if any on the firing weapon.

A90-467 TITLE: Effects of Long-Term Storage on Electronic Devices

CATEGORY: Exploratory Development

OBJECTIVE: To identify failure mechanisms, investigate and determine cost effective packaging techniques while determining new technologies and design methods for protecting electronic devices during long-term storage. Draw on these results to generate a guide which will be used by ARDEC as a design manual for reducing or eliminating the adverse dormant storage effects on Smart Munitions.

DESCRIPTION: Electronic components and devices used in one shot ammunition such as Smart Munitions experience a completely different life-cycle than most electronic components. They will be stored for long periods, sometimes up to 20 years in an inactive state and then must operate reliably over a short, active lifetime. Most data on the reliability of electronic components provide information on the failure rate per 1000 hours of active life. Little inactive life data is available that directly applies to Smart Munitions, namely SADARM Munitions, and presently, long term storage effects are not predictable. Since large numbers of integrated circuits (ICs) and other related devices are being and will be used in a number of Smart Munitions programs, ARDEC is investigating the overall problem of assuring component reliability and the associated ordnance problems which emerge as a result of storing electronic devices for periods of up to 20 years. ARDEC is concerned with: ensuring component operation; long-term storage effects of electrical specifications; predicting possible failure modes, or their trends; and with identifying and analyzing mechanisms, packaging techniques and failure modes so that they can be corrected or designed out of the system.

Phase I: Identify the factors that will cause deterioration of electronic devices on long-term storage, as well as the principal failure mechanism(s) and what analysis and testing is required to proveout these failure mechanisms in Smart Munitions applications.

Phase II: Utilize the data and results, developed and surfaced in phase I, to investigate and determine the appropriate packaging methods, new technologies, materials, and designs, for protecting, decreasing, and eliminating the adverse effects of dormant storage. Address critical electronics located in Infra Red (IR), Millimeter Wave (MMW) sensors, and associated Smart Munition electronics. Drawing on the data generated in Phase I and II prepare a design manual which will be used as a guide for protecting electronic componentry and circuits from the adverse effects of long-term storage.

A90-468 TITLE: Standardized Digital X-Ray Viewer

CATEGORY: Advanced Development

OBJECTIVE: Develop and implement an image viewer for very high resolution archived images.

DESCRIPTION: The Army has developed several systems for automated x-ray inspection of armament devices and material using digitized x-ray images. The images and the analysis results are archived in digital format on 8mm

Sony video tape. Current images are stored as 8-bit grey levels, 512 x 512 pixels; future systems will use higher resolution.

This solicitation is for the development of an inexpensive system which can recover, duplicate, enhance further process, and display the images. Such a system need to read the archived data, strip out the image data from the rest, and display the image data and the analysis data on user demand. The images will need visual enhancement before being displayed.

The system should be developed so that one may increase its capability incrementally with various options. One of those options would be to duplicate the image analysis capability of the original inspection system. Such an options could be used to perform off-line algorithm development or merely to further process an archived image.

The system should be developed around pc or workstation computers of the nature which are readily available to DoD. The system should include all hardware, interfaces and software. Wherever possible hardware and software components should be readily available consumer items.

The Army will be expanding the requirement for automated x-ray inspection systems to the manufacturers of munitions items. The Phase III marketplace for the system developed under this topic will be the load plants and manufacturers of the munitions items.

Phase I: Develop a prototype system with at least minimal capabilities to recover, duplicate and display the archived data. This prototype system should cost less than $10,000 if it were to be purchased as an off-the-shelf item. The software of the prototype shall be a Phase I deliverable. Write a full detailed scope of work (SOW) for the total system which will be developed and completed in Phase II.

Phase II: Develop and deliver a total system. The system, discounting the option of image analysis, should cost less than $20,000 if it were to be purchased in duplicate or as an off-the-shelf item. The image analysis option should simulate that of the automated x-ray inspection systems currently used by the Army.

A90-469 TITLE: Electronic Safe and Arm for High Velocity/Acceleration Projectiles

CATEGORY: Advanced Development

OBJECTIVE: Develop an electronic safe and arm of high velocity/acceleration projectiles.

DESCRIPTION: The development of the slapper detonator and associated electronic components have made the design of in-line all-electronic safe and arm mechanisms feasible. Electronic safe and arm mechanisms (ESA) are now being designed for missile applications. ESA's offer advantages for high velocity projectiles as well. One such advantage is the improved reliability gained from safe and arm mechanism with no moving parts.

However, the high-G launch environment and restrictive size and power requirements add to difficulty of designing an ESA for high-velocity projectiles.

Phase I: Design a module containing a slapper detonator and high-voltage converter and trigger circuits which can be utilized in a fuzing system for a high-acceleration projectile.

The module shall be no more than 1.25 inch in diameter. A length of 2 inches or shorter is desired. The module shall be operable after being subjected to launch accelerations of 50,000 G's minimum. The module shall be chaged and capable of providing an output within 15 milliseconds after application of power. The explosive output of the module shall be in the direction of the applied acceleration. The module shall operate when powered by voltages from 24 to 32 volts and shall draw a current not to exceed 1 A. RMS.

Phase II: Fabricate 10 prototype modules for high-G airgun and lab tests. Refine the design where necessary.

A90-470 TITLE: Verification and Validation of Expert Systems

CATEGORY: Basic Research

OBJECTIVE: To develop a comprehensive methodology to perform verification and validation of expert systems, and to incorporate these items into an automated tool(s) to facilities its use.

DESCRIPTION: Software engineering methodologies exist which can be used in the verification and validation (V&V) of weapon system software. Governing standards include DOD-STD-2167A, Defense System Software Development, DOD-STD-2168, Defense System Software Quality Program, and MIL-STD-1815A, Ada Programming Language. However, the V&V of expert systems (knowledge based systems) poses some unique problems not typically faced with non-AI software engineering. Some of the factors which may contribute to these problems are:

- A modularized, top-down structured architecture may not be possible in all expert systems.
- Defining testable requirements for expert systems is difficult.
- Expert systems tend to be more problem-oriented than process-oriented.

Phase I: Phase I should investigate, but not be limited to, the following items:

- Specifically, what are the characteristics and/or methodologies of expert systems that differentiate them from that of software development efforts which use classical software engineering? Examples of items to investigate include:
- Defining/determining requirements for expert systems/knowledge based system
- Documenting an expert system and its knowledge base(s).
- Testing an expert system and its knowledge base(s).
- Expert system architectures.
- Rapid prototype development of expert systems.
- How do these differences impact how V&V is performed? How can these differences be dealt with and resolved?
- Who is performing research and/or similar work in this field?
- Are there automated tools which can be sued to accomplish these tasks?

Using the information gathered, determine a methodology and/or a series of checks and balances which can be used to perform V&V on expert systems. All software life cycle phases should be addressed. The results should be documented in a handbook and/or technical report.

Phase I should include two visits to Picatinny Arsenal, NJ, one for an initial kickoff meeting, and one for a final presentation. Bimonthly progress reports and a final technical report should be provided, documenting all work performed, problems encountered, results achieved, and conclusions reached. All documentation and software developed shall be delivered on both 1) paper listing and 2) magnetic media (format to be approved by the government).

Phase II: Using the Phase I results as a baseline, Phase II should develop a comprehensive methodology and/or checklists for performing V&V expert systems. These items should then be incorporated into an automated tool(s) to facilitate its use. The contractor shall also provide comprehensive software documentation for the developed tool. Detailed requirements for the tool will be determined upon successful completion of Phase I.

A90-471 TITLE: High Speed Method of Primer Drying

CATEGORY: Exploratory Development

OBJECTIVE: Develop an explosion proof method of drying caliber primers, 5.56mm, 7.62mm, Cal. 50, and 20mm, in less than five minutes to meet production requirements for pellet weight control.

DESCRIPTION: The whole primer consists of a cup, disc, anvil and pellet. For example, the 5.56mm primer no. 41 found on drawing no. 10534279 consists of a pellet made of Lead Styphnate, Tetracene, Barium Nitrate, Antimony

Sulfide, Aluminum powder, Petin, and Gum according to Primer Composition FA-956, drawing no. 10522386. On the current production line the pellets are made in trays that are divided first in half and then each half in fifths. One pellet from each of the ten sections is weighed. The primer pellets are weighed in a wet condition assuming 10% moisture. The assumption has caused the crap out of primer pellets that were within specification for dry weights, but were scrapped due to varying amounts of moisture in the pellets at the time of wet weighing. The current procedure requires three hours for drying and one hour for cooling before weighing the dry primer.

Phase I: Investigate methods and techniques for drying primer pellets. (i.e., convetion and/or vacuum drying) with explosion proof apparatus. The new process should take less than five minutes to be practical for production requirements.

Phase II: Construct and/or procure a model of the method selected. Work test this model, set up test to prove out the accuracy, repeatability, and output efficiency of the equipment.

A90-472 TITLE: Powdered Metal Preforms for Barrel Liners

CATEGORY: Exploratory Development

OBJECTIVE: Develop a process for inserting and finishing a powdered metal perform barrel liner which permits the use of superior material in the rifled barrel section without a unacceptable cost impact.

DESCRIPTION: Recent improvements in hot isostatic pressing techniques have allowed an Austrian company to supply full length liners made from Nimonic 105 to a Swiss gun manufacturer. The linear perform is then pressed a s afull length liner component in a twin gun product. This technique allows a thin layer of a State-of-the-Art Material to be utilized as a component part of a layered barrel. In turn, the limits presently placed on the use of high performance propellants and barrel life can be drastically extended with this technique without the attended cost impact of a homogenous State-of-the-Art material barrel.

Phase I: Develop methodology for the process of producing full length performs and insertion into a conventional material barrel hollowed to allow the press fit of the powered metal perform. The costs of powdered materials, isostatic pressed necessary finishing equipment finished product output, intangible performance benefits and spare barrel inventory reduction would be evaluated against present cost profiles of a high performance machine gun barrel such as the M60.

Phase II: Given that both the benefit of performance advantage and spare barrel inventory reductions, construct a pilot operation to produce rifled preformed Nimonic 105 liners and further processing for insertion in used and rebored M60 barrels. Develop producibility and efficiency factors on pilot operation.

A90-473 TITLE: Integrated Target Recognition and Tracking

CATEGORY: Exploratory Development

OBJECTIVE: Develop fire control systems for air and ground targets that use high resolution imagery for enhanced trajectory prediction.

DESCRIPTION: The subject of this topic involves tracking the present position of a maneuvering aircraft or ground vehicle as well as predicting its future position. Tracking filters for both fixed and rotary wing aircraft have already been developed that use attitude angles (yaw, pitch, roll) in addition to the usual radar measurements. Computer simulation of tracker performance when tracking violently maneuvering aircraft indicates that a dramatic improvement is obtained by using optically-derived attitude information. It is desired to develop a similar filter for ground vehicles and to test it against real targets, as well as to improve the performance of the aircraft trackers and test them against real targets.

The development of an automatic target recognizer that will accurately determine target type and orientation is very important to this topic and may include techniques for global and partial shape recognition of three-dimensional objects by using two-dimensional exterior contour information, or recognition of three-dimensional objects by using three-dimensional surface information, or use of time-varying imagery to segment shape. Neural networks may prove useful here in hybrid combination with classical shape description methods. The development of very fast Kalman-filter calculation filter calculation techniques is also important to this topic because of the requirement to work in real time and indicates the necessity of using parallel computations and making appropriate simplifying assumptions in the filter structures.

Phase I: Develop methodology for integrated target recognition and tracking of violently maneuvering aircraft and ground vehicles, including target identification and identification and orientation determination algorithms, tracking and prediction algorithms, and choice of a target locator and imaging sensor hardware suite.

Phase II: Develop a demonstration of the integrated target recognition and tracking algorithms working in near real time against real targets.

A90-474 TITLE: Computer Model for Indirect Fire Control System Simulation

CATEGORY: Advanced Development

OBJECTIVE: The objective is to develop a PC based computer model for simulation of indirect fire control system.

DESCRIPTION: A need exists to develop a PC based simulation model that will model the indirect fire (i.e., target not in direct line of sight from the weapon) fire control process to enable the simulator to characterize a fire control system (either existing or conceptual) and to determine its performance against specified targets. The simulation should model, to a useful level of detail, the entire indirect fire process from location of a target, transmission of that information to a tactical fire control center, assignment of a fire mission to weapon(s), computation of the technical fire control data, laying of the weapon, flyout of the bullet to the target, and, finally, location of the impact with respect to the target. Using such a model, an investigator could determine the sensitivity of the weapon system performance to a large number of system parameters and external variables associated with fire control. Examples of such investigations are: investigation of the potential benefit of monitoring individual round muzzle velocity and the use of that data to correct the firing data for subsequent rounds; investigation of the potential benefit of monitoring individual round muzzle velocity and the use of that data to correct the firing data for subsequent rounds; investigation of the potential benefit of observation of the fired projectile's flight path and application of correction to subsequent projectile based on the difference between the observed trajectory and expected sensitivity of the system performance to weapon location and alignment errors. The simulation should be capable of operation on an IBM compatible PC and should operate in a manner consistent with acceptable user friendly formats. It should be modular in construction so that portions can be modified and updated as necessary. It should contain adequate storage capacity so that a large number of real and conceptual fire control systems can be defined and stored for later use.

Phase I: Investigate the indirect fire, fire control problem to determine its basic structure. Define the basic structure of the simulation to model that process. Develop some software to demonstrate sufficient features of the model to enable a Phase II decision to be made. Provide a cost and schedule to complete the model development and validate it by comparison of the model to real system test results.

Phase II: Complete the simulation development and support its installation on PCs at ARDEC. Provide support during demonstration and training of ARDEC users. Use ARDEC supplied real system test data to validate the model by demonstrating that the results obtained from it agree, to an appropriate level, with those from the test.

A90-475 TITLE: Sight Integration of an Automatic Muzzle Reference Sensor

CATEGORY: Advanced Development

OBJECTIVE: Develop an Automatic Muzzle Reference Sensor fully integrated in the fire control system, i.e. into the ballistic computer and a primary sight, to be employed in the Abrams Main Battle Tank (M1MA1) or future armored vehicles.

DESCRIPTION: Recent developments in the Automatic Muzzle Reference Sensor (AMRS) arena have made it possible to provide muzzle orientation data from an instant before triffer-pull occurs, until long after the bullet exists the gun barrel. The resultant of this source of data is the ability to aim a weapon with a much higher degree of accuracy, thus substantially increasing the hit probability of a gunner's system. Currently, main gun muzzle position is measured by conducting a measurement of the muzzle position using a manual Muzzle Reference Sensor (MRS) and comparing them to a reference position achieved by going through a boresight procedure. Various attempts at improving the existing manual reference sensor have achieved a tremendous increase in the ability of the MRS to survive the harsh muzzle environment, but have done little towards meeting main gun accuracy requirements.

In view of the above, the time is appropriate to fully integrate an AMRS device into the Fire Control System, providing the ballistic computer with an automatic update of muzzle orientation before each bullet is fired (and possibly gather information as the bullet is traveling along the tube) and to further integrate the primary sight into the AMRS loop by referencing the end of the muzzle to the main sight.

Phase I: Develop concepts and projected performance for integration of an Automatic Muzzle Reference Sensor into the Fire Control System (sight and Ballistic Computer) on an M1A1 vehicle. This will provide the ability of the ballistic computer of interpret the muzzle orientation data from the AMRS, and to process the data through the ballistic solution so that the proper rectile offset by projected on the primary sight.

Phase II: Implement the system developed in Phase I and integrate it into the Gunner's Primary Sight (GPS) on an M1A1 vehicle. It is expected that relative motion will take place between the GPS and AMRS transceiver unit, therefore, a scheme has to be developed to compensate for such motion (or eliminate the use of transceiver at the trunnions) and have that information processed through the ballistic computer.

Army Research Office

A90-476 TITLE: Magnetic Field Processing for Improved Material Properties

CATEGORY: Basic Research

OBJECTIVE: To develop the principles influencing the properties of materials processed under magnetic fields.

DESCRIPTION: Pulsed magnetic fields can influence the metallurgic properties of a wide range of ferro and dia-magnetic metals and alloys. This influence has been shown to be directly related to the interaction of the magnetic field energy with the defect structure of the crystal lattice. With careful study and development, these effects may be used to influence important mechanical properties such as extending life by the modification of surface and subsurface dislocation structure and stress relief by promoting dislocation and vacancy movement. The focus of the study will be to further our understanding of the fundamentals of metallurgical changes affecting fatigue properties and stress relief as well as the influence of variation of magnetic field properties.

Phase I: Develop the principles underlying the use of pulse magnetic fields in the processing of improved materials.

Phase II: Assess and demonstrate the potential of this technology to improve the fatigue life of military and commercial components.

A90-477 TITLE: Tribology of Refractory Ceramics

CATEGORY: Basic Research

OBJECTIVE: Perform research to provide new technology and processes for reduced wear and corrosion of refractory ceramics.

DESCRIPTION: Prototype ceramic engines must operate for extended periods of time reliably. Research is needed for the discovery and design of new classes of solid state lubricants that are resistant to deterioration.

Phase I: The goal of Phase I is to identify potential candidate classes of materials and processes for introducing lubricants; rationalize choices through crystal chemical design criteria, and carry out preliminary experiments establishing their usefulness.

Phase II: The goal of Phase II is to validate the high temperature ceramics lubrication potential of materials identified in Phase I.

A90-478 TITLE: Time-Accurate Wall Stress Transducers

CATEGORY: Basic Research

OBJECTIVE: To develop new unsteady wall shear-stress transducers with enhanced spatial and temporal resolution.

DESCRIPTION: The measurement of wall shear stress is of vital importance for many problems in aerodynamics and fluid mechanics, especially for separated and/or turbulent flows. Unfortunately, the quantitative measurement of this quantity is a very difficult task. Techniques such as Preston and Stanton tubes, hot-film gauges, floating elements and thermal tufts have all been used to measure wall shear stress. Additionally, a new generation of laser techniques (interferometric, LDA, dual cylindrical wave laser Doppler, etc.) have recently been developed. Unfortunately, each of these methods have limited spatial and temporal resolution which limits their use for the measurement of wall shear stress in many unsteady separated flows. The focus of the current solicitation is the development of new non-intrusive direct techniques capable of accurate wall shear-stress measurements with adequate temporal and spatial resolution. Small but rugged transducers, resistant to normal handling and installation forces but with high frequency response are of particular interest.

Phase I: The basic research activity of Phase I should include the examination of the various concepts and design options for the proposed scientific instrumentation.

Phase II: The Phase II goal is the development and validation of the prototype(s) of the best-concept design alternatives, leading to a Phase II commercialization of the transducer.

A90-479 TITLE: Refractory Materials Coating Processes

CATEGORY: Basic Research

OBJECTIVE: Perform research to provide new technology for refractory materials coatings/surface modification processes.

DESCRIPTION: Refractory materials coatings/surface modification technology is required for many U.S. Army applications requiring erosion, corrosion and wear resistance at high temperature. Such protective coatings/surface modification must be adherent and have reduced stress levels over wide temperature ranges.

Phase I: The goal of Phase I is to identify potential candidate processes; to rationalize choices based upon environment, performance, thermodynamic, kinetic, and economic considerations; to carry out preliminary experiments establishing the correctness of the approach chosen, and to establish preliminary design criteria for scaleup.

Phase II: The goal of Phase II is to design and operate a pilot scale implementation of the approach chosen in Phase I.