

## ARMY 1987

### SBIR SOLICITATION

#### INTRODUCTION

It is important that the SBIR proposal be prepared with care in order to facilitate its consideration. Specifically, a valid proposal shall:

- (1) Be innovative, unique, or meritorious
- (2) Be independently originated and developed by the offeror
- (3) Include sufficient detail to permit a determination that the Government's support could be worthwhile, and that the proposed work could benefit the Army's Research and Development or other mission responsibilities:
- (4) Not be an advance proposal for a specific document Army requirement that can be acquired by other competitive methods.

The contracting office will insert a special clause in the Phase I contract similar to an option clause identifying the specific time frame for submission of Phase II proposals. For cost type contracts, it is imperative that Small Business have an accounting system adequate for determining costs applicable to the contract. The contracting office will insert an option clause in the Phase I contract to cover an interim period not to exceed four months for preliminary Phase II work while the total Phase II proposal is being evaluated. (See fiscal reports for both Phase I and Phase II contracts.

Final reports shall be required for both Phase I and Phase II Army SBIR projects. These reports are to be submitted in connection with the final update of the DD Form 1498 – Research and Technology Work Unit Information Summary which is managed by the Defense Technical Information Center (DTIC). The contracting office shall incorporate a requirement that the DD Form 1498 be furnished to DTIC and to the Government Technical Program Manager who shall assure that appropriate interim updates are provided to DTIC. This information system will receive serve as the central database for the Army SBIR Program.

For general questions on the Army Solicitation

Topics, please call Army SBIR Program Manager

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Topics A87-001 – A87-026

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Topics A87-027 – A8-030

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Chemical Research, Development and Engineering Center  
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Procurement Directorate  
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Topics A87 – 031 – A87-040

Commander  
U.S. Army Aviation System Command  
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Topics A87-041 – A87-067

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2800 Powder Mill Road  
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Topics A87-068

Commander  
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Topics A87-069 – A87-073

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U.S. Army Atmosphere Sciences Laboratory  
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Topics A87-074 – A87-097

Director  
U.S. Army Ballistic Research Laboratory  
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Topics A87-098 – A87-101  
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Topics A87-116-A87-134  
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Topics A87-135 – A87-148  
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Topics A87-149 – A87-155  
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SBIR Program  
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Topics A87-156 – A87-172  
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U.S. Army Tank Automotive Command  
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Topics A87-173 – A87-181  
Director  
U. S. Army Natick Research and Development And Engineering Center  
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SBIR Program  
Natick, MA 01760-5011

Topics A87-182 – A87-186  
Commander  
U. S. Army Aberdeen Proving Ground  
Installation Support Activity  
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Aberdeen Proving Ground, MD 21005-5001

Topics A87-187-A87 – 199  
Commander  
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ATTN: STEAP-PR (SBIR Program)  
Dugway, UT 84022-5000

Topics A87-200 – A87-213  
Commander  
U.S. Army White Sands Missile Range  
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White Sands Missile Range, NM 88002-5031

Topics A87-214 – A87-218  
Commander  
U.S. Army Cold Regions Test Centre  
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Topics A87-219 – A87-220  
Commander  
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Topics A87-221 – A87-224  
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Topics A87-225 – A87-234  
Commander  
U.S. Army Test & Evaluation Command  
ATTN: AMSTE-PR (SBIR Program)  
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Topics A87-235  
Commander  
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Topics A87-236 – A87-238

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Topics A87-239 – A87-244

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Topics A87-245 – A87-259

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Topics A87-262 – A87-270

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Topics A87-271 – A87-285

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Topics A87-286 – A87-290

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Topics A87-291 – A87-304

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Topics A87-305 – A87-317

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Topics A87-318 – A87-322

Director  
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Topics A87-323 – A87-330

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A87-001            TITLE: Adaptive weapon Pointing and Tracking

DESCRIPTION: Developed a flexible high bandwidth digital weapon pointing and control module capable of implementing a state-of-the-art adaptive control and target lead prediction algorithms. The module will be portable and sufficiently rugged for field test bed applications. The module will accept and process current Army Weapon Sensor information and output control command signals for weapon pointing. System will support high-level interactive programming for algorithm development, implementation and validation.

A87-002            TITLE: Application & Comparison of Asphere & Gradient Index

DESCRIPTION: Investigate applicability of axial gradient and aspheric lens technologies to visible and IR fire control sighting systems. Determine how the two technologies compare for performance enhancement and cost reduction and how they might be coupled in design solutions to fire control sighting problems. Existing optical systems will be evaluated for cost reduction and improved performance as well as unmet military requirements; e.g., rifle sight studies. The producibility of the components by fast optical fabrication techniques will be included. The Phase I effort will end in a report describing the results of the study and a preliminary design of a system or subsystem applicable to Army requirements either as a replacement or original item.

A87-003            TITLE: Commandable Safety and Arm Devices for Landmines

DESCRIPTION: There is a need for safety & Arm Devices concepts that can be commanded to repeatedly cycle between a safe or armed condition under electronic command. A safety and arm device is the subsystem of a munition that converts a fuze electronic signal to an explosive output capable of initiating the main warhead and assures by electronic and mechanical means that this output is possible only when a specific munition deployment environment has occurred. It is desirable to remotely command a mine to a safe condition to allow friendly forces to maneuver and then rearm the mine if necessary. The device must be small (less than 2 cubic inches and use minimum transient power (typically a few hundred microfarad capacitor charged to 7 volts, any continuous power should be in the tens of microampere). Reliability should be on the order of .999 for being in a safe condition when commanded. Command signal would be a CMOS device 7-volt logic level. Innovative approaches are needed to reliably convert and direct energy under control within the munition such as optical concepts or use of memory alloys.

A87-004            TITLE: Electromagnetic (EM) Launch Component Technologies

DESCRIPTION: EM Launch technology provides the opportunity for hypervelocity solutions to tactical gun system requirements, but development of innovative approaches in the requisite support technologies may be necessary. Primary needs are lightweight, efficiency and robustness in the areas of: intermediate energy storage (e.g., rotating machines or high power batteries); launcher subcomponents (e.g., rail gun insulators and coil gun structures); and a means to achieve and/or avoid high-current opening switches.

A87-005            TITLE: Intelligent Gunner/Commander Decision Aid

DESCRIPTION: Develop and prototype intelligent tank gunner/commander decision aid for laboratory demonstration and validation. The system should be capable of interfacing with and processing simulated sensor/command control, communication, and intelligence (C3I) data and interfacing with tracker hardware for autonomous target acquisition, recognition, and tracking. The system will provide online tactical planning with intelligent display and provide flexible environment for artificial intelligence algorithm development and knowledge engineering.

A87-006            TITLE: Robotic Control

DESCRIPTION: Develop and demonstrate an intelligent sensor based robotic control module capable of integrating multi-sensory information, i.e., force/torque, range, vision, tactile and acoustic and perceiving its workspace environment and accomplishing online planning to complete a specified part mating/assembly task. The module should provide a flexible programming environment for sensor-based control law development, i.e., compliance control, model reference adaptive control, and task planning. Module should be capable of interfacing with a laboratory Puma 560 robot.

A87-007            TITLE: Robot Vision

DESCRIPTION: develop prototype 3-D robot vision module and associated algorithms, which will permit high speed processing of (arm mounted) camera data and recognition and tracking 3-D objects in the robot workspace. The vision module will support high level programming of candidate vision algorithms using standard subroutine libraries and provide interface compatibility with the Puma 560 robot for algorithm validation.

A87-008            TITLE: Design of a Rapid Reload Feeder System

DESCRIPTION: The Combat Vehicle Armament Technology (COMVAT) program is developing a 30mm armament system for the future armored family of vehicles. COMVAT is developing a cased, telescoped ammunition/gun and a twenty round link less feeder, but there is a need for a full scale feed system. An analysis of ways to efficiently and rapidly reload feed systems is needed. A design of the best system chosen from the analysis will be required. The goal is to design a feed system that will be compatible with future and present resupply vehicles and require little effort from the crew and support personnel.

A87-009            TITLE: Maneuverable Projectile Control Technology

DESCRIPTION: Recently developed maneuverable projectiles in the Command Adjusted Trajectory (CAT) program utilize lateral control squibs to divert the projectile from its current trajectory based on command signals generated by a ground tracking system. Due to packaging constraints only a limited number of discrete control events are available to correct for target motion. The purpose of the effort is to improve on the control efficiency of the maneuverable projectile by the development of more efficient guidance and control algorithms. Current system concepts rely on the use of proportional navigation or pursuit navigation laws to affect the control events; however, these methods are not the most efficient ones for this application. Improved guidance schemes are required, that will account for variations in target prediction uncertainty and loss of control authority during the ballistic phase.

A87-010            TITLE: Simultaneous Engagement Armament System

DESCRIPTION: A turreted gun control unit that will allow the attack of threats off axis from the attack helicopter while it is engaged with the attack of armored targets with its missile systems. The unit must be semi-autonomous with its own target sensor/tracker capability but yet linked to the basic system sensors capability and to the pilot.

A87-011            TITLE: Voice Activated Gun Turret Control

DESCRIPTION: a turreted gun control unit that allows the pilot in stressful combat scenarios to receive and provide verbal information to the turret as to target locale, armament status, etc.

A87-012            TITLE: Ammunition Logistics

DESCRIPTION: The ammunition logistics system provides munitions and explosives to the soldier in the field all the way from the manufacturing point. All types of munitions are included, and the system interfaces include packaging, material handling equipment, transportation, storage, and communications, command and control.

There is a need for a range of items that support this area in the logistics system. Some of these items include:

- Lightweight materials for packaging
- Methods for adhesion of various types of labels to plastic or plastic coated containers
- Methods of producing enhanced wood products capable of being used in a chemically contaminated environment and being decontaminated.
- Light weight, manpowered, materials handling equipment capable of augmenting existing resupply equipment for light forces.
- Methods for tie-down and securing cargo in a range of large containers
- Methods of improving storage capabilities while meeting safety requirements for munitions
- Inventory methods and software for igloo storage using electronic storage data at the igloo

Given above are a few representative areas for investigation but ideas are being sought across the range of the ammunition logistics system. Proposed enhancement should be specific and well defined to an existing technique or item in the logistics system.

A87-013            TITLE: Software Maintenance Tool

DESCRIPTION: The McCabe Cyclomatic Complexity Metric, as documented in NBS Publication 500-99, is a metric, which quantifies the relative complexity of a software module based on the logic constructs used in the algorithm. As this quantity increases, there is a probability that the number of errors in the module will increase. Similarly, the ability of one to understand, and therefore to test and maintain the module decreases. The metric also identifies the minimum number of paths that need to be tested in order to assure the software performs in a consistent and reliable fashion.

The Complexity Analysis Tool (CAT) is an automated tool, which analyzes the mission critical computer software (MCCS) source code. This tool currently has the capability of analyzing 3 languages and 2 program design languages (PDL's). As a result, the complexity, data flow diagram, and test paths are generated for each module of the program.

Software changes made during the maintenance phase of the life cycle cost up to 30C times the amount of changes made during initial design. Also, a change in any one of the software modules may have a drastic impact upon the performance of other system components. Because of these facts, a need exists to extend the principles of the McCabe Cyclomatic Complexity Metric and CAT to the system and/or requirements level. A quantitative indication is needed to answer the following questions:

- How maintainable is the system
- Given various change options, which these will either improve or have the least effect on the maintainability of the module being changed?
- What other portions of the program might be affected by changing a particular module? How does this affect the program's structure? What logical paths of the software must be retested because of the potential effect propagated as a result of one change?
- What modules are the most likely to be problematic from a maintenance point of view?
- What effects do the proposed changes have upon supporting documentation?

The resulting indicator(s) should show the maintenance status of the system as well as indicating high-risk areas. This indicator(s) should be incorporated into the CAT automated tool, and may require use of an expert system.

The overall intent is to develop a comprehensive, set of tools based on McCabe's methodologies which will provide measurements through the software development life cycle, and on into post-deployment maintenance.

A87-014            TITLE: Automated Tailoring Assistant for DOD-STD-2167/2168

DESCRIPTION: DOD\_STD2167, Defense System Software Development, and DOD\_STD\_2168, Defense System Quality Evaluation, are the new DOD standards aimed at software acquisition, development, and support. DOD\_STD2167 establishes the requirements for software during its development and acquisition. DOD\_STD2168 establishes the requirements the requirements evaluation of software and the establishment of a quality program.

DCD\_HDBK\_287, Defense System Software Quality Program Handbook, aid in the application and use of these new standards. By answering a series of questions contained in the handbook in regards to a particular project. A list of applicable DIDs for that project is generated. Another series of questions is used to tailor sections out if each DID so that you are left with a customized list of tailored DIDs and requirements for the software development project.

To result in a more consistent, timely and efficient utilization of this process, a need exists to have this process transformed into an automated tool. The tool should possess the following capabilities:

- Be an interactive, user-friendly tool, prompting the user for information regarding the software development project.
- When the tool prompts the user for input, the tool should have the ability to provide the corresponding reference (i.e., DOD\_STD\_2167,Section XXX states that....) where the question/information is derived from.
- Should the questions prove to be subjective in nature, expert system technology should be applied to aid in the decision process, drawing upon past experience or established policies.
- The tool should have provisions for distinguishing between:
  - Mission Critical Computer Systems (MCCS) Tactical Items
  - MCCS Non tactical items
  - Non-MCCS Items
- The tool should have an automated report generator, outlining the final requirements and DIDs as tailored.

A87-015            TITLE: Applicability of Ada Compilers for Armament and Munitions

DESCRIPTION: DOD validates Ada Compilers to ensure compatibility of the Ada language constructs to those specified in DOD\_STD\_1815A. However, this validation process makes no attempt to evaluate performance characteristics of these Compilers nor the code they generate for their potential usefulness. For example, I/O memory usage and timing (i.e., micro-processor overhead) may not meet system design requirements AMCCOM is finding that certain compiler/processor combinations are not practical for particular armament/munition applications.

AMCCOM needs a way for Ada compiler to be evaluated in terms of their applicability to specific missions critical software development efforts. In addition certain compiler/processor combinations may give rise to particular problems, such as not meeting program operation time constraints, for particular problems, such as not meeting program operation time constraints, for particular programming constructs. These potential problems need to be determined and document.

A method for continually assessing Ada compilers and their performance characteristics on target microprocessors must be developed. This method tool, etc., must have the ability to adapt its assessment capabilities to the requirements of the system for which Ada is to be used, so that it could be applied time and time again.

A87-016            TITLE: Stress Test Assessment Tool (STAT)

DESCRIPTION: The Complexity Analysis Tool (CAT) is an automated tool, which analyzes mission critical computer software (MCCS) source code. The tool is based upon the McCabe Cyclomatic Complexity Metric, as documented in NBS Publication 500-99. The metric gives an indication of the relative complexity of a software module based on the logic constructs used in the algorithm. The metric also identifies the minimum number of paths that need to be tested in order to assure the software performs in a consistent and reliable fashion.

Upon analysis of the code, the following are provided for each module of the program:

- The complexity
- Data flow diagram (program flow mapping)
- The test paths, which need to be tested

This tool currently has the complexity of analyzing HP-71 BASIC, Equate ATLAS, PDL (Caine, Farber, and Gordon), and Aba (MIL\_STD\_1815A).

Modules with small complexities are tested without too much difficulty. Modules with large complexities often require a greater amount of time and effort to test. Because of various program constraints, these modules are often not thoroughly tested, thus leaving doubt as to their reliability.

A tool is needed to automatically stress test MCCS software to ensure that it does not “crash” when stressed and/or saturated to and beyond established limits. This tool shall utilize the output of CAT, develop a gamut of input for each control taken, and develop the necessary stubs and drivers for each module. With this data, the tool shall then automatically do stress testing on software. The testing results should be sent to a report file, noting if the program crashed, accepted bad data, rejected good data, where the error occurred, which data caused the error, etc. The tool may utilize artificial intelligence/expert system technology. The overall intent is to develop a comprehensive set of tools based on McCabe’s methodologies which will provide measurements through the software development life cycle, and on into post-development maintenance. The tool described above would further reduce the labor intensive and costly testing effort associated with MCCS software and would reduce the probability of not finding an undetected bug.

A87-017            TITLE: Software Rework Metric (SRM)

DESCRIPTION: AMCCOM has a need to develop quantitative measure of software quality attributes of evolving software products, specifically in terms of reliability and maintainability. Unfortunately, these two quality characteristics are the most important and most visible to Government and industry software development.

The development of a software rework metric (SRM) as a measure of time, money, and effort needed to modify and correct software documentation. Designs and code will make it possible to express reliability and maintainability characteristics of a software product. The metric will measure the effort, in terms of labor, travel, computer time, document, processing, etc., that is incurred as a result of reworking a software product in any life-cycle phase that has been affected by a process and/or activity performed in a previous phase that has been affected by a process and/or activity performed in a previous phase. This SRM measure must be based on previous program experiences, (i.e., corporate memory dependent) and must have the ability to expand its knowledge and/or database relative to new data, which is gathered from current system development efforts.

The SRM measure will provide program managers with a quantitative measure of the effectiveness of their software development methods and quality evaluation techniques.

A87-018            TITLE: Software Quality Analysis Extension to the Common APSE Interface Set (CAIS)

DESCRIPTION: The DOD is committed to the use of Ada as the programming language to be used as the preferred Higher Order Language for all DOD projects in the future. The DOD has also specified the requirements of a group

interfaces to the Ada Programming Support Environment (ASPE) known as the Common APSE Interface Set (CAIS) is designed to promote the source level capability and the portability of the Ada software development tools.

The analysis and assessment of software quality factors in contractor-provided software has been impeded in the past by lack of software design information and poor coding and annotating methods. With the CAIS establishing a uniform language specification, language development environment, and human interface, there exists a need for a uniform series of Ada development tools for subsequent evaluation of code developed under the CAIS. These tools would:

- Perform ongoing design flowcharting
- Log changes/additions/enhancements to the source code
- Perform modularity and procedural checks
- Assess the sufficiency of annotation and remarks
- Perform other tasks, which would be useful to assess and/or measure the quality of the aifware

A87-019            TITLE: Software Test Hooks

DESCRIPTION: In today's software intensive weapon systems, it is require to provide software test points, or test hooks, which permit the diagnostics of hardware, software and/or operator induced faults, These hooks are to be identified early in the development of the software, utilized during testing, and provide support assistance to fielded systems. The need exists for a test hook design concept, which answers the following question

- What should a test hook consist of?
- What features are available to be included in the test hook design concept, i.e., memory overhead, computation speed, timing, path execution
- Where should test hooks be placed?
- How can test hooks tie into built in test (BIT)
- What will their impact be upon the timing of the program? Upon the program as a whole?
- Should they be part of the production version of the software and should they be in a test version?

This test hook design concept should be generic in nature and not specific to a particular language.

A87-020            TITLE: Reducing Noise from Artillery, Tank, Mortars, and Small Arms

DESCRIPTION: Currently, the U.S. Army is faced with major ecological/political noise problems (during worldwide peacetime training exercises caused by the high noise levels of the firing and impacting of projectile from artillery, tank, mortars and small arms. There is a need to have research done so as to lower the noise from both gun and projectile solutions can be generic or specific to gun, projectile, impacting scheme or geographic locations.

A87-021            TITLE: Ignition Concepts for Tank and Artillery Ammunition

DESCRIPTION: Develop ignition system for insensitive munitions. Let vulnerability propellants are being developed for several applications including tank and artillery ammunition. These materials, by design, are more difficult to ignite.

Ignition systems are required which do not increase the vulnerability of the insensitive propellants. As an example, materials, which produce excess oxidizers during combustion, have been found to be effective igniters.

Design, construct and test an ignition system which may include new igniter materials that produce oxidizer rich combustion products, novel flame spread techniques via grain configuration and novel igniter position in the propellant bed. The new design is directed to the replacement of the bayonet primer in tank ammunition or base pad igniter in artillery.

A87-022            TITLE: Encasement of stick propellant for artillery charges

DESCRIPTION: Stick propelling charges currently are encased in a combustible case, which presents ballistic problems. A preferred design from a strictly performance point of view is the non-cased charge. However, this is not practical because of field handling, storage and environmental concerns. Therefore, an alternate method, other than a cloth bag is desired which will provide the protection and consumability of the combustible and the performance of the non-cased charge. It is required to develop a design, which can accomplish this goal.

A87-023            TITLE: Development of combustible case test procedures

DESCRIPTION: Develop test procedures which can be used for quality control testing of finished nitrocellulose-based combustible cases. The project will require a study to determine parameters important for end-use and the development of tests to address these parameters. As a minimum, the data required are mechanical strength, combustibility, storage life, and capability with propellant.

A87-024            TITLE: Polymeric Binder Compounds for Energetic Materials

DESCRIPTION: studies have shown that the structural behavior and mode of failure of energetic materials has a marked effect on their ballistic performance. It has also been shown that changes in binder composition change the mechanical behavior of the material.

Investigations should be conducted on determining the binder composition, which yields optimal properties. These studies should include mechanical formulation. Research is currently being conducted on the thermoplastic elastomer and cellulose binder compounds.

A87-025            TITLE: Determination of Coating Thickness

DESCRIPTION: Techniques are to be developed which can rapidly determine the completeness and thickness of coatings such as waxes or polyethylene on energetic materials, which are usually nitro compounds.

A87-026            TITLE: Packaging of Army Ammunition

DESCRIPTION: The Packaging Division, ARDEC, is responsible for supplying packaging and packaging technology for all Army manufactured and supplied weaponry. In addition the packaging division is responsible for improving any Army packaging currently fielded, active or otherwise, in order to complement and enhance the logistic nature of the package. As part of this effort to improve packaging technology, the packaging division entered the initial stages of research and development in three areas.

The first of these three areas relates to packaging in a general way. Five programs fall under this heading, they are: Computer Aided Design/Engineering, Improved Cushioning Materials, Improved Gasket Materials, Improved Marketing Applications and Light Weight Materials that will be used in the packaging design and in finding new materials.

The second area will be used to aid in the development of plastic containers now being developed in the product improvement area. This program will help in predicting the longevity of plastic containers after production.

The last area can be described as special projects. There are two projects in this area. They are enhanced Wood/NBC Protection and Foreign Exploitation. The Enhancement Wood Program is an attempt to make wood NBC protectable. The Foreign Exploitation project is design to exchange information on U.S. weapon packaging with our allies in an attempt to improve and speed packaging design.

A87-027            TITLE: Miniature LIDAR System for Standoff Detection

DESCRIPTION: Develop a LIDAR system using 4 frequency agile coaxially aligned CO<sub>2</sub> lasers, with an energy output (full width, half maximum at line (10P20) of at least 100 mj and a PRF of 100 Hz. Lasers should be tunable to at least 66 lines (min. FWHM energy - 30 mj) with a tuning rate of 100Hz The system must have 9 in collecting optics, state-of-the-art detectors, and be configured in a package of no more than 40 lbs. Lasers must be sealed, preferably with a passive catalyst to attain a life of 10 million shots per laser. The system must operate on a 28-volt power supply, and provide buffered 16 bit digital data for each laser shot. This effort would support the Army's program to develop equipment for the standoff detection of chemical warfare agents

A87-028            TITLE: Regeneration of Immunologically-active Surfaces

DESCRIPTION: Currently Army requirements call for sensors to detect chemical and biological agents in a continuous or semi-continuous (repetitive) manner. Some of the sensors under consideration employ immunological recognition steps as the sensors under consideration employ immunological recognition steps as the essential part of the transduction mechanism. A need exists to regenerate the "baseline" state of the antibody- or antigen coated surfaces (that are an essential part of such sensors) in between successive analyses. This regeneration process would include antibody-antigen dissociation and perhaps the reloading of the surface with a labeled immunoreagent for a subsequent competitive reaction. While many different methods for dissociating antibody-antigen conjugates exist, most of these methods are effective only in certain applications. A method is desired that will have a more universal applicability and that, at the same time, will not denature baseline conditions of sensing surfaces composed of immobilized biological receptor proteins.

A87-029            TITLE: Production of Heat-stable enzymes from Thermophilic Organisms

DESCRIPTION: There is a great potential to improve the heat stability and shelf life of enzymes of interest in chemical/biological defense. These include enzymes (primarily oxidases and peroxidases) used in immunochemical tests for chemical/biological agents and toxins, as well as, catalytic moieties with potential as decontaminants. Commercially available, non-heat stable enzymes currently used could be stabilized by synthetic means, but only at great expense. Alternatively, an investigation of potential sources of naturally occurring heat stable enzymes from thermophilic organisms is desirable. Because thermophilic organisms exist in environments such as hot springs, they produce heat-stable enzymes naturally. The resulting baseline data would be used to conduct process engineering and scale-up work to prove out the production of these heat-stable enzymes by large-scale culture of these organisms.

A87-030            TITLE: Hydrophobic Treatmentsfor carbonaceous Adsorbants

DESCRIPTION: The medium used in all military agent filtration systems for removal of agent vapors is ASC Carbon. This adsorbant is a coal-based carbon, which has been impregnated with salts of copper, silver, and chromium. ASC carbon has been demonstrated to provide excellent protection against a wide range of toxic chemical agents. However, the performance against some agents (those that absorb weakly on carbon) is adversely affected by high relative humidity in the filter challenge stream. It is desirable to alleviate the undesirable effect of relative humidity so that sorptive performance is high at all relative humidities. One approach might be a carbon treatment method, which reduces the number of polar functional groups. This effort will require novel technology because the existence of the impregnants themselves likely contributes to the level of water adsorption by ASC Carbon. This technology also has commercial application to the manufacture of adsorbants used in NIOSH approved industrial chemical vapors filters.

A87-031            TITLE: Conformal Thermoplastic Composite Materials

DESCRIPTION: Commercially available thermoplastic composite material forms possess two significant drawbacks: they are excessively boardy and have no tack. As a result, laminating compound curvature parts is more

difficult and results in lower quality parts than with conventional epoxy prepreg construction. Innovative and novel product forms are required which solve these problems. These forms must be capable of providing all of the combination of fibers (graphite, Kevlar, glass) and different thermoplastic matrices of potential interest to helicopter primary structural applications. In addition, little or no degradation of material properties is desired compared with state-of-the-art preregs. These materials should be equivalent to or lower in cost than conventional composite material forms. Demonstration of novel product forms applied to helicopter primary structure possessing compound curvature is necessary to achieve high quality thermoplastic components.

A87-032            TITLE: Repair Techniques of Fiber Optic Connectors/Cabling

DESCRIPTION: Repair of such hardware is now limited to bulky, skill-intensive techniques and hardware. Work needs to be conducted on developing repair concepts for field level maintenance of fiber optic subsystems, primarily the cabling and connector interfaces.

A87-033            TITLE: Measurement & Control of Static Electricity on Hovering Helicopters

DESCRIPTION: Electrostatic charges are generated on hovering helicopters by several mechanisms and result in extremely high residual voltages which can be hazardous during helicopter can be quite complicated making sensing and control of the voltage relative to earth to earth difficult. Innovative research is needed in the solution to this problem.

A87-034            TITLE: Improved Ocular Target Acquisition (IOTA)

DESCRIPTION: The improved ocular target acquisition concept is based on a set of infrared sensors that monitor an operator's eye position and orientation to determine direction of focus and generate the line of sight angular data required to effect target handoff or to accurately aim weapon systems. This concept has potential application as an improvement over helmet mounted sighting systems. By directly monitoring eye position and orientation to establish direction of focus, the sensors are affected by inaccuracies resulting from the operator's head motion and helmet shifting which are inherent in helicopter helmet sighting systems. Accordingly a 4 to 1 improvement in aiming accuracy is anticipated. Under this effort breadboard hardware/software will be fabricated and integrated into a suitable helicopter cockpit simulator in order to evaluate performances and verify potential application as a helicopter sighting system.

A87-035            TITLE: Multi-rotorcraft, Multi-threat air to ground Engagement

DESCRIPTION: develop, verify and validate a micro-computer based simulation of air to ground combat engagements between rotorcraft flying in the nap of the earth and ground based missiles and guns having acoustic, optical, infrared, able to operate autonomously or in teams. Effects of terrain on intervisibility are required. The simulation is needed to evaluate the benefits of emerging rotorcraft technologies.

A87-036            TITLE: Air to Air Combat Engagement Analysis Utilizing Terrain

DESCRIPTION: Conduct investigation of the Family of Light Helicopters in a one-on-one air-to-air combat environment. The investigation is to include the dynamic characteristics of air vehicles (6 degrees of freedom), weapon characteristic sensors and sensor cueing, active and passive counter measures, counter-counter measures, target selection and target selection and target handoff, terrain shielding.

A87-037            TITLE: Ceramic Component Non Destructive Testing Technology

DESCRIPTION: there is an increasing use of silica and alumina based ceramic material systems in gas turbine components. The ability to detect a good component from a materials standpoint is at best limited. This project would pursue new and innovative approaches to determining a good ceramic component form badly due to material effects.

A87-038            TITLE: Advanced Recuperator Technology

DESCRIPTION: The need for advanced methods to recuperate lost energy in small flight weight turbo shaft or compound cycle engines are increasing with higher operating temperatures. This project would investigate novel approaches to exchanging the energy and getting it back into the cycle, to increase the overall cycle efficiency while minimizing performance penalties due to increased weight.

A87-039            TITLE: Titanium Webbed Gearing

DESCRIPTION: Investigate techniques for bonding steel rims to titanium gear webs. The bond between steel and titanium will be evaluating both destructively and non-destructively to determine success of process. Utilizing titanium webs could save 20-30% of gear weights.

A87-040            TITLE: Rotorcraft Advanced Transmission Concept

DESCRIPTION: Investigate the potential of a Squirm drive system for possible use in a rotorcraft transmission of 500 shp size. Conduct feasibility study, calculate transmission efficiency and life. Fabricate prototype for testing at the Army Propulsion Directorate.

A87-041            TITLE: Digital Beam Forming (DBF) Radar

DESCRIPTION: In any radar employing an array-receiving antenna, signals from a number of antenna elements are appropriately weighted and combined to form various antenna beam outputs. Digital beam forming (DBF) denotes the formation of these beam outputs by digital computer. The elemental signal are sampled and digitized, then weighted and combined as "numbers" in the computer. The stream of numbers thus formed present the signal that is seen by a given antenna beam. Changing the weights applied to the digitized samples changes the direction and/or shape.

Now by providing the proper analog "pre-processing" at each element just prior to the A/D conversion, the converter dynamic range (number of bits) can be significantly reduced. This reduces the size, complexity, power consumption, and cost of the converter to the central processor. Proposals to explore this line of research are of interest, including the consideration of design and mechanization of appropriate integrated circuits, and their implementation as part of a DBF receiver. Signal processing architectures and designs, which take maximum advantage of DBF technology, including VHSIC and VLSI hardware, and advanced FFT algorithms will be considered.

A87-042            TITLE: PIN Diode Limiter Dynamics

DESCRIPTION: PIN diodes are mounted as limiters in shunt across TEM transmission line to protect microwave receiver components from damage by high power microwave pulses. They are characterized by a finite burnout threshold and spike leakage when subjected to fast rise-time pulses. Theoretical and experimental work is needed to characterize these burnout and spike leakage properties. There are many life terms associated with semiconductor devices, but none of them describes directly how PIN diodes perform as limiters.

Theory and experiment are needed to find ways to measure the important parameters of PIN junction diodes wherein the electrical parameters measured are traced directly to the Physical parameters of the structure of the junction. When this work is complete, a design engineer using a PIN diode should be able to measure the diode in a non-destructive test and predict what its spike leakage and damage threshold will be. A PIN junction manufacturer should be able to specify the physical process used in fabricating it and know what performance it will provide. System designers should be able to know the theoretical limitations of PIN diode limiters.

A87-043            TITLE: Safety & Reliability Theories For Electronic Safing And Arming

DESCRIPTION: The Army needs reliable theories for the safety and reliability of electronic S&A's which will have in line (stationary) explosive trains. The objective of these efforts is to formulate such theories with the emphasis on logical-controlled safety and firing systems. The desired starting point for development S&A system analyses is a study and critique of the assumptions, methodologies and conclusions found in a recent report related to electronic S&A's. This report is "The Worst Case Mathematical Theory of "Safe-Arming" by Dennis A. Silvia; Technical Report ARBRL-TR-02444 (ADA143789). Any study and critique of this report should highlight areas of agreement and disagreement with the methodology presented. In addition, reasons for disagreement and resulting corrections are to be substantiated and explained. This effort should be conducted with intent of (1) extending the critique where needed and making initial theoretical applications of the "new" theories using some of efforts and preparing a test plan for the more critical threats, including the required test equipment and methods.

A87-044            TITLE: Total Dose PROM Test

DESCRIPTION: The object of this program is to measure the total ionizing dose failure on either an ultra violet erasable programmable read only memory (EPROM) IC or erasable programmable read only memory (EEPROM) IC.

The IC is to be selected by the contractor with HDL's approval. The IC will be a current high memory density (greater than either 16k for an EEPROM or 64k for an EPROM), metal-oxide semiconductor (MOS) IC with scaled down geometry (less than 3.5 microns gate length) and will have a good potential for military usage. It will be a US manufacturer's part made with nonradiation hardened process. The device tested will not have been tested before (no existing test data).

Testing will be done at a Cobalt 60 facility in the dose range of 50-200 rad (Si)/s. Alternatively, a linear accelerator (LINAC) with an electron energy greater than 10 MeV delivering a peak dose rate of less than  $5 \times 10$  rad (Si)/s may be used. If the LINAC is used, the number of pulses per second and the peak dose rate will be chosen to deliver an average dose rate of 50-200 rad (Si)/s.

The test shall be a functional test (all memory locations checked) with checkerboard test patterns used in a manner as to insure that any bad address or data line will be detected as an error. Due to annealing effects, the proposal acceptance will be weighted towards continuous device testing as opposed to step testing. For continuous testing, the time between an error's occurrence and detection should be less than 2 seconds. However, if step irradiations are used, the device will be powered during irradiation and unpowered afterward with all pins grounded until tested.

The irradiation steps shall increase by a 5 times multiple of the previous step with details being worked out with HDL. The time between irradiation and the end of the functional test shall not exceed 5 minutes. The minimum testing shall be a read verify cycle for an EPROM. At least 25 parts will be tested preferably 5 samples each from 5 lots and, if there is more than one American supplier of the part, the sample size shall be 15 samples from each supplier, 5 samples for 3 different lots.

The contractor shall supply everything necessary to accomplish the test, pay for radiation facility, and supply HDL with a written report describing as a minimum any problems encountered, The test setup, test procedures, the test conditions, the test results, and the contractor's conclusions. If the contractor chooses to use the HDL Cobalt 60 facility, this shall be supplied as GFE with three month scheduling notice.

A87-045            TITLE: Electromagnetic Field Coupling to a Wire Inside a Metallic Enclosure

DESCRIPTION: Novel ideas and approaches are solicited to understand and predict the coupling of pulsed electromagnetic fields to a thin wire located inside a metallic enclosure. The enclosure is a thin walled body of rectangular shape. The internal electromagnetic fields are produced by the diffusion of the external fields into the interior. The wire is assumed to be in electrical contact at both its ends with the cavity interior wall surfaces. It spans a pair of opposite wall surfaces. The external electromagnetic field has a fast rise time (a few nanoseconds) and a relatively long delay time (a few microseconds). Thus there is significant frequency content in the region from dc to 100 megahertz. The cavity size is not small compared to the wavelengths in the exciting field. The description of the coupled transients, both voltage and current, on the internal wire is required. Of particular interest are how these transients would change due to the variable parameters of cavity size, external field pulse rise time, decay times and polarization.

A87-046            TITLE: Multistatic Radar Technology

DESCRIPTION: Development in this area should examine approaches, concepts and related technology needs addressing multistatic radar issues. Issues of interest include methods of achieving coherency; beam, pulse and burst chasing processing techniques; antenna beam forming approaches, etc. The study should emphasize items such as target and clutter processing, plus techniques unique to multistatic systems.

A87-047            TITLE: Micro-scale, Active Threshold Accelerometers

DESCRIPTION: Electronic fuses for various munitions use simple G-switches for sensing launch acceleration, spin forces, and forces due to target impact. Current G-switch designs are large assemblies of several mechanical parts. In keeping with the trend toward miniature, low cost electronic circuit assemblies in fusing, G-switches that are physically compatible with integrated circuits need to be developed. Nominal requirements for such switches are: manufacturable using integrated circuit related techniques, size on the order of 10 Cubic mm max and a few cubic mm desired, costs on the order of \$0.20 each in quantities of 100k units per year, designs for integration with circuit chips and designs to stand alone in surface mount or hybrid circuit component fashion, voltage switching capability in the range of millivolts to 5 volts, various designs for threshold closure levels in the range of 20 G to 20000 G, and ability to resist closure under vibration levels to 15 G.

A87-048            TITLE: Passive Type Micro-scale Self-integrating Accelerometer (Velocimeter)

DESCRIPTION: The objective is to design, analyze and evaluate concepts for a device to sense projectile and rocket acceleration that will change the state of its output only if the change in velocity produced by the acceleration pulse exceeds a critical level. This sensing and "information processing" function must be performed without external electric power except as discussed below. The sensor is not intended to be an instrumentation grade device; a tolerance of +20% on the velocity change shall be designed goal. This self generating (passive) type sensor, could, for example, generate electrical energy proportional to the change in velocity and store 200 ms, after which it could be interrogated by a fuse a battery powered logic circuits. Fuse power will be available within 200 ms after the start of launch acceleration. The sensor need not be electrical/electronic in nature but a switch closure output or equivalent would be required for an otherwise all-mechanical device. The acceleration pulses to be measured by the sensor are those associated with firing of projectile and rockets. Peak accelerations will range from about 800 G to 40000 G; the pulse duration will range from about 4 to 40 ms; and the velocity change will range from about 250 to 3500 FPS. The sensor will be exposed to angular acceleration coincident with the linear acceleration if used in fuses for spin stabilized artillery projectiles. The effect of such angular accelerations on velocity change measurement shall be accommodated within the +20% tolerance goal. The sensor will also be exposed to shocks produced during and levels to 100,000 G, but the velocity change associated with the shock be designed to survive handling shocks (and retain its "calibration") and not indicate a valid launch. Similarly, the sensor shall not be indicating a valid launch (velocity change) under swept sine and random vibration inputs from 50 to 2000 Hz at 10 G amplitude. The acceleration sensor and associated signal processing system should fit in a volume on the order of 1 cc or less. This volume should include any protective packaging, or shock mitigating material required. The preferred form of

mounting the components is by surface-mount PC board technology. Ultimately, the acceleration sensor must meet all performance requirements over a temperature range of -40F to 140F and not be adversely affected by a storage temperature range of -65f to -165f.

A87-049            TITLE: Fuse Air Flight Sensor for Safety and Arming Projected Munitions

DESCRIPTION: A method or device is needed which will sense air speed or air flight for tube -launched munitions. The required device is a sensor which will transduce some aspect of the air flight environment into an analyzable signature. Approaches which transduce structural vibration or strain waves, which result from boundary layer excitations due to air flow, are currently anticipated. The sensing device will be combined with a processing circuit, whose design is the subject of another task. Together the sensor and circuit will be able to generate an air flight signature and discriminate handling environments and flight speeds of less than 60 fps from flight speeds of 200 fps up to 4000 fps. The output signal will be used in safety and arming of munitions. The sensor may include temperature compensation in its design, but if not, the temperature compensation can be provided as part of the associated processing circuit, which will also provide logic which recognizes preselected characteristics of the flight signature. The task is to design a sensor which: (1) will produce an air flight signature for the given speed range (2) can be contained in the fuse body and which preferably can be mounted on an IC board, (3) does not require ingested air, (4) is small (micro scale is the goal), (5) is battlefield rugged, (6) will be inexpensive to produce in volume, and (7) will work to altitudes of 15,000 ft and at temperatures from -40F to 140F. Post-Launch power will be available for operation of the sensor.

A87-050            TITLE: Fuse Air Flight Signature Processing for Safety and Arming of Projected Munitions

DESCRIPTION: A signal processing technique and circuit is needed to analyze an air flight signature and to produce a logic output for safety and arming decision making. A sensor is being designed, as part of another task, which will transduce some aspect of the air flight environment of a projectile and produce an analyzable signature. Assume that this signature corresponds to structural vibrations induced by aerodynamic excitations in the boundary layer. Assume also that the output from one or two sensors at different locations may be available in the fuse. Design a circuit process that will discriminate handling environments and flight speeds less than 60 fps from flight speeds of 200 fps to 4000 fps. The circuit should provide processing and logic whereby only pre-selected characteristics of the signal. The circuit boards are of less than 1 in.

A87-051            TITLE: Fluidic Amplifiers

DESCRIPTION: The objective of this program is to increase the performance capabilities of fluidic laminar proportional amplifiers (LPA's) in the frequency domain when the control signal of interest is applied to a single control port. During the mid-1970's, scientists at the Harry Diamond Laboratories (HDL) developed second-generation, laminar-flow fluidic components. In the absence of flow noise in the laminar regime, laminar fluidic devices can detect and amplify extremely small pressure and flow signals. The basic building block of second-generation fluidics is the laminar proportional amplifier (LPA). A standard LPA configuration has been in use for many years now at HDL, its geometry is the result of a combination of analytical and experimental investigations. The standard LPA was optimized for use as a differential amplifier; i.e., it operates on those signals applied differentially, in a push pull fashion, to both controls of the LPA. There has been little or no effort to design an LPA specifically for the case where a single control signal is introduced into only one input. As an example, in a fluidic public address system, the acoustic input voice (AC pressure) signal enters one control of a LPA, while the opposite control is intentionally grounded.

Proposed program would investigate and develop new LPA configurations that are specifically designed to accept nondifferential AC inputs signals; i.e., an LPA with only one active control port. Such newly designed LPA's would then be used as the first stage (preamplifier) in a LPA gain block. The rest of the gain block would be made up of standard LPA's. Initial examination of some very preliminary designs of a concept for the new AC LPA already suggest that a single input LPA would have higher frequency response and better gain than the standard differential LPA. This overall task will require both an iterative parametric study and an analytical study of critical dimensions

to identify the optimum geometry. Among the parameters to be investigated are the control nozzle width, the setback of single active control and the splitter distance.

Subsequent research would address overall fluidic circuit design techniques to improve dynamic performance (e.g. to obtain a flat, or at least linear response over a specific bandwidth).

A87-052            TITLE: Optical Protection from Nuclear Thermal Energy

DESCRIPTION: There is a need to prevent high intensity thermal energy (radiated from the fireball of small nuclear weapons) from entering a variety of optical devices. A number of photochromic and electrochromic techniques, which have been developed for other purposes, might be applicable for thermal energy ( which has approximately the same spectrum as sunlight) without significantly interfering with the normal performance of the optical devices before and after nuclear exposure. A survey should be conducted to determine the relative amount of protection afforded by the various techniques as well as their cost, availability and compatibility with militarized optical devices. An analysis should be done to determine if the protective device could operate in the associated non-nuclear environments (neutrons, gamma, blast, EMP). The most promising techniques should be developed and demonstrated in simulated nuclear weapon environments.

A87-053            TITLE: EMP Environment Prediction for Collimated Sources

DESCRIPTION: Develop theoretical framework and computer code implementation of a means of predicting the EMP produced by collimated sources. Techniques are needed to evaluate the possible impact of EMP environments produced by gamma sources and by collimated Compton electron sources in the above the atmosphere. The first step is to predict the EMP environment (electric and magnetic fields) spatial variation and time history for variety of possible configurations involving collimation of the gamma or Compton electron sources in the vicinity of the gamma source. This is an important potential area of concern to electronic system developers at the time when migration of weapon systems into the upper atmosphere and near space is contemplated.

We would like a contractor with previous experience in EMP environment prediction and code building and with a strong theoretical capability to handle new problems in EMP prediction.

A87-054            TITLE: Void Sensor For Artillery Fuzes

DESCRIPTION: Develop a concept for a new method for sensing passage of an artillery round into a void after impact with a masonry or concrete target. The device may be electronically powered and must be small enough to be integrated into the body of the safety and arming device. The void sensor must be cost compatible with the rest of the fuse. An artillery fuze using the void sensor could be expected to cost about \$65 in production. Gross body decelerations of 5000 to 15000 g's with shocks to 100,000 g's can be expected during passage through the target. When a void is sensed after passage through a target the sensor must provide a switch closure or electrical signal to initiate the S&A device.

A87-055            TITLE: Adaptive Control, Nonlinear Multi-axis Vibration

DESCRIPTION: The objective of this program is to investigate concepts and techniques to achieve stable control of field vibration signatures reproduced on state-of-the-art, 3-axis vibration simulator in the high modal density regime (1800-2000 Hz range) causes control instability which leads to system shutdown. The active control method employed, which sets shaker gain based on predetermined drive axis impedance and cross-axis coupling effects, is based on stationary linear control theory. This theory does not account for the nonlinear effects of frequency and time inherent in the system's spatial (#X#) transfer function. Accumulation of control error due to non linear effects may exceeds 20dB and cause 180F phase shift (within a single 5 ms loop) leading to control instability, particularly in the high modal density regime. New adaptive control models/concepts must be investigated to allow for continuous corrections to the spatial transfer function based on frequency, time, and excitation level. The model

must interface with existing digital controller and control algorithm. Concurrently, the research will establish the feasibility of using 3D animated color graphics to assure spatial compliance of nonstationary random vibration in real time.

A87-056            TITLE: Zinc-Air Fuse Power Supply

DESCRIPTION: study the zinc-air electrochemical system as applied to power sources and determine its suitability for application to a fuse power supplies. Packaging size, gun ruggedness and electrical capabilities will be examined and prototype units will be constructed and evaluated.

A87-057            TITLE: Magnetic Gradient Sensor

DESCRIPTION: Design and fabricate a three-axis magnetic gradient sensor to operate over a 20 to 1000Hz frequency range. The sensor will be capable of sensing a gradient from .25mOe/foot to 200mOe/foot. It should have three analog output voltages which are linear over the full specified range. The outputs shall have a noise level equivalent to less than .1mOe/foot over the whole frequency band. The sensor shall be shielded from electronic radiation and fit in a 4"X4"X4"X4" Cube. The sensor shall be mounted to withstand a missile environment of 10G's vibration and 100G's set back. The sensor shall draw less than 100mA from a 28V battery.

A87-058            TITLE: Magnetic Field Sensor

DESCRIPTION: Design and fabricate a three-axis flux gate magnetometer. The magnetometer will be able to sense magnet field varying from D.C. to 1KHz. The sensor shall have a 4Hz wide dynamic notch filter that attenuates the strongest interference signal in the range from 20 to 60 Hz with at least 40 dB attenuation. The sensor will be capable of sensing a field from 1mOe to 10e with at least .1% linearity and less than .1mOe noise over the whole frequency range. It should have an analog output for each axis. This magnetometer shall be shielded from electronic radiation and fit in a 3"X3" X3" Cube. The sensor shall be mounted to withstand a missile environment of 10G's vibration and 100G's set back. The sensor shall draw less than 100mA from a 28Vbattery.

A87-059            TITLE: Commercial Emergency Fuse Power Supply

DESCRIPTION: Assemble commercially available active batteries and/or cells into packages capable of surviving gun fire, i.e., capable of with standing the dynamic gun characteristics of high "g" setback and high "g" spin. units will be configured to be exact size and shape replacements for the military item and which, in case of national emergency, could be incorporated into fuses until such time as production rates of the military version will no longer require their use.

A87-060            TITLE: Numerical approaches to the solution of Electromagnetic Coupling/Scattering Problems

DESCRIPTION: develop new and innovative techniques for the solution of complex electromagnetic coupling and scattering problems. In particular the Army is interested in the development of techniques that can substantially reduce the computer run times and size limitations imposed by extant numerical approaches (e. g., NEC MCM, 3D finite difference code) Main concern is focused on the interaction of the nuclear produce electromagnetic pulse (NEMP) with objects on/in/over a real earth. "The region " which permits innovation in the time variant and non-linear regimes as well as the purely linear regime. Non-linear effects such as corona and arcing are of interest. Environment other than NEMP that are of interest include pulsed microwave fields, MHD-EMP, an electromagnetic environments collaterally produced by SDI weaponry

A87-061            TITLE: Low Cost Miniature DC-DC Converter

DESCRIPTION: The Army is presently developing electronic safety and arming (S&A) systems for use in low cost artillery and missile applications. One vital part of the system is the dc-dc converter which charges an energy storage capacitor. The nominal requirements for this dc-dc converter are operates with an input voltage of 20-40 volts, charges a 0.068 F capacitor to 3kV in 0.5 seconds maximum, provides adequate reliability (depending on specific application), while charging draws an average current of 50 mA or less with peaks of 200mA maximum, has an inactive operating mode which draws 10 mA or less, is compatible with a high acceleration (up to 30,000 G) launch environment, fits in a max space of 0.4 cubic inch with no dimension greater than 1.30 inch and operates over the temperature range of -40 to +70C. One deviation from these requirements which is acceptable is to use numerous available integrated circuits and discrete devices to implement a design which ultimately could be integrated into monolithic/hybrid device which is compatible with the packaging requirements. We would like a contractor to design such a dc-dc converter prototype converters, verify the viability of the design such a dc-dc converter fabricate prototype converters, verify the viability of the design through analysis and tests and provide prototype converters to HDL for further evaluation.

A87-062            TITLE: Low Cost Miniature Energy Storage Capacitor

DESCRIPTION: The Army is presently developing electronic safety and arming (S&A) systems for use in low cost artillery and missile applications. One vital component is an energy storage capacitor for use in the system. The nominal requirements for this capacitor are: stores 150 m Joules at 2-K-volts with adequate reliability ( depending on specific application) reliability interconnects to a low inductance flex print assembly, provides discharge peak current of 30000 A minimum with a maximum rise time of 50 ns is compatible with a high acceleration (30000) launch environment, I cost competitive with extended foil plastic film and low cost ceramic capacitors, fits in a mix space of 0.4 cubic inch with no dimension greater than 1.3 inch, and operate over the temperature range of -40 to +70C.

Extended foil plastic film capacitors with a dielectric stress of 2 KV/mill will meet all of these requirements except size. Some known ceramic capacitors have the potential for meeting most of these requirements but use precious metal electrodes and are far too expensive for these applications. What is required is a new generation of low cost capacitors which make better use of the intrinsic properties of plastic film, ceramic or possibly other dielectric materials than existing capacitors. Both plastic film and ceramic materials have the potential for development into a capacitor which meets the stated requirements. We would like a contractor to design such a capacitor, fabricate prototype capacitors, verify the viability of the design through analysis and tests and provide prototype capacitors to HDL for further evaluation.

A87-063            TITLE: Low Cost Miniature High Voltage Switch

DESCRIPTION: The army is presently developing electronic safety and arming (S&A) systems for use in low cost artillery and missile applications. One vital part of these systems is a high voltage switch. This switch stands off the voltage on an energy storage capacitor and, when triggered efficiently transfer the energy in this capacitor. The nominal requirements for this switch are: stands off 3 KV when triggered passes a circuit of 3000 amps with a rise time of 50-n seconds, has a voltage drop of no more than 300 volts at a current 3000 amps, has a volume of 0.05 cubic inches or less, is low cost (Comparable to commercial grade small signal transistors), has triggering requirements that are compatible with miniature low cost systems, that are compatible with miniature low cost systems operate over a temperature range of -40 to +70 and is not degraded under 20 years of military storage conditions. Other desirable characteristics the switch to be included in a flex print assembly. Three candidate technologies have been identified so far for this application: spark gap switch (modular and printed circuit) avalanche diode (semi conductor-triggered switch), and explosive/plastic film switch. We would like a contractor to review the different technologies for this application, design a switch and trigger circuit which meets the stated requirements, fabricate prototype switches, verify the viability of the design through analysis and tests and provide prototype switches and trigger circuits to HDL for further evaluation.

A87-064            TITLE: Code Reader for Artillery Fuse Setting

DESCRIPTION: The task is to develop a code reader for an artillery fuse. The code reader will read it's from the interior of a stack of three rings with a 1.240 inch inner diameter. The top ring will have 17 circumferential positions and be .200 inches tall, the middle 10 positions at .140 tall, and the bottom 20 positions and be .200 inches tall (yielding over 3000 discrete settings). The output from the code reader should be digital, whether in the form of switch closures or active signals. The code reader can be supplied with power from the fuse battery. The unit should be as small as possible and be able to withstand 30000 G's axial and 500,000 rad/sec radial acceleration at gun launch. The unit must also be very low cost due to the low unit cost of artillery fuses. Current code readers are eight-channel mechanical switches reading one ring which is .500 inches tall with 80 positions around the circumference. Very small switches and optical devices are only possibilities. Modifications to the rings may be made, such as etching electrical patches, printing optical reflectors, and embedding materials to be used by a non-contact (shall effect or inductive) sensor.

A87-065            TITLE: Direction Sensor for Artillery Fuse Setting

DESCRIPTION: The task is to develop a small device to determine the direction of rotation of a setting ring on an artillery fuse. The ring would have approximately a 1.5 to 2 inch i.d. and be .125 to .250 inches thick. The detection would take place from the inner surface of the ring. The detector must be very small, volumes of under .080 cu. In. would be desirable. Low unit cost is also very important due to the low unit cost of artillery fuses. The detector must also be able to withstand launch from an artillery weapon, an acceleration of 300000 G's and 500000 rad/sec radial acceleration.

The detector should be very low power and have a digital output. Detection may be through mechanical, optical, or other non-contact means. Non-contact methods, i.e., low power hall effect, capacitive, or inductive means, would be desirable. The detector should have a resolution of 20 possible state changes per revolution of the ring. The detector circuitry should be as simple and compact as possible, and may be considered separate from the actual detector volume. Modifications to the ring may be made, such as etching electrical contact patches, printing optical reflectors, and embedding materials to be used by a non contact sensor. Any modifications to the rings must also follow the same ruggedness guidelines and be inexpensive.

A87-066            TITLE: Liquid Crystal Display Illumination for Night Use

DESCRIPTION: Develop a low power illumination concept for thin film plastic liquid crystal displays. The LCD has a thickness of .015 in and a width of .75 in and is formed into an arc of 120 degrees at a radius of 1 inch. This display will be mounted on the surface of an artillery fuse and will have minimum intrusion into the fuse body. The concept must be cost compatible with a total fuse cost of \$65 in production. Electrical and non-electrical illumination should be considered.

A87-067            TITLE: Dual Purpose Explosive Output for Artillery Fuses

DESCRIPTION: Current fuses for cargo dispensing projectiles are designed to have their output lead charge initiate a special expelling charge in the projectile. However, these fuses can also be fitted with a high explosive (HE) booster pellet and used to initiate HE burster type projectiles. Since they fit both types of projectiles, the fuse with lead only can be mistakenly used on HE projectiles and this results in a dud. Furthermore, the need for a booster on HE projectiles means two different types of fuses must be fielded where their only differences is the presence of the booster. A preferable situation is one in which a single fuse could be used on either type of projectile without the need for special booster handling procedures in the field. The objective if this research is to devise a new lead charge and explosive interface configuration that can function to properly initiate both HE and cargo type projectiles (propellants, etc.). The current lead charge output must be made more powerful so that it can initiate HE warheads over the long gap presented when the traditional booster pellet is omitted from the fuse/projectile interface. However, the charge must not be so powerful that it vents the pressure cavity sealing required by epulsion type

projectiles. Special flyer plate or fragment output from the lead charge may be required and the solution must be compatible with the design constraints of the explosive train in future artillery projectile fuses.

A87-068            TITLE: EW Vulnerability

DESCRIPTION: The US Army has an extensive program designed to stress developed systems and systems under development to electronic warfare (EW) environments. The objective is to establish or determine each system's performance limitations or vulnerability when exposed to existing and/or postulated EW threat environments. The EW environments consist of active and passive electronic countermeasures (ECM). EW vulnerability can be reduced by the incorporation of electronic counter-measures (ECCM) into the weapon system to harden it against hostile EW. Electronic support measures (ESM) are an integral part of the total EW picture. ESM is used to detect, locate, and identify systems on a modern battlefield. The Army EW vulnerability assessment (EWVA) program seeks technology advances in the ECM, ECCM and ESM areas as well as innovative techniques in the determination or system EW vulnerability.

An innovative technique in EWVA that needs to be addressed is the use of artificial intelligence (AI). The application of the AI should be directed toward the structuring of the EWVA data base to support AI computer-aided EWVA's. This computer-aided EWVA technique will permit the necessary cost control of out-year EWVA programs. EW vulnerability is required for the theoretical, laboratory, and field investigations. In addition, the Army's EWVA program requires applicable advances in the electromagnetic (EM) technology areas involving the following regions of the EM spectrum: acoustic (A), millimeter wave (mmw), infrared (ir), optical (O), and ultraviolet (UV). The trend is to use three or more of these regions in a weapon system which categorizes the system as having multispectral capabilities. Technological advances that can broadband the ECM, ECCM, and ESM areas are required.

A very broad base of scientific knowledge exists in the areas of magnetic fields. However, there are limitations to their applications because of such things as limited detection range capabilities and low field densities, etc. These have limited the uses and applications of magnetic fields for effective CM and ESM use. There is a need to develop magnetic field applications that can be used to complement existing ESM techniques across spectrum. Multispectral sensor technology needs to be developed to permit simultaneous operation across RF, mmw, ir, O, and UV wavelengths.

For ECM advancement there are requirements to address advanced passive ECM, Low observables, and smart munitions ECM techniques. The advanced passive ECM techniques are required for Multispectral ECM environments. The tailoring such as missiles, aircraft, ground vehicles, artillery, and high value assets should be addressed. Smart munitions ECM techniques must be as broadband as possible to minimize the costs of applying them to a wide variety of munitions currently undergoing development.

ECCM advances required are for electro-optical (EO) devices. These ECCM techniques should be used to reduce the ECM effects of lasers against EO devices. The importance of very fast optical switches/filters that can respond to the variable postulated wavelengths of hostile threats should be stressed. Emphasis should be on ir, television (TV), night sights, UV systems, and the human eye.

There is a trend in the development of new weapon systems based on directed energy technology (high power microwave (HPM), high energy laser, particle beams, kinetic energy weapons, etc.). This process requirements for advances in EW techniques to counter their effects/sensors/fire control systems. These sensors include both active and passive systems. The sensors are expected to operate in the microwave through UV regions of the EM spectrum. Advances in EW techniques are required to defeat these sensors to include search acquisition, track discrimination, fire control, and kill assessment. ECCM technology development for hardening against directed energy weapons (DEW) will be required. Near term ECCM technology for protection of U.S. systems against high energy lasers and HPM should be addressed. Far term efforts are required to develop technology for hardening against particle beams.

An important area in assessing the EW vulnerability of systems is the ability to perform accurate EW signature measurements across the EM spectrum. Advances are needed in signature measurements that will not only provide

comprehensive data with the data with the required accuracy, but will also minimize the time in accomplishing the measurements; i.e., minimize cost.

A87-069           TITLE: Satellite Analyses for Special Forces Operations

DESCRIPTION: applications and techniques for utilization of meteorological satellite data are required for use in providing weather intelligence to the battlefield commander involved in Special Forces Operations Consideration is to be given to data acquisition, conversion of the data into intelligence relating to environments effects on operations and equipment, and data displays.

A87-070           TITLE: Model of Port Scatter from Lasers

DESCRIPTION: The contractor will develop a model of the angular scattering pattern from the port optics of laser sources. The model will describe scattering from lasers both with material windows and with cassegranian mirror structure. Material imperfections surface defects, and the presence of dust will be considered.

A87-071           TITLE: Mesoscale Environmental Nowcasting for Tactical Army Operations

DESCRIPTION: techniques and methods suitable for implementation on tactical computer systems are required to provide maximum weather and environmental intelligence from limited battlefield observations of atmospheric and other environmental parameters. Analysis and display techniques are needed to provide a means of displaying current weather conditions over limited tactical area (typically 100 km square) based on various ensembles of environmental data sources and knowledge of terrain and surface features.

A87-072           TITLE: Knowledge Representation for Weather Classification

DESCRIPTION: The use of Artificial Intelligence to determine weather effects requires that efficient schemes for knowledge representation and knowledge acquisition be developed. Innovative projects to develop and test such schemes are needed.

A87-073           TITLE: Non-Emitting Device to Measure Visibility along a Path Length

DESCRIPTION: There exists point source visibility measuring devices that do not emit RF, light, or other radiation while they measure atmospheric turbidity, extinction coefficient, or some other atmospheric parameter which can be correlated to visibility at that single point of measurement.

A87-074           TITLE: Interferometric High-Pressure Sensor

DESCRIPTION: A high pressure, wide bandwidth sensor is required for many research measurements in the ballistic community. The basic concept is to use a monolithic Fabry-Perot etalon constructed of a material such as sapphire at the end of an optical fiber. Physical size of the etalon should be clean limited to maximize response to transient pressure pulses. A miniature monolithic single frequency Nd: YAG laser pumped by a diode laser would be located external to the pressure cell. By generating interference fringes with the etalon inside the pressure cell, changes in pressure are detected by fringe shifts. In order to obtain sufficient signal-to-noise ratio during transient events, the laser should operate power levels of 100 milliwatts or greater and coupling in and out of the system should be done efficiently. Detection can be done with diode arrays (e.g., Reticon or CCD arrays) or Commercial arrays are adequate for demonstration purposes; in application to transient events a development rapid scan array should be available if required. The fiber optic should be mounted in a conventional or easily adapted mechanical fitting adequate to seal the required pressures.

A87-075            TITLE: Instrument for Calibrating Thermocouple Thermometers in High Temperature Gas Flows

DESCRIPTION: A requirement exists for an instrument which can provide routine calibration of small, bare-wire thermocouple in flows of hot gases. The instrument would comprise two separate functions: a means for producing a hot flowing gas over a range of temperatures and velocities (all at atmospheric pressure) and a means for accurately determining the temperature and flow velocity produced. The former might consist of a flat-flame burner capable of providing a region (on the order of a centimeter) of uniform temperature. Temperatures and flow velocities might be selected by choice of fuel gas and equivalence ratio and or use of diluents. Flow velocity might be measured by monitoring the cold gas flow into the burner and combining this data with the temperature of the flow in the calibration region. The most difficult part is the measurement of the temperature in the calibration region. Flow temperatures of at least 1700 C are required (based on using Pt thermocouple) and up to 3000 C desirable (based on tungsten thermocouple). Minimum flow temperature should be at most 800 with somewhat lower temperatures desirable. Since the instrument is to be used as a calibration standard, the error of temperature measurement should be of the order of 0.25%. Such accuracies can easily be obtained by optical fiber thermometry, if proposed, must be both reliable and "turn-key". It is further desired that the instrument be as compact and mobile as possible.

A87-076            TITLE: Radiation Contour Synthesizer/Detector System

DESCRIPTION: A system is needed for training purposes to artificially generate and simulate the measurement of nuclear radiation-like contours, in the "absence" of the radiation. The task is to develop (proto-type) and demonstrate a radio frequency type battery powered sender-receiver system operable over semi-level terrain, within 3 ½ feet of the ground, and to generally function as follows: The hand-held receiver would display a numeric value, both on digital and log scale meter that would change as a function of distance from the sending unit, decreasing numerically with a "reciprocal-of-the-distance-squared" relationship (as if measuring a free field point radiation source) contour pattern of constant numeric value around the separated sending units. The sending unit(s) should have a high/low power setting and be effective to produce a detectable, reliable numeric value (within +/- 20 percent over all ranges) at a radial distance out of 800 meters. A circuit in the receiver should be capable of discriminating low input signals to provide a threshold radiation field). Eventual intent is to incorporate the receiver electronics into present instrument cases to add realism. Size is a constraint, miniaturization is desired.

A87-077            TITLE: Tank Meteorological Sensor

DESCRIPTION: Current fire control algorithms for tank munitions require input data on ambient pressure, temperature and relative humidity. These are now input to the fire control systems by hand; thus, standard conditions often selected to simplify set up. It is desired to take the gunner out of the process by developing a meteorological sensing system which will digitally input to the fire control computer. The system shall be required to sense atmospheric pressure and temperature, with relative humidity sensing desired. These properties shall be sensed external to the vehicle crew compartment in a manner that is not influenced by vehicle exhaust. Incident radiation, and contamination by dust or gun emissions. The sensors shall be sufficiently robust to withstand vehicle motion and weapon firing, including both the main and secondary armament systems. The sensors will be designed for ease of calibration, fault diagnosis and replacement. The accuracy of the sensors shall be: pressure: +/- 0.02 in Hg from 17 to 33 in hg over the temperature range -65 F to +150 F; temperature: +/- 1 deg F; and relative humidity: +/- 3 percent. For initial test purposes, the output of the sensors will be in digital format with compatibility to civilian interface such as RS-232 and formats such as ASCII. Since it is desired to provide good quality within available resources, cost and performance tradeoffs should be identified.

A87-078            TITLE: Transitional Armature for Rail guns

DESCRIPTION: The launch of a projectile from Electromagnetic Rail gun requires that megampere range currents be coupled from rails to projectile by a pair of sliding contacts. Both solid and ionized gas (plasma) contacts have been employed. Solid sliding Contacts work effectively at low velocities providing conduction without head damage to the rails. Barring application of extremely high pressure, these solid contacts become ineffectual above velocities on the order of 1500 m/s. For these higher velocity conditions, contacts massive enough to remain solid under the

resultant frictional and electrical heating would, thus, accrue and waste kinetic energy comparable to that of the projectile. Plasma contacts are effective at high velocities and require far less mass, but being less efficient conductors, produce great heat damage in the rails at low velocities. A "transitional contact would provide low velocity efficiency as a solid contact but would be sized for consumption and conversion (in part) to a plasma contact. Our requirement is for a proven predictive model for the transition. Choice of variables in the model should be such that conclusive tests can be conducted. The response to this request may be so written as to include these tests or to provide information for the sponsor to test premises and final results.

A87-079            TITLE: Insensitive Explosives

DESCRIPTION: Current Army explosive are more sensitive than is desired. In particular munitions loaded with these explosives often sympathetically detonate in their storage configuration and react violently in a fire. Less sensitive explosive, which will make possible less vulnerable munitions, are desired. In addition to sensitivity characteristics, cost processibility, stability in storage and transport, and de-milability are always important considerations in development of explosive formulations.

Composite explosives, which are combinations of a fuel and oxidizer, show promise in meeting the conditions mentioned above. Emulsification of composite explosives is currently being investigated. This process yields smaller grain size and greater intimacy of ingredients as well surrounding each explosive grain with a lubricating integument. All of these tend in the right direction and also tend toward greater resistance to degradation from humidity. The use of solvated explosives, in combination with emulsification, may also be desirable. Solvation may make it possible to incorporate a higher percent of energetic ingredients into an emulsified explosive without raising viscosity.

We seek to develop low vulnerability explosives as energetic as competition B, which will react mildly in a fire when loaded into munitions. Cost, processibility, and stability are factors which will also be considered. We will consider any proposals, but we are particularly receptive to proposals dealing with emulsified explosives.

A87-080            TITLE: Fire Resistant Explosives

DESCRIPTION: The Army has a need for explosives which do not burn at atmospheric conditions but which will detonate in response which do not burn at loading. Such explosives may burn when exposed to a strong heat source, such as a flame or embedded hot fragment but they should not sustain burning when the source is removed. Some degradation of energy is permissible to achieve this objective. We would consider materials with a Gurney energy as low as 1.5 MJ/kg, but more energetic materials are desirable. Ideally the materials should be capable of being processed by casting or extrusion, but pressed materials might also be acceptable. Ideally, the materials should have some small strength, perhaps a yield strength of 100 psi, but pastes and powders would also be considered. The contractor should perform his own screening tests, and the proposal should explain how this will be done. For final evaluations, two kilograms of materials should be delivered for evaluation.

A87-081            TITLE: Strand Burner for Spectroscopic and Photochemical Probing of Burning Propellants

DESCRIPTION: Current studies of solid propellant combustion require advanced laser diagnostics. There exists a need for a strand burner facility that can allow for infrared (10.6 microns) and ultraviolet access for laser induced fluorescence and absorption studies. Also, appropriate photomechanical means should be included to maintain the burning propellant strand burner should be rated for operation studies. Also, appropriate photomechanical means should be included to maintain the burning propellant strand in a fixed vertical position for sufficient signal averaging. The strand in a fixed vertical position for sufficient signal averaging. The strand burner should be rated for operation up to 2,000 psi.

A87-082            TITLE: High Temperature Gaseous Flow Furnace for Laser Photomechanical Studies

DESCRIPTION: Currently, there exists a need to experimentally determine the primary products of laser photolysis where the sample is at a high temperature and high pressure. Primary detection means for Photochemical product detection are emission (e.g., laser induced fluorescence), laser absorption, and mass spectroscopic sampling. The facility needs include a sample chamber in which appropriate chemical (gaseous) samples can be flowed slowly or be kept in a static fill. The chamber has to be windowed to allow ultraviolet (ca. 200nm) photolysis, as well as that by a CO<sub>2</sub> laser (10.6 micros). Also, it has to possess sufficient heating means to assure a thermally equilibrated sample at a high temperature. Furthermore, it should have appropriate sampling means for mass spectrometric sampling. Minimum requirements include high temperature operations to 500 degrees Celsius and pressures up to 20 atmospheres.

A87-083            TITLE: Very High Burning Rate (VHBR) Combustion and formulations Research

DESCRIPTION: Advanced burning rate promoters such as "hivelites" offer increased probability for fielding advanced ballistic concepts.

Both hydride (B10 and B12) salts, in particular, have shown great effectiveness as burning rate promoters in propellant formulations. Current use of these materials is based on Empirical relationships and their mechanism of action is not understood. There exists a need for gaining further understanding of the details of VHBR propellant combustion and ingredient functioning.

The research involves combustion diagnostics and formulations work to examine in detail, variations in burning rate and safety binder, plasticizer and oxidizer species. In addition, the effects of catalysts in promoting the efficacy of boron hydride burning rate additives should be explored. Chemical decomposition and combustion studies of ingredient combustions and propellant samples should be conducted to help unravel the chemical details of the mode of action of the B10 and B12 salts. Finally, quantitative evaluation of the relative importance of physical factors such as density/porosity, particle size and sample mechanical properties relative to chemical effects should be made.

A87-084            TITLE: Titanium Alloy Fins

DESCRIPTION: There is a need to produce high strength-to-weight final sections that can withstand the severe inbore launch cycle and high aerodynamic heating experienced in flight phase. Titanium alloys appear to have the properties if economical manufacturing procedures can be developed. Typically the interior launch cycle may have peak temperatures near 2200 C for periods up to 20 milliseconds. Equivalent stagnation temperatures would be expected from aerodynamic heating for up to 5 seconds. The finished fin must be of a design to provide an aeroballistics efficiency equal to or better than those presently in use.

A87-085            TITLE: Protective Coatings

DESCRIPTION: There is a need for thin, light weight coatings that can be applied to aluminum alloy fins that can provide protection against the high temperature, abrasive environment of the interior launch cycle of tank guns and high stagnation temperature due to aerodynamic heating experienced during flight. The typical interior launch cycle may have temperatures near 2200 degrees Celsius for time periods up to 20 milliseconds. Temperatures due to aerodynamic heating may approach that of the interior cycle for a period of 5 seconds. Protective coatings should not greatly affect the overall ballistic characteristics of the projectile; that is, the basic design drag, spin stability parameters.

A87-086            TITLE: Improved Manufacturing Methods for Producing Steel Fins

DESCRIPTION: The present methods of manufacturing fins for kinetic energy (KE) ammunition requires full machining of all surfaces of the fin units in order to insure straightness and tolerance requirements. An alternative

method of manufacture using injection molded power steel alloys shows promise in producing high quality parts with reproducible tolerances equivalent to machined parts. The use of steel alloys as opposed to aluminum alloy stock will provide higher strength parts capable of withstanding much higher temperatures. Molding also will allow much thinner sections of more complex design, thus improving the aerodynamic efficiency. The requirement is to develop techniques and procedures that can produce high strength parts with tolerances and straightness equal to machined parts that survive the hostile environment and can be produced at competitive prices with existing methods of production.

A87-087            TITLE: Variable Pressure and High Temperature Closed Bomb Apparatus for Laser Ignition and Photochemistry Studies

DESCRIPTION: Ongoing laser ignition studies necessitates the construction of a closed bomb which will allow for both CO2 laser (10.6 microns) and uv laser (193nm) ignition of a reactive gas mixture. This closed bomb should be heatable up to 200 degrees Celsius and be able to withstand peak pressures up to 2000 psi. It should possess appropriate plumbing for rapid sample introduction and evacuation.

A87-088            TITLE: Helmet-mounted Stereo Display System

DESCRIPTION: design/construct/characterize a helmet mounted display system, capable of presenting a different view to each eye so as to produce stereoptic vision. The display would be an attachment to a helmet, and would be fitted with optics necessary to focus images properly within the eye, provide wide-angle viewing, and be used with minimal operator fatigue.

A87-089            TITLE: Flat Panel Display

DESCRIPTION: Devise and construct a flat panel TV-type monitor display, sufficiently rugged to withstand vehicular use, with viewing areas 9-10 inches diagonal measurement. Resolution should be 512 X 512 nominal. Thickness on the order of one to three inches is desired.

A87-090            TITLE: Tracking Laser Data Link

DESCRIPTION: Devise and prototype a laser data link that would consist of a stationary laser source/modulator/receiver and a passive retro reflective mobile modular that could be mounted on a vehicle. The source would track the mobile unit, keeping the reflector/reflector illuminated, would send modulated data to the mobile unit. The mobile unit would keep the reflector/modulator aimed at the laser source to send data. Data bandwidths of 200 MHz are desirable.

A87-091            TITLE: High speed Non-polarizing Light Attenuator for Images

DESCRIPTION: Design and construct an electronically controllable neutral density filter that would provide attenuation of light levels prior to image intensification. The device would act as a front end to an image intensifier to both protect the image intensifier from damage by excessive light levels to allow for the use of night vision devices over a wider range of lighting conditions.

A87-092            TITLE: High Speed Electro-optic Image Shutter

DESCRIPTION: Design and construct a high speed shutter that would allow frame exposures of 0.1 milliseconds or less. An electro-optic approach is desirable. Such a system would be coupled to a high speed video camera unit to reduce motion induced blur in the acquired images.

A87-093            TITLE: High Light Level Image Intensifier

DESCRIPTION: design and construct an image intensifier system that would provide light gains of 20 to 10000, with output light levels on the order of 3000 ergs/square-cm at 570 nm. Such an intensifier would be used on the front end of both electronic and photographic high speed cameras to provide adequate light for recording of high speed events.

A87-094            TITLE: Labnet Operating System and Host Workstations

DESCRIPTION: Design and construct a network of high performance work stations that have ability to launch processes to other stations in the net for parallel processing. The inter-processor communications system and the operation should be transparent to users.

A87-095            TITLE: Fiberoptic Redundant Communications Link Interfaces

DESCRIPTION: Design/construct an interface board that would accept digital data in the form of 32-bit words and would transmit/receive data over fiberoptic links at an 8 MHz word rate. The board would support 6 or more redundant links, could be instructed as to which link to use for a particular message, and would be transparent to data passing through any link not being used by the board.

A87-096            TITLE: High Frame Rate Video Sensor

DESCRIPTION: Design/fabricate/characterize a video solid state area sensor with resolution of 512 X 512 pixels (nominal) capable of providing frame rates of 1000 frames/second or greater, with intrascene dynamic range of 500:1 or more. Such a sensor would be incorporated into a camera and would replace many high speed film camera applications.

A87-097            TITLE: High Speed Data Acquisition System with Direct Link

DESCRIPTION: Design/construct an 8 or more channel data acquisition system with an 8 megabyte/second data rate per channel, capable of writing the data continuously to disk systems at this rate. Such a system should be modular and expandable to more channels. Such a system would be used for image data acquisition, and other high bandwidth applications.

A87-098            TITLE: Embedded Help for Military User-Computer Interface (UCI) Design

DESCRIPTION: work should focus on evolving techniques for aiding operators of computer systems while they are actually operating the equipment. The goal is to recommend standard ways of embedding training/operator aids in the system itself rather than relying on external prompts such as user manuals and cue cards.

Emphasis should be on innovative application of emerging technology such as icons and similar graphic tools. Use of task simulation games and other methodologies which will permit easy updating of information and help techniques as the systems evolve.

Proposals should demonstrate an understanding of the primary problems of the tactical computer environment-unsophisticated users, high turnover of personnel, limited educational background – and how these would be addressed through the suggested research.

A87-099            TITLE: Helmet Mounted Display Eye Sensor

DESCRIPTION: An coulomotor type devices is required for use in laboratory based aviation and air defense human factors research which has the virtual visual Environment Display system (VIVED) developed by NASA's Aerospace Human Factors Research Division (reference: Electronic Engineering Times January 13, 1986).

It is desired that the device provide two capabilities:

1. Provide an output signal which is a measurement of pupil dilation as a response to workload stress which will be correlated with other workload/stress measurement techniques.
2. Provide an output signal which is the x/y coordinate of the helmet display upon which a subject is attempting to focus the eyes.

A87-100            TITLE: Human Factors and Artificial Intelligence for Logistics Planning Systems

DESCRIPTION: There is a need for the integration of advanced research techniques for the application of artificial intelligence (AI) to tactical logistics planning and scheduling problems. AI based decision support systems will be required to enable field logisticians to make maximum effective use of available supplies, storage and transportation assets for effective use of available supplies, storage and transportation assets for combat service support. AI based decision support systems will enhance the prediction of resupply requirements, the allocation of transportation assets, the rapid evaluation of evaluation of alternative logistics support plans, and the determination of stockage, repair and distribution policies. Specific requirements are for:

- a. an active, adaptive user interface to the knowledge based system which can recognize and model the goals, plans and preferences of which can recognize and model the goals, plans and preferences of individual users. The interface will recognize and resolve user-system misunderstandings, correct ambiguous queries, and provide compact, understandable explanations beyond the listing of rules fired.
- b. A blackboard architecture for knowledge representation and effective communications between expert systems with specific domain applications such as inventory management, transportation, resupply requirements, weather, etc.
- c. Interaction with standard operations research techniques such as simulations, graph search methods, statistical analysis, etc.
- d. Analysis and expression of complex goals and constraints which have major bearings on the feasibility of logistics plans.

A87-101            TITLE: Human Factors Engineering Implications of Supervisor Control for Manipulative Robotic Systems

DESCRIPTION: A wide variety of Army applications have been proposed for systems which posses some measure of robotic performance. The robotic capability may be a mobility function or be associated with the specific mission the system performs or both. Many of the missions envisioned for military robotic systems required manipulative capabilities e.g., ammunition handling, explosive ordinance disposal, vehicle refueling , are decontamination. As system control evolves from teleoperation to autonomy the human's role transitions from operator to supervisor (manager). This transitional zone offers many near term opportunities for ford multiplication thru extension of system capabilities, proliferation of unmanned vehicle systems controlled by a single operator training requirements and workloads thru reliance of automated functions.

Supervisory controlled systems impose new, frequency unprecedented demand on the human supervisor and the displays/controls with which he interacted. The principal focus of this activity is the expansion of the empirical database regarding supervisory control regimes for manipulative function of Army interest. The SBIR activity will enhance an existing research activity, the soldier Robot Interface Project, thru which a mobility manipulator equipped robotics/human factors testbed is being developed by the Human Engineering Laboratory. An important aspect of the interaction with the Soldier Robot Interface Project is the requirement for systems to demonstrate proof

of principal for function in the field environment which volume, power and weight constraints have a critical impact on the operational utility of the system.

Specific areas of interest within this SBIR topic include:

- a. A machine world model consistent with human cognition, task is to reduce operator and machine. Workload by enabling high-level communication between operator and machine. World model may require vision or other sensors, and should enable ( or may require) interaction with operator by means of designator, voice input etc.
- b. Operator perception of the machine, or “tele-presence” The operator requires remote viewing with depth perception (stereo vision, orthogonal views), and presentation of encoded sensor information (kinesthetic sensor tactile sense, force/torque, etc.) Presentation of machine world model is also desirable.
- c. Operator control of the machine. The operator must control manipulator(s), cameras, designators(s), displays, and vehicle, perhaps concurrently. Interaction with machine world model is also desirable.

A87-102            TITLE: Nondestructive Evaluation Techniques

DESCRIPTION: Innovative Approaches are necessary to improve nondestructive evaluation (NDE) techniques for applications to structural materials of interest to the Army. Areas being considered for study area

- a. Develop a NDE technique for the quantitative determination corrosion, with novel material discrimination and detection capability. Typical accomplishments for proving feasibility are the separation of aluminum alloys in detection/image processing, the measurement of the ratio of aluminum oxide (hydroxide) to aluminum, and the quantitative determination of water content and it's location in aluminum-containing and other Army component samples. Detection of corrosion in critical areas these samples, such as in delaminations, should be emphasized.
- b. Develop a NDE technique to determine fiber volume fractions at given point within composite materials.
- c. Develop a NDE technique to extract information about the quality individual bonds and layers within thin laminar composite materials.
- d. Develop a NDE technique for prediction of the strength and integrity of adhesive joints between metals, between metals and composites, and between composites of the same or different matrices.

A87-103            TITLE: Protection for Fiberglass Reinforced Plastics

DESCRIPTION: Special characteristics are needed for fiberglass –woven roving laminated structures made with unsaturated polyester resins in combat vehicle applications. These are (1) non-absorption of chemical agents (stimulants) and resistance to DS-2 and super tropical bleach decontaminating agents, (2) retardation of its combustion when in contact with burning diesel fuel or ammunition and not continue to burn when the fire source is exhausted or removed, and (3) resistance to scraping and abrasion. Protection may be provided by (1) external well-bonded layers that might be molded in when the laminate is made or can be applied later (2) one or more ingredients added to the resin before laminating, or (3) by combinations of (1) and (2). Any increase in weight should be limited to 1 pound per square foot and preferably ½ pound per square foot. Strength and other properties of the laminate should be not more than minimally affected adversely.

A87-104            TITLE: Repair of Thick Fiberglass Reinforced Plastic Structures

DESCRIPTION: Novel procedures are needed for the repair of ballistic battle-damaged, reinforced plastic armor structures that are simple, rapid and capable of being performed throughout a wide range of ambient conditions. Temporary repairs will be performed by crew personnel using hand tools with ambient conditions ranging from air temperatures of –40 degrees F to 120 degrees F, and in fair weather and in rain. Whatever is added to make the temporary repair should be easily removable to permit permanent repairs. Permanent repairs will be done by rear

echelon personnel in sheltered situations and having access to power tools. Battle damaged may be only single impacts or multiple impacts closely spaced (3 to 12 inches apart on center). The damage may be holes partially or completely through the armor with surrounding local delamination and laminate deformation. Several temporary repair procedures are needed for achieving the following objectives: (1) sealing the hole or crater to exclude dirt, rain, and snow from the damaged area and to prevent air flow through it. In the case of a through hole access is available only from the inside: (2) in addition to achieving the objectives of (1) above, restore the strength (stiffness/ballistic performance) to at least 75% of the original property. Access is available from both sides. Permanent repairs should restore these properties to the 90 percent level.

A87-105            TITLE: Surface Plasma Fluorination of Rubbers to Enhance Chemical Resistance

DESCRIPTION: Many flexible and resilient rubbers suitable for belts, hoses, and gaskets are not resistant to the deleterious effects of chemical warfare agents and decontaminants. Techniques must be developed to confer chemical resistance to the surface, while retaining the desirable bulk polymeric materials have not produced useful improvements in the barrier properties. Recent methods have been developed for the fluorination of polymer surfaces by means of a plasma generated from fluorination of polymer surfaces by means of a plasma generated from fluorination gases. Utilization of the recently developed surfaced plasma fluorination treatments of rubber materials is desired to reduce or eliminate the sorption of (and degradation by) chemical agents and decontaminants.

A87-106            TITLE: Cure Monitoring of Composites

DESCRIPTION: Real time nondestructive methods are required for in process cure and determination of residual stresses in fiber-reinforced organic matrix composites. Techniques should be capable of operating at cure temperatures up to 350 degrees F in a harsh processing environment such as an autoclave, press cure, or resin transfer molding; and be able to measure stresses induced in a composite structure during cure or as a result of environmental exposure or service conditions.

A87-107            TITLE: Nondestructive Evaluation of Thick Fiber-Reinforced Composites

DESCRIPTION: Novel nondestructive methods are required for real time (or near real time) inspection of thick (up to 2 to 3 inches) fiberglass or aramid fiber-reinforced organic matrix composites. Methods must be capable of determining the quality including delaminations. Methods must be capable of determining the quality including delaminations, porosity, and density variations of large composite structures (10 X 4 feet) that have sweeping or complex curvatures.

A87-108            TITLE: Processing of Organic Matrix Composites

DESCRIPTION: Novel approaches are being sought in the processing of organic matrix composite materials to include:

- a. Development of a computerized model which will predict the flow of liquid resin through thick (1"-2" thick) laminates in the resin transfer molding process. The model would subsequently be used to drive a control system for the resin transfer molding process.
- b. Methods for producing sandwich structures using continuous fiber-reinforced thermoplastic matrix skins. Techniques for establishing bond strength criteria in a continuous fiber-reinforced thermoplastic matrix sandwich structure. The core of the sandwich structure is preferred to be honeycomb. Novel approaches using structural foam core will be considered.
- c. Methods for readily impregnating continuous high strength fibers with thermoplastic resins for use in subsequent fabrication of advanced composite structures via processes such as pultrusion or filament winding.

A87-109            TITLE: Innovative Machining Techniques

DESCRIPTION: The development of innovative material removal techniques as well as cutting tool materials and geometries for the machining of ceramic and metal matrix composite work pieces is desired.

A87-110            TITLE: Low Cost, High Performance, Ceramic Materials

DESCRIPTION: High Performance ceramic armor materials are expensive and because of this their applications are limited to date, low cost ceramic armor materials have exhibited low performance. To meet current Army requirements, ceramic armor must be more widely used. Innovative materials processing techniques are sought to produce low cost high performance ceramic armor materials.

A87-111            TITLE: Ceramic Materials for low Heat Rejection Diesel Engines

DESCRIPTION: Advanced diesel engines with minimal or no forced cooling is desired for Army applications. Key to obtaining such engines are structurally sound ceramics and ceramic coatings capable of maintaining mechanical and physical properties and dimensional stability with time in an engine environment. Innovative materials and processing techniques sought.

A87-112            TITLE: Improved Optical/Electro-Optical Materials Processing Methods

DESCRIPTION: Innovative technology is required to increase performance, availability and reduce costs of optical/electro-optical materials for Army systems. Areas of importance include:

- a. Hard Optical Coatings: Broadband sensors require hard, erosion-resistant coatings which are transparent from ultraviolet, through the visible, well into the infrared radiation wavelengths. New concepts for such coatings compatible with state-of-the-art optical materials are desired. Such concepts should also address the practicality of operating reliably and being reproducible in production mode.
- b. Single Crystal Growth: Many applications for single crystal optics are limited by size, perfection and cost of currency available single crystals. New or Innovative methods of crystal growth aimed at addressing the above issues for materials such as Lithium Niobate, Strontium Barium Niobate, Gallium Arsenide, Indium Phosphide, or Magnesium doped Lithium Niobate are desired.

A87-113            TITLE: Shock Absorber Filler Materials

DESCRIPTION: Metal ceramic composites are currently used for armor applications. A filler material is used between materials in a metal/ceramic/metal composite. The choice of filler is based on its ability to minimize the shattering of the ceramic when impacted ballistically. Innovative filler materials are sought to improve structural integrity.

A87-114            TITLE: Effect of Weld Discontinuities on the Mechanical Properties of Armor

DESCRIPTION: In order to develop standards for acceptable weld discontinuities in Army vehicles, experimental data is required on the effects of discontinuities on armor. Welding discontinuities of interest include cracks, mechanical properties are ballistics, fracture toughness, should be Mil-A46100 high-hard steel, Mil-A-46027 (5083-H131) aluminum, MIL-A-46063 (7039-T64) aluminum, or 2519-T87 aluminum.

A87-115            TITLE: Fluid Flow Past Complex Configurations

DESCRIPTION: Much progress has been made in the last decade in generating numerical procedures for solutions of both integral and differential equation formulations for fluid flow past complex configurations. Such subject areas as turbulence model formulations, unsteady flow, viscous phenomena, heat transfer and interacting or interference flows together with accompanying mesh generation and computer architecture coupling have been considered for a variety of applications. The time seems to be appropriate to encourage innovative research and development approaches for integrating some of these advanced methodologies into practical analysis tools for various types of relevant configurations. Accordingly, the Army Research Office seeks small business sources for development of innovative research and development efforts for generating ad hoc analysis tools for strongly 3-D flows such as in skewed rotating channels, rotor tips, blade-fuselage juncture, angle-of-attack bodies, etc. Of special interest are situations of aerodynamically loaded bodies period moving past attached structures, such as occur in small turbo machinery components or helicopter blade fuselage configurations. Complex and Practical 3-D geometries should be the focus of such work. Augmentation of these tasks by various experimental studies for verification of concepts and the generation and/or use of benchmark experimental results for calibration of generated software might also be considered.

A87-116            TITLE: Optical Control of Microwave/Millimeter wave Devices

DESCRIPTION: Microwave systems such as radar and communication systems which require phased array structure have increased in complexity and accuracy. Improved control and faster switching speeds have become inevitable for steering beams in phased array radars. Steering these beams is conventionally done by shifting the phase of individual amplifiers/antenna modules using microwave control devices. These devices are controlled electronically. Improvements can be made in the control of these devices by the use of optical control. Some advantage of optically controlling microwave devices is short response times, high signal isolation, system flexibility, immunity to electromagnetic interference, low cost of fiber, and lightweight.

The principal goals of this program will be to (1) investigate an integrated optical/microwave GaAsFET and/or PIN device to control the phase of a microwave signal (2) investigate the feasibility of an optical/microwave monolithic phase shifter for use in high volume phased array systems and (3) investigate fabrication techniques for this type of configuration that are compatible with proven microwave monolithic fabrication techniques.

A87-117            TITLE: Digital Spectroscopy of Piezoelectric Crystalline Media

DESCRIPTION: Apply the methods of digital spectroscopy to the precision determination of the effective permittivity and attenuation tensors of single crystal and composite structures comprised of piezoelectric crystalline media at microwave, millimeter wave and optical frequencies as functions of temperature and orientation. These basic material properties are required to be known to greater precision in order to more accurately design acoustic wave devices at higher frequencies and take full advantage of advances in circuitry. The objective is to achieve improved low noise oscillator design for air defense radar receiver application.

A87-118            TITLE: Components for Rechargeable Ambient Temperature High Energy Lithium Batteries

DESCRIPTION: The Army requires a high energy (lithium) battery chemistry which can be used in either rechargeable or throwaway mode for training or combat applications, respectively. For such applications, a cell must utilize low cost materials, must possess a theoretical energy density well above 300 watts/ib., must have the capability for providing internal current densities up to 5mA/cm<sup>2</sup> and must be capable of operating over the full military temperature range. These goals will be furthered through the development of new cell components including:

- a. Low cost, high energy, positive plate materials and positive plates.
- b. New chemically and electrochemically stable low cost, high conductivity electrolytes compatible with high energy electrodes

- c. Coatings and additives for improving the storage and recharge ability of the negative plate.
- d. New microporous battery separators which will resist lithium dendrite penetration and possess resistance to highly corrosive electrolytes such as SO<sub>2</sub>-LIAICl and either solutions containing halogens

A87-119            TITLE: Millimeter-Wave Semiconductor Wafer Probing

DESCRIPTION: With affordability becoming an increasingly important issue, MMIC's will find increasing application in Army systems. MMCI's will have significant cost impact on a wide variety of systems, including smart munitions, wideband EW warning receivers and phase array radars and jammers.

A major cost factor in the manufacturing of MMIC's is the test and screening of the individual circuit dies. This problem becomes even more acute as more functions are integrated on a single chip (i.e., T/R Module) and as frequency of operation is extended into the MMW region. Automated RF wafer level probe stations are commercially available today and most producers of MMIC's use of some form of automated RF testing. The available equipment allows for automated wafer level calibration and corrected vector measurements to about 18 GHz. The RF probes employ co-planner waveguide structures in order to transition from the test equipment to the GaAs wafer. At frequencies beyond 18 GHz cross coupling between the signal and ground lines increases along with insertion loss and measurement accuracy is significantly degraded. This project will develop probe structures which will permit accurate automated RF wafer level measurements at MMW frequencies up to 40 GHz. This capability will allow for testing of MMIC's prior to being diced and mounted in a test fixture, resulting in a significant cost savings for MMW smart munitions and sensors, EW phase array jammers and phased array radars and ELINT warning receivers. This program will directly address the Army goals of affordability, producibility, low cost and packaging density.

A87-120            TITLE: Surface Acoustic Wave (SAW) Band Elimination Filter

DESCRIPTION: Perform a study which addresses the technology necessary to use high SAW resonators to perform a frequency band notch or band elimination function. The study will then be applied to model/breadboard devices verifying concepts. The filters shall be monolithic, applicable to the UHF range and address the following target specifications, notch width of less than 0.01% with the lowest skirt ratio possible, notch depth of greater than 50 dB and attenuation of less than 2dB in the pass band. Temperature stability is an essential parameter for very narrow notch filters and must be considered in the selection of substrate material. Low power dissipation, compact temperature compensation schemes may be considered.

A87-121            TITLE: Crystal Plate Angle Correction for Precision Quartz

DESCRIPTION: The frequency versus temperature characteristics of crystal resonators depends primarily on the angles of cut of the crystal plate. State-of-the-art cutting techniques cannot provide the angles of cut accuracies required for the high yield fabrication of precision resonators. Cost effective methods of correcting and maintaining the angles of cut subsequent to cutting need to be developed. Of special interest are SC-cut resonators, are expected to be the principal cut accuracies of a few seconds of arc are required in some critically important applications.

A87-122            TITLE: Epitaxial Gallium Arsenide Layer Growth on Silicon Substrates

DESCRIPTION: Large, high quality gallium arsenide substrates for discrete microwave, millimeter wave devices, the proposed millimeter wave integrated circuits (MMIC) and high speed digital signal processing applications which have good mechanical strength and thermal properties are needed for DoD systems. The present bulk wafers (GaAs) are limited to three inch diameter and their mechanical and electrical properties are not sufficiently uniform for projected high quality production needs of DoD.

A87-123            TITLE: High Efficiency Monolithic Gunn Oscillators

DESCRIPTION: GaAs Gunn diodes have uses in many microwave/millimeter wave systems. Missile seekers, low power radars, EW jammers, and communications links all utilize Gunn diodes as oscillators for power generation. Presently, the microwave/millimeter wave performance of these devices is below potential. Next generation Army systems will need to incorporate a Gunn diode and its matching circuit onto a single substrate.

This monolithic approach has the following goal:

- a. To lower the per-unit device cost by eliminating discrete device labor intensive fabrication procedures.
- b. Improvement of reliability, uniformity, and reproducibility by overcoming fabrication difficulties associated with discrete devices.
- c. Reduction of size and weight achieved by incorporating the matching circuit and the device on the same substrate.
- d. Better performances due to the reduction of device to circuit transition parasitic.

A87-124            TITLE: Models for Multi-Region SAW Waveguides on Anisotropic Substrates

DESCRIPTION: To develop an analytical model which describes the behavior of surface acoustic waves (SAW) traveling within a S.W. transducer whereby the transducer structure is viewed as an acoustic waveguide consisting of three distinct regions: metal (i.e. bus bare); semi-metal (i.e. electrode region) and free surface. The program would have the following goals:

- a. Develop the saw waveguide modeling techniques necessary to analyze the complex transducer structure that results in achieving the desire modes of propagation that in turn significantly improve SAW device performance.
- b. Develop methods for modeling the effects of SAW substrate anisotropy in the waveguide model.

The results of this effort would provide the basis for developing a wide range of high performance SAW devices including band pass filters with 75-80 dB of out of band rejection; low-loss band pass filters with 2-4 dB insertion loss and pulse compression filters with 40-50 dB time side lobe suppression.

A87-125            TITLE: Millimeters Wave InP Device Structures

DESCRIPTION: Millimeter wave missile/submunition sensors require high efficiency/power and low noise Gunn devices at frequencies to 300 GHz. InP and its related materials are superior to GaAs in both efficiency and output power. Theoretical efficiency of an optimized InP Gunn oscillator with uniform E-yield is 45%. However, at present this figure is limited to 7-9% using VPE grown current-limiting cathode device structures. This program is to address optimized profile Gunn devices in InP, GaInAs, and GaInAsp by use of MOCVD technology wherein doping layer control is typically 20Å. Various profile Gunn devices structures are to be grown, processed, packaged, and evaluated for performance at 100 GHz. Device design is to be optimized using graded-drift region, Schottky barrier, ohmic contact and current limiting cathodes. Discrete and planar/monolithic device structures are to be addressed.

A87-126            TITLE: Ultrahigh-Speed GaAs/AlGaAs Heterostructure Devices

DESCRIPTION: future military requirements for real-time information acquisition and processing in tactical EW, DC3I, and smart munitions establish a need for ultra large-scale and super high-speed integrated circuit microelectronics. New classes of solid state devices such as quantum-well super matrix structures and selectively doped heterostructure transistors, promise the possibility of ultrahigh-speed (picoseconds) switching and high frequency (10-100 GHz) mm-wave components for microwave/microelectronic integration. These devices exploit the concept of one-, two-, and three dimensional electron confinement through the use of molecular beam epitaxy (MBE) and ultra fine lithographic techniques. Application of patterning methods such as e-beam direct write with plasma etching (RIE, RIBE, ion, milling) is required for fabrication of these device structures having feature sizes

from 100A to 1000A. Damage effects, noise figures, and high frequency response and logic delay times are to be studied through electrical characterization.

A87-127            TITLE: Heterostructure Launched Gunn Oscillators

DESCRIPTION: Next generation smart missile and munitions systems will require high efficiency/power and low noise solid-state millimeter wave oscillators at frequencies to 100 GHz. In particular, these devices should be designable for monolithic integration for low cost and weight considerations. Present solid-state materials selection for monolithic integration is limited to III-V compound semiconductors, in particular GaAs and AlGaAs. Current GaAs Gunn device structures are characterized by low output power, frequency of operation, and efficiency which, in turn severely limits present system performance. An approach which shows promise in advancing the state-of-the-art in millimeter wave oscillators is the GaAs/AlGaAs heterostructure launch Gunn structure which offers a new technology input for the increased control of efficiency power. This program will address the basic fundamental design considerations of this device structure, identify the various modes of operation, designs for launching of a Gunn dipole or accumulation layer, placement and composition of the launching region, relevant output power and efficiency, and planar versus discrete device construction.

A87-128            TITLE: Heterojunction Double Barriers for Logic Circuits

DESCRIPTION: Heterojunction double barriers which have a negative resistance region are potentially a high speed logic storage device. Such a device would be driven by the high impedance of a transistor collector. Calculations of the characteristics of such a device geometry.

A87-129            TITLE: Radiation Hardened Crystal Oscillators for Clocks and Frequency Standards

DESCRIPTION: Evolving C, navigation, radar and IFF systems require ever tighter tolerances on frequency standards and Clocks. As the tolerances become tighter, the radiation-induced frequency shifts become an increasing portion of the tolerances. For some systems currently under development, the radiation-induced frequency shifts are a major limitation on the achievable system performance. Novel methods of reducing the frequency shifts due to low and high levels of ionizing radiation (gamma rays, X-rays, neutrons) need to be developed.

A87-130            TITLE: Comprehensive Computer Models for GaAs IMPATTs

DESCRIPTION: GaAs IMPATT devices generate more power, both pulsed and CW, with higher efficiency, than any other microwave/millimeter wave solid state device. Improved accuracy of computer models is needed to improve and speed up design procedures. For millimeter wave operation this is particularly true because many physics of device limitations remain unknown.

The principal goal of the program will be as follows:

Utilizing DC, small signal analysis, large signal analysis and an accurate thermal model, develop software that will enable the user to calculate any of the vital characteristics of IMPATT diodes. The following stipulations apply:

- a. The software must be flexible enough to allow the user to change any parameter in regard to device material, structure, size, doping, DC and RF operating characteristics, operating temperature, thermal resistance and other important considerations.
- b. It should be kept in mind that the purpose of the software will be for two major uses, that of design and optimization of doping profiles and for the analysis of existing profiles.
- c. The software should be able to plot the calculated E-field, hole current vs active layer depth.

- d. The software shall be able to analyze all types of structures including hybrid, single and double drift.
- e. The software should be IBM PC compatible, and written in PASCAL.
- f. Deliverables will be one or more 5-1/4 inch floppy disks with the software on it, and a commercially produced PASCAL compiler.
- g. Complimentary sub-programs may be included.

A87-131            TITLE: Optically Isolated Sensors for Megawatt Components

DESCRIPTION: Efficient, reliable megawatt electronics for advanced tactical and strategic weaponry requires optical isolation of sensor signal feeding command/control logic. The power levels needed for future weapons such as electromagnetic launchers, microwave weapons, lasers, particle beams are so high that existing isolation techniques will not protect the low voltage computer-controllers. The sensor signals include pulsed voltages across multi-kilo ampere switches which vary in voltage from tens kilovolts to a few hundred ampere to megamperes in a millisecond or less; timing signals with 100 picoseconds jitter. The goal is to devise passive optically isolated sensors that derive their operating power from the signal it is measuring, though tens of hours of battery powered operation would be acceptable. Approaches should include the use of electro-optic, Faraday rotation, and similar techniques. Active techniques include the use of a laser diode probing signal transmitted to the device to be measured via fiber optics with the return signal converted to analog or digital voltages at the computer-controller.

A87-132            TITLE: Microwave/Millimeter Wave RF Interaction Circuits

DESCRIPTION: RF interaction circuits are required which provide the necessary interaction with electron beams for high efficiency, wide operating bandwidth and low cost manufacture. Emphasis is directed to innovative fabrication techniques such as developed for solid state IC's but using vacuum qualified materials such as BeO, BN, and Cooper.

A87-133            TITLE: High Current Density Electron Emitter for Vacuum Electronics

DESCRIPTION: New Microwave Power Generators, Oscillators and Amplifiers require electron emitters (cathodes) that will viably provide high electron currents, 100-10,000 amperes (Current densities of 100-1000 (a/cm<sup>2</sup>). Emission materials must be investigated and cathodes fabricated to demonstrate high current. A secondary effort requires life test under pulsing conditions to achieve long life in vacuum environment of 10<sup>-6</sup> to 10<sup>-6</sup> pascals.

A87-134            TITLE: Computational Techniques for RF Circuits and Electron Beams

DESCRIPTION: Modeling of vacuum electronics devices such as traveling wave tubes, crossed-field amplifiers and electronics devices such as traveling wave tubes, crossed-field amplifiers and relativistic-interaction devices is critical to avoid false starts and expensive hardware fabrication. Computer simulation will avoid costly experimental development and provide a substantial theoretical baseline from which to develop improved classical tubes and discover mechanisms for advance tube designs.

A87-135            TITLE: Composite Applications for he Counterobstacle Vehicle (COV)

DESCRIPTION: Phase I – Study to investigate and recommend weight reduction through the use of composite or other lightweight structural materials on the mine plow, telescopic arms and other appropriate components. Change of materials shall not degrade current performance subsystems. It is describe to reduce major subsystem component weights by 50%. Phase II – Design, Fabricate, Integrate and Test one telescopic arm on the COV using recommended materials changes.

A87-136            TITLE: Quantification and Measurement of Visual Bireflectance Distribution for Decoys

DESCRIPTION: Phase I shall the capability of the Bireflectance Distribution Function (BRDF) or an alternative approach to specify the needed visual replication parameters for decoys. Equipment needed and measurement procedures shall be identified and bread boarded for the best technical approach. The realism of a decoy is highly dependent upon the resemblance of color, reflectance, and texture to the object it is to simulate. Presently, the replication of most complex 3 dimensional objects having shadows and depth consists of painting a two dimensional fabric panel. A means is needed to define, measure, and establish tolerances for the replication. The Bireflectance Distribution Function is believed to be one potential solution. Presently available commercial gloss meters have not proven useable due to the low (usually5%) reflectance of the real object. Phase II shall provide a prototype measurement system and demonstrate the technical feasibility of specifying visual parameters of decoys. Supporting test and evaluation shall be performed.

A87-137            TITLE: Foam Air Decoys

DESCRIPTION: Research of materials and concept development for determining feasibility of fabricating two and three dimensional decoy devices using flexible foam air inflatable beam molding techniques that store in small volume, low weight and provide rapid deployment. Phase I shall study and establish the concept of inflatable foam with hybrid support means to be technically feasible with small scale alternate material demonstrators for decoys. Phase II shall provide selected full scale, large volume, decoy material demonstrates with supporting test and evaluation to evaluate concepts.

A87-138            TITLE: Research in Materials with Dual Radar and Thermal Suppression Characteristics

DESCRIPTION: Research in materials and/or coatings that have both radar absorbing properties and low emissivities in the infrared wavelengths Phase I theory and material feasibility explored. Phase II sample materials should be produced and submitted with test data verifying the thermal and radar characteristics. Thermal data should include low emissive in infrared band, reflectance spectra from visible through infrared, and thermal imagery. Radar data should exhibit good attenuation by absorption and/or scattering in X band radar.

A87-139            TITLE: Advanced Field Fortifications Protective Structure Systems or Weapons/Personnel Positions

DESCRIPTION: development of an advanced lightweight and deployable structural system for protection of battle field weapons and personnel positions. The goal is to enhance fortification capabilities on the Modern Airland Battlefield to protect the individual soldier, his equipment and weaponry. (Tent-type above ground shelters, are not to be considered viable candidates for the purpose of this effort.) Effort will consist of two phases: (1) study to identify viable candidates to include evaluation of their logistics burden and (2) prototype fabrication for demonstration and evaluation of the best technical approach

A87-140            TITLE: Universal Cleaner for reverse Osmosis Water Purification Unit Membranes

DESCRIPTION: Fouling of the RO membranes is a principal obstacle to the continuous, steady, and rated output of potable water from the field Army Mobile Water Purification Units (ROWPUs). The fouling can take many forms including organic slimes, microorganisms accumulation, and inorganic scale. Also, the degree and type of fouling is a function of the three different membranes currently being used. A universal cleaner is needed which will remove the fouling material quickly and effectively without damaging any of the different type membrane being used.

A87-141            TITLE: Hybrid Circuit Designs for Power Processing Applications

DESCRIPTION: It has been shown that multiple discrete transistors can be interconnected in parallel on a common heat sink and integrated with control logic and driver functions in a package to form a high capacity to combine these functions on single substrates for higher reliability and lower weight and volume. The purpose of this effort is to investigate hybrid circuit designs combining logic and protection circuits with power devices for application in power processing.

A87-142            TITLE: Improved Chlorine Feeder for Reverse Osmosis Water

DESCRIPTION: The disinfection step is a way important unit operation in the total Reverse Osmosis Water Purification Unit (POWPU) treatment scheme. It is essential that the chlorine be delivered continuously and precisely. The present feeder does not operate satisfactorily on the high test calcium hypochlorite mandated for use. Insoluble calcium hydroxide and calcium carbonate cause clogging and other problems. A new feeding system is needed to handle Ca (OCI<sub>2</sub>).

A87-143            TITLE: High Energy Density Storage System

DESCRIPTION: build and test a 1 kw prototype of a battery which could be rechargeable, have an energy density greater than 3 times a lead-acid battery, have a long storage life, have a short activation time and be low cost. The system should be scalable for the development of larger storage systems.

A87-144            TITLE: Automated Intelligent Power Distribution Modules

DESCRIPTION: Tactical military systems are heavily dependent on electric power. For efficiency and to reduce the logistics burden of supplying electric power in the field, user equipment is often interconnected with a distribution system to a central generator set. It is desirable to apply load management techniques to these distribution systems to allow load shedding, duty cycle scheduling and graceful degradation under adverse conditions. The objective of this effort is to investigate the development and application of "intelligent" load management and power distribution modules.

A87-145            TITLE: Weld Aging of 7005 Aluminum Alloy

DESCRIPTION: There is a need to field weld repair structural aluminum alloy 7005 and to speed-up the aging process of the alloy beyond the 21 days now required to reach its high yield properties. There have been reports of the use of sub resident vibration of materials to effect stress relief and/or stress redistribution. Since part of the process of material aging is an establishing of a stable stress level, the treatment of new weld metal deposits to sub resident vibration energy input may serve to speed up the aging process. An evaluation program to compare 7005 welded Samples subjected to sub resident vibration during and/or after welding to unexposed weld samples by tensile testing could be explored in a Phase I program. If results proved positive, then Phase II could be used to determine effects on the full range of mechanical properties for all 7005 series aluminum.

A87-146            TITLE: Aluminum Welding Radiographs, Development of Standards

DESCRIPTION: There exist graded radiographic standards for steel welded (ASTM E390), however there are no graded radiographic standards for welding of wrought aluminum only reference radiographic. The use of grade welding radiographs developed using steel material continues to generate contractual administrative problems when there is a need to quantify (grade) aluminum welds. Welded aluminum materials are being designed into increasing numbers of military items in order to take advantage of the lighter weight material. Graded aluminum radiographic for incomplete penetration, lack of fusion, tungsten inclusions, fine scattered porosity cause scattered porosity, clustered porosity and linear porosity for various thickness ranges, for example 0.03", 0.08", 3/16", 3/8" and 3/4 "

are needed. The ascertaining of aluminum radiographic data bank along with their reference descriptive data for use by evaluations to formulate the base II in which specific graded radiographic, standard welded blocks, and consensus standard are developed would be the goal.

A87-147            TITLE: Tactical Deception Infrared Signature/Generator Alternatives

DESCRIPTION: Phase I shall research alternative means of replication IR/thermal signature in the form of a two dimensional panel IR/thermal signature in the form of a two dimensional panel It is intended that these panels be employed in decoys simulating combat vehicles. Selection of best alternative shall include RAM, safety, weight volume and overall feasibility considerations. Phase II shall research and develop a means to power the two (2) dimensional panel resulting from Phase I efforts. Selection of power source alternative shall be based on Phase I considerations with special emphasis placed on safety (currently, gasoline generators represent a safety hazard when field deployed).

A87-148            TITLE: Lightweight Low Emissivity Materials

DESCRIPTION: Research in lightweight materials which are flexible, drab color, heat resistant, and suppress thermal radiation. Phase I theory and material feasibility explored. Phase II sample materials produced and submitted with test data to support required characteristics. Data to include reflectance spectra from visible through infrared, thermal imagery, emissivity measurements.

A87-149            TITLE: Low Cost Dual-Polarized Microwave and Millimeter Antenna Designs

DESCRIPTION: Innovative designs for dual-polarized microwave and millimeter antennas that may be used in a monopulse configuration for seekers and sensors are needed. The design must feature the potential for low cost production and integration with monolithic microwave and millimeter integrated circuit technology to provide a low cost front end for sensor or seeker applications. The design may feature any number of basic antenna approaches, including arrays of elements, or primary feed and reflector with producibility a key element in the approach.

A87-150            TITLE: Highly Oxygenated/Low Hydrogen Content Plasticizers for Solid Propellants

DESCRIPTION: Minimum smoke solid rocket propellant requires larger amounts of oxygen in the combusting materials to achieve a minimum or no smoke production and eliminate afterburning. The problem has been that oxygen in the energetic groups such as nitro and nitrate in plasticizers such as nitroglycerine, have increased oxygen at the expense of making the propellant sensitive to shock, friction and impact. What are needed are plasticizers which have significant amounts of oxygen, similar to nitroglycerine, but do not have the sensitivity of nitroglycerine. Also, low hydrogen content plasticizers offer potential advantages of signature reduction, increased energy, and improvement of propellant physical properties. Desired properties of the new plasticizers would be to have low vapor pressures, similar to the adipates, have low crystallization temperatures and be thermally stable to 74 degrees C and have a freezing point about -30 degrees C.

The investigation should identify potential liquids which are highly oxygenated and/or relatively low in hydrogen content to be used as plasticizers for solid propellants. In addition, effort should be directed towards obtaining from commercial sources a number of candidates which could then be compounded with other typical propellant ingredients formulate one or more typical solid propellants. Finally, a synthetic effort to obtain any outstanding candidate(s) that had been turned up the literature survey or in professional discussions would be initially with the candidate(s) submitted to formulation in a propellant.

A87-151            TITLE: High Altitude Plume Modeling

DESCRIPTION: In a high altitude maneuvering interceptor vehicle, content jet and/or main propulsion system motor plumes can expand to very high angles. The exhaust jet materials will create an obstruction to rarefied high speed approach flow and produce very complex gas dynamic interactions. The exhaust gases may contaminate sensors and windows on vehicle compromising the effectiveness of the vehicle. The low energy boundary layer of the exhaust jets is the primary source of potential contaminants. Innovative approaches to the solution of these high altitude, rarefied expansion and interaction regions are sought. New idea for gas dynamic modeling techniques applicable to free molecular transition, and continuum flow regimes are needed to produce comprehensive solution to this complex problem.

A87-152            TITLE: Video Image Overlay

DESCRIPTION: A technique or device is needed which allows the simultaneous display of several synchronized or unsynchronized video images. The images should be displayed on single monitor with each image having independent control for parameters such as brightness, contrast, and to number of pixels occupied. It is important to display these images real-time without processing delays. The display should be updated television frame rates.

A87-153            TITLE: Compact Near-Millimeter Wave Sources

DESCRIPTION: There is a need for small, compact, and rugged sources to operate in the 0.7-2mm wavelength region. Such a source would probably solid state. Presently, available sources are limited to either laser that requires bulky CO2 laser pumps or backward wave oscillators to require large power supplies. Output power requirements are 100 microwatts required, 10 milliwatts desired

A87-154            TITLE: Automatic On-Line High Strength Fiber Optic Splicing

DESCRIPTION: Manual optical fiber splicing techniques are presently employed to repair broken optical fiber links. These techniques are by time consuming and labor intensive. To date, no on-line repair method exists for correcting fiber breakage associated with production-wound fiber optic bobbins or cable packs. Current techniques lack automated control and quality inspection units that are required for automated on-line splicing of optical fibers that are wound using an automated winding system. This project will analyze system requirements and develop a concept for low cost, automated, on-line system capable of producing high strength fiber optic splices to repair fiber broken during winding. The concept resulting from this effort will provide for a "menu-driven" computer controlled system which will result in limited specialized operator training, manual intervention, and will substantially reduce the time and labor required to perform the task of splicing the optical fiber, thus allowing greater productivity by the user.

A87-155            TITLE: Environmental Effects on Optical Fibers Wound Under Tension

DESCRIPTION: optical fibers designed for military applications must maintain high strength and uniform optical properties over long storage life (10 years). Use of optical fibers in guided missile applications poses special problems in environment effects that are distinctly different from those in the commercial sector. The fiber must be wound, under tension, onto a tapered spool to be played out at high speeds. Stress corrosion caused by water vapor can degrade the mechanical properties of the fiber under stress during long-term storage. Further, the adhesive used as a binder for cable pack stability, can cause defects in the fiber buffer coat when stored in various environments.

The objective is to provide research on the degradation of the mechanical and optical properties of fiber-optic bobbins under simulated environmental conditions. An integrated program to investigate the simulated environmental effects on optical fibers for guided missile applications is needed in order to understand the interrelationship between the variables including: bobbin design; tension profiles; adhesives; fiber types including

both single mode and multimode, with and without hermetic coatings. An important part of the investigation is to also understand the differences in affects caused by an aluminum bobbin vs a composite bobbin.

A87-156            TITLE: Water Canteen Temperature Maintaining System for Combat Vehicles Crews

DESCRIPTION: Study and develop a concept for keeping the available portable water supply in a combat vehicle at such a temperature that will encourage the crew to drink it. At present, the plastic water container and crews personal canteen are affected by the vehicle interior temperature which could rise 20 to 30 degrees above the ambient temperature in all buttoned up missions. Thus it is very difficult to encourage the crew to drink sufficient water needed to keep up with their body electrolyte balance. Some type of technique is required, that would consume very little or no power, at least for water canteen temperature control.

A87-157            TITLE: Robotic Vehicle Mission Packages

DESCRIPTION: The capability for a combat vehicle to accomplish a mission has been driven in the past by human control requirement. The concept of robot vehicles accomplishing missions performed originally by soldiers will result in more efficient, smaller and potentially more potentially more productive robot systems. The reduced volume, elimination of controls (pedals, handles, knobs, etc.) microprocessor management, reduction of crew interior volume, sensor improvements for machine and human remote control can now be realized in robotic combat vehicles. Robotic sensing systems might include but not limited to, stereo thermal imaging, NBC contamination, mine detection, terrain typing, vehicle following, etc. Techniques described above can be applied to a number of robotic missions the Army will consideration include tactical reconnaissance, NBC reconnaissance, mine detection, rearm, refuel, decoy, etc.

A87-158            TITLE: Robotic Vehicle Command And Control

DESCRIPTION: The Army is interested in the remote management multiple robots from a single command center. The operation of the robot vehicle will be simultaneous with no degradation in system effectiveness. In order to control multiple robots simultaneously, new techniques in operation interface are required. The operators will manage up to a platoon of four or five robots from a single Robotic Command Center(RCC) located in a manned close combat vehicle operating in concert with the robots. The requirements for the RCC to operate on the move, also constrained by the small volume within the combat vehicle, require a new approach to controls and displays for the robot operator. Control of the robots, the remote displays or information being processed considered by the operators must be controlled through optimized operator interfaces. New techniques in interactive aids displays technology, voice control, vehicle status indicators, decision aids for single and multiple robot control and other human interface augmentations are required before the full combat benefit can be realized for robotic combat vehicles.

Techniques described above would supplement on going joint ARMY/DARPA robotic vehicle programs. Simulation of the capability would be considered an essential first step in the implementation of the techniques in the ARMY/DARPA programs.

A87-159            TITLE: Development of Dust Detector for Combat/Tactical Vehicles

DESCRIPTION: failure of air cleaner systems is a major cause of engine failure. TACOM is currently investigating various methods of detection and alarm when particles are entering the engine. Methods include acoustical electrostatic, light scattering and laser defraction. It is not clear what approach is optimum or whether investigations to date have been comprehensive. Requirements exist for inexpensive sensor with simple warning to the operator and for more elaborate systems which provide data with prognostic potential. Examples of this data would be particle size distribution, concentration (grains/ft<sup>3</sup>) and total ingested mass.

A87-160            TITLE: Vehicles Instrument Panels

DESCRIPTION: Vehicle instrument panels are an item that has never received a great deal of attention. Fabrication costs and maintenance and installation effort could be reduced. Panel configuration could be less restricted.

An instrument panel could be considered as an adapter between input connectors and gauges. Input connectors could be located at a convenient location. All gauges and switches could be face mounted. The panel could be solid, insulated block with internal wiring between input and output with connection for test instruments.

A87-161            TITLE: Military Diesel Engines

DESCRIPTION: The general needs of military diesel engines include extended fuel tolerance, extended environmental tolerance, increased RAM-D, increased fuel economy, improved transient response, high power density and reduced specific heat rejection.

Some key technology areas which will allow advancement in the above area to be accomplish include: (1) high temperature engine materials and tribology systems, (2) fuel injection systems for better light load and idle fuel economy, (3) fuel and air systems for combustion control, (4) high efficiency, broad range turbo-machinery (providing APU functions if possible), (5) full authority engine control, (6) techniques for friction minimization, (7) cold start techniques, and (8) variable valving mechanisms.

Work efforts which address the above areas would be most relevant to the enhancement of military diesel engines.

A87-162            TITLE: Diesel Engine Reliability/Durability Aligorithm/Methodology

DESCRIPTION: In the process of the assessment/selection of an engine for a given military vehicle, the task which presents the greatest difficulty and yields the most uncertain results is the determination of reliability and durability. Basically, this is due to he large number of complex factors and interrelationships involved. However, for military vehicle applications, the task is further complicated in that (1) the military rating of an engine is often considerably higher than the commercial rating and (2) the military environmental conditions are considerably more severe than encountered under commercial use.

As a means to upgrade the reliability/durability assessment, there is a need for the development of an algorithm/methodology that will (1) address all of the diverse parameters and processes involved, (2) accept the design and operational input criteria required, and (3) calculate a valid prediction of reliability and durability for an automotive diesel engine.

A87-163            TITLE: Computer Aided Design (CAD) for Producibility

DESCRIPTION: A need exist for the ability to assess producibility considerations during the design conception of a given component. Ideally, one would want inherent in a CAD system, the capability to optimize apart design from a manufacturability perspective during or following the design of the part. This could be a powerful tool for part design and for evaluation of a given design for producibility review purposes.

A87-164            TITLE: Vetronics Laboratory Equipment requirements

DESCRIPTION: There is a need to determine what kind of laboratory/field equipment is desired for efficient integration of electrical/electronic systems in military ground combat vehicles.

Some of the military vehicle systems that would require VETRONICS application are as follows: fire control, stabilization, engine control, integrated defense, and target acquisition system.

A87-165            TITLE: Robotic Laboratory Equipment Requirements

DESCRIPTION: The objective of the robotic laboratory/field testing is to evaluate advanced techniques in remote operation on ground combat vehicles, digital terrain displays, computer-aided packages and demonstrate military potential of advance robotic vehicle and technology.

To fulfill the Army requirements for robotic vehicles, there is a need to determine in advance what kind of laboratory and field equipment is required to conduct laboratory field testing in order to evaluate the robotic concepts and systems.

A87-166            TITLE: Portable Electrical Components

DESCRIPTION: The cost of cost of electrical boxes in combat vehicles could be reduced, along with a reduction in maintenance costs and an increase in reliability if the electrical boxes are designed as modules. Materials and assembly costs would be reduced. Modularization would reduce the size of the units and replace maintenance and repair operations by the simple replacement.

Electrical boxes, such as a switch box or control box could be made of bare components encased in plastic or some other insulating material. Other boxes could be investigated for adaptability to similar fabrication techniques.

This project consists of fabricating electrical boxes, calculating their cost on a production basis, and testing those boxes in a combat vehicle.

A87-167            TITLE: Track Standing Wave Analysis

DESCRIPTION: At higher speeds, the momentum of the track on tracked vehicles forms standing waves. These standing waves absorb power and reduce drive train efficiency. The hysteresis of rubber bushings in single pin tracks or the hysteresis of the rubber surrounding the pins in double pin tracks dampens the standing waves to an acceptable level. However, the rubber material on tracks is a prime cause of failure and represents a large portion of the life cycle cost of the track. It would be possible to use a more rugged and less costly unbushed track if a means could be found to externally dampen the standing wave formation.

The project would consist of performing analysis on single pin bushed, single pin unbushed and double pin tracks. The analyses should consider using either front or rear sprocket drive with or without support rollers. The analyses should determine track motion, force, and energy, and a critical damping factor should be derived in each case.

A87-168            TITLE: Vehicle Input Loads

DESCRIPTION: Vehicle input loads remain an educated guess. There are no agreed upon parameters to which suspension systems and frames of vehicles can be designed. Competing companies are thus each designing a vehicle to the same set of requirements, but using different parameters.

Existing literature and company standards should be compiled for suspension input loads as a function of vehicles type, terrain, and speed. Loads should be listed as multiples or the acceleration of gravity(g's). If a standard were derived from these tables, vehicles could be designed by different from these tables, vehicles could be designed by different companies to the same set of boundary condition.

A87-169            TITLE: Quick Disconnect Coolant Hose Clamp

DESCRIPTION: A major cause of engine failure in combat vehicles is loss of coolant, resulting in engine overheating. Cooling systems consist of a myriad of hoses connecting radiator(s), expansion tanks, engine and

auxiliary coolers, Silicone or rubber hoses are connected to aluminum or steel fittings with heavy-duty automotive screw actuated band clamps. Connections may be "blind" causing incorrect installation, hoses deteriorate and harden, clamps fail, resulting in loss of the engine.

A quick disconnect hose clamp is envisioned that will have the following features:

- a. Easy to use
- b. Prevent long term coolant leakage
- c. Maintenance free
- d. Compatible with silicone hose

In addition, the quick disconnect hose clamp will not require tools during installation and removal.

A87-170            TITLE: Field Remanufacturing/Rebuild

DESCRIPTION: If failed parts could be remanufactured or rebuilt in the field, the burden on supply channels could be eased and vehicles could be returned to service sooner. In many cases parts or assemblies could be modified to take advantage of a remanufacturing capability.

The first part of the project would consist of tabulating failed parts by frequency of failure and also by the critically of the failure to operation of the vehicle. Each failed part would then be analyzed to determine the feasibility of remanufacturing or rebuilding it under field conditions.

The second part of the project would be consist of selecting or describing machines that would comprise a flexible machining system would have to be transportable on one or more tracked or wheeled vehicles.

A87-171            TITLE: Barrierless Air Cleaner (Non-Electrostatic)

DESCRIPTION: To develop a non-electrostatic barrier less air cleaner that has no moving parts has a 99.5 dust removal efficiency on AC course and obtains a minimum 50-hour service life to 20 inches of water pressure drop. Today, air cleaners require frequent servicing in dusty conditions and pose a contamination risk factor to media material and maintenance personnel during cleaning in a NBC environment.

Exploratory development concepts will be evaluated to determine approach feasibility. Mathematical modeling and parameter generated studies will be formulated to provide performance predictions. Successful paper study will provide for continued breadboard evaluation of lab working model in Phase II.

A87-172            TITLE: Time Domain and Frequency Spectrum Analysis

DESCRIPTION: Develop software to conduct a menu driven Time Domain and Frequency Spectrum (TDFS) signal analysis on an IBM PC/Compatible Computer (MSDOS 2.0). This software will be comprised of commercially available TDFS signal analysis software modified to incorporate a user friendly menu operating system to allow the operator easy access to all the TDFS signal analysis programs contained in the software. The software would be required to analyze Time Domain and Frequency Spectrum waveforms ranging from 0 to 1 sec and 5 msec data resolution and 0 to .2 MHZ with 20HZ data resolution, respectively. In addition, the software would contain search routines that would be able to locate specific signal waveforms stored in various storage mediums (i.e., floppy disks, hard disks, etc.) and store them in a standardized format.

A87-173            TITLE: Improved Optical Materials and Materials Processing Methods for Eye Protection

DESCRIPTION: The need for eye protection for combatants is currently provided by googles that use polycarbonate lenses. To improve the versatility of such lenses, new transparent materials are needed that are hard, scratch

resistant, lightweight, transparent throughout the visible region, easily coated, and readily available. New concepts for ballistic lenses are desired. Such concepts should also address the practicality of being reproducible in production. The capability of being a corrective lens is desirable.

A87-174      TITLE: Radiographic Layer Counter for Composites

DESCRIPTION: The Army helmet is a composite composed of layers of resin-bonded Kevlar. Currently, verification of the integrity of the helmet is by ballistic testing. This project requires the development of a hand-held instrument, possibly containing a radiographic energy source, to determine the number of layers of Kevlar at any particular location in the helmet.

A87-175      TITLE: Ballistic Face Shield with Deicing/Defogging Capabilites in Extreme Climate

DESCRIPTION: The Explosive Ordinance Disposal (EOD) Community is currently being outfitted with an EOD Body Armor System to protect against fragmentation from military munitions and Improvised Explosive Devices (IED). EOD Body Armor System includes a face shield that attaches to a chest plate and rests in a pocket on the front of the jacket. The face shield is a composite structure consisting of 3/8" acrylic and 1/4" polycarbonate laminated at the interface with a thin polyurethane film. Extreme Climate conditions limit the use of the system. Ice and fog build up in arctic conditions (-30 degrees F) along with fog build up in tropic conditions (100 degrees F at 90% RH) impede the vision of the wearer, not allowing him to complete his mission. The need is for a ballistic face shield that eliminates ice and fog build up in these extreme climate conditions.

A87-176      TITLE: Energy Absorber for High Speed Airdrop

DESCRIPTION: Future Army personnel airdrops will require higher aircraft speeds (up to 250 knots) at time of jump to decrease ground fire vulnerability. The current Army 150-knot airdrop system does not provide sufficient protection for the paratrooper from the high, opening-shock force at higher speeds. A small, light weight, energy absorption device between the parachute and the paratrooper is needed. This project calls for the design, manufacture and lab-test of such a device.

A87-177      TITLE: Thermo Electric fan

DESCRIPTION: There is an Army requirement to circulate the heated air produced by non-electric military standard heaters. Current standard military tent/barracks stoves only have the capability to transfer heat by radiation and natural convection in which heated air rises to the top of the tent creating substantial vertical temperature gradients. The objective of the work is to develop a thermo-electric tent fan that converta a portion of the heat output of the standard Army tent/barracks heaters, through the use of thermo-electric modules, into 5 watts minimum, of electric power to rotate a fan to produce at least 390 CFM air flow. The thermo-electric power until will also have the capability to provide electric power (5 watts) for lights, radios, and other low power electric equipment. This auxiliary power can be supplied by disconnecting the fan or providing an additional power unit.

A87-178      TITLE: Target Acquisition Reduction Evaluation of Camouflage for Personnel

DESCRIPTION: To date, the evaluation of camouflage measures have been subjective. This project will attempt to provide an objective means of determining the increased survivability of a soldier provided by the camouflage pattern being evaluated. An algorithm is needed to permit the objective determination of Target Acquisition Reduction (TAR) afforded by camouflage to personnel in various environments. This proposal should include probability of detection capabilities, commensurate with the present state-of-the-art, and result in an objective method for the assessment of camouflage effectiveness.

A87-179            TITLE: Radar Signature Reducing Fabric

DESCRIPTION: This project is to develop a fabric suitable for uniforms, parachutes, and other personnel items that would provide a stealth-like capability against radar detection. This protection would be accomplished by reducing the radar signature by reflecting, scattering, or absorbing microwave energy in a manner similar to that of the surrounding environment. Additional desirable characteristics of the fabric include; suitability for printing with camouflage patterns to provide protection against visible and near infrared detection, flame protection, and overall durability.

A87-180            TITLE: Integrated Lightweight Combat Boot

DESCRIPTION: There is a requirement to develop a lightweight combat boot to protect the soldier from chemical and environmental threats, while still providing necessary traction and comfort. Ballistic and fire resistant materials will be incorporated into the design. The boot will partially or completely eliminate the need for chemical protective over boots depending on degree of protection capabilities. The boot will be for both temperate and desert environments, provide easy donning and doffing and be part of the chemical protective ensemble.

A87-181            TITLE: Real Time Method to Determine Even Deposition of Fungicide in Textiles

DESCRIPTION: clothing, uniforms and textiles that are in storage can be damaged or destroyed by mildew and fungus. A means of preventing this deterioration is by application of suitable fungicides such as copper-8-quinolinolate or 2, 2 methylene bis-4-chlorophenol. A critical factor in the success of this method of treatment is the evenness of distribution of fungicide on the material. Currently there is no method available to measure this uniformity. This project is to develop a nondestructive and nondamaging method of determining the uniformity of applied fungicides on textiles.

A87-182            TITLE: Combat Vehicle Track Temperature Sensor

DESCRIPTION: The tracks and track pads of combat vehicles undergo buildups in temperature in excess of 300 degrees F. The work described here requires that a non-contact sensor be developed to measure track temperatures. The sensor must be ruggedized to withstand the harsh environment, be capable of providing continuous temperature readings, have an output of 0 – 5 volts, and provide temperature readings accurate to +/- 10 degrees F.

A87-183            TITLE: Diesel Engine Fuel Consumption Measuring System

DESCRIPTION: Provide a system that can be temporarily installed in the vehicle fuel system to measure fuel consumption during field operations. The measuring system should not significantly alter normal vehicle operation. The system will have the capability of measuring the mass flow consumption rate over the range of a few pounds per hour (pph) to 1300 pph. System power will be supplied at 28VDC and the output signal should be in the 0 – 5 volts range with a 2.5% error in the consumption measurement.

A87-184            TITLE: Mechanical Shock Sensor

DESCRIPTION: A need exists for a passive (i.e., self contained, nonelectronic) mechanical device that is reasonably inexpensive to be used to measure ballistic shock. Velocity changes in the range of 1. to 50 meters/second need to be measured. A device using the “Taylor technique” (used to determine dynamic yield strength by measuring deformation of cylinders impacted at known velocity) or an improvement of the “Multiple Mechanical Gage” developed by NOL (see NOL Technical Report 76-151, available through DTIC) might be appropriate, if the gages could be made cheaply and read easily. If a peak acceleration technique were used, a 10 KHz frequency response (pot a 10 KHz resonance) would be desirable, and an acceleration range of 100 to 20000 g’s would be desirable.

A87-185            TITLE: Ballistic Shock Simulator

DESCRIPTION: A need for a machine capable of simulating high frequency mechanical shock transients. A technique (preferably non-pyrotechnique) for generating transient velocity changes of .1 to 50 meters/second containing high frequency acceleration levels (100,000 to 1 million g's at 100 KHz to 1 MHz) to a test item of 1 to 100 kg is needed. The only known device capable of approaching these requirements is a large, outdoor, pyrotechnique facility run by IABG in West Germany.

A87-186            TITLE: Improved Blast Overpressure Transducer

DESCRIPTION: A need exists for an improved blast overpressure transducer to operate in the 1 – 100 Kpa region. It is desired that this transducer be of "blunt cylinder" configuration, with the sensing membrane flush with the top surface for clean aerodynamic coupling. DC frequency responses are needed for ease of calibration. An upper frequency response of 100 KHz with no overshoot, or 300 KHz if undamped is desired. The transducer must be capable of driving 200 meters of cable with at least 50 KHz frequency response. Very low sensitivity to acceleration and thermal effect is needed. See report number APG-MT-5481 "Improvement of Air Blast Measurement" by W. Scott Waiton (March 1981), which is available through DTIC, for a description of the limitations of transducers currently available.

A87-187            TITLE: High Output Microbial Aerosol Generator

DESCRIPTION: A requirement exists for a field aerosol generator for operational detection and decontamination testing. The aerosol generator must produce droplets with aerodynamic diameters between 2 – 5 micrometers with microbial suspending fluids (1 g/cm). Output capacities must be between 500 – 1000 mi/min at pressure around 75 PSI. Multiple nozzle capability should be incorporated into the design.

A87-188            TITLE: Real Time Smoke and Aerosol Analyzer

DESCRIPTION: The current method of measuring smoke and aerosol mass concentrations using filters and bubblers is both labor intensive and slow. The development of an inexpensive, portable instrument capable of continuous sampling and real time analysis for use in the field is desired. The use of light scattering as the quantitative tool is undesirable because the wide range in particle size distribution, shape and obscurant material (both liquid and solid) would make calibration difficult. Among other possibilities, photo acoustic spectroscopy or magnetic susceptibility, etc., might be useful as quantitative tools.

A87-189            TITLE: Meteorological Influence on Smoke/Obscurant Effectiveness

DESCRIPTION: The U.S. Army conducts smoke/obscurant field tests to determine the relative screening effectiveness of different smoke/obscurant materials or dissemination systems and to identify degradations in effectiveness that occur over time as a result of storage (stockpile reliability). Screening effectiveness is documented by electro-optical measurements, photographic coverage, meteorological measurements, and observer responses. Comparisons of screening effectiveness for different materials or systems and for the same material or system before and after storage are complicated by the fact that the effects of trial-to-trial variations in micro scale to mesoscale meteorological conditions can mask significant differences in performance. To assist in these comparisons, there is a need for a reliable objective, and quantitative means to account for meteorological influences on apparent smoke/obscurant effectiveness.

A87-190            TITLE: Laser Testing on Open Ranges

DESCRIPTION: Lasers can be used in field testing of battlefield obscurants to characterize the obscurant properties and to determine how the lasers are defeated by the obscurant. In realistic situations, test ranges up to 5 km may be encountered. Wavelength from ultraviolet to the far infrared is used.

The hardware for both generating the laser signal and for measuring the effects of the obscurant, i.e., attenuation, scattering, bending, blooming, must be developed. Operating procedures and safety contrasts for personnel and wildlife must also be developed.

A87-191            TITLE: Wind Tunnel Development

DESCRIPTION: A continuing mission of DPG is to sample airborne particulate material in field tests. Before conducting field test for particulate materials, samples must be calibrated to determine their collection efficiency. On-going requirements exist for evaluation of smoke/obscurant source burn rates and expenditure testing. In the past, the existing wind tunnel facility at DPG has been used to perform those functions. Results indicate that the tunnel facility has many uncontrolled factors that are limiting its usefulness. Nonuniformity in the wind stream and particulate concentration can be considered to be contributing to the uncertainty of the results. Also, a more efficient method for disseminating particulate material into the tunnel must be developed. The instrumentation for the wind tunnel is inadequate and should be updated for accuracy, control and efficiency.

A87-192            TITLE: Infrared Radiance instruments

DESCRIPTION: Instruments to measure the infrared radiance of background, targets an obscurant cloud at various wavelengths, similar to instruments available for measuring luminescence in the visible part of the electromagnetic spectrum are required. Data on radiance and contrast in the infrared region are frequently critical for determination of the performance of various types of electro-optical devices. They are also useful for the purpose of mathematical modeling. They are also used to determine the absorptive and radiative characteristics of obscurants.

Automated instruments that have high repeatability and self-contained calibration systems need to be developed.

A87-193            TITLE: Tracer for Visualization of Physical Removal of Warfare Agent Simulants

DESCRIPTION: spraying a vehicle with a high pressure water jet to remove chemical warfare agent contaminant is an example of physical removal. Effectiveness of proposed decontamination devices of this type can be quantified on a laboratory scale through techniques such as extraction or even direct weighing of the test surface at appropriate intervals. The purpose of the proposed work is to develop a tracer material which can be added to agent simulants employed in large scale decontamination testing or training vehicles. Operators should be able to see the tracer disappear as simulant is removed. Means suitable for use in remote areas must be developed to determine amount of tracer present and relate that to mass/meter<sup>2</sup> of stimulant remaining on the test vehicle.

A87-194            TITLE: Image Analysis Enhancement for counting Fibers and Florescent Particles

DESCRIPTION: This study will support outdoor diffusion trials and NBC contamination/decontamination programs requiring the use of fluorescent particles. The current method of fiber counting and fluorescent particle analysis is tedious and physically tiring. A requirement exists to utilize current image analysis instruments (Zeiss IBAS 2000, or Cambridge Quantimet 920) and develop software/hardware to be able to efficiently count fibers and fluorescent particles.

A87-195            TITLE: Quartz Crystal Delta-Temperature System

DESCRIPTION: Dugway Proving Ground performs testing in the ambient atmosphere where micrometeorological measurements are required. A prime measurement requirement is for temperature at 2, 4, 8, and 16 meters, to be used in gradient computations. Current temperature measurement accuracy is limited to 0.1 degrees Celsius. Accurate gradient computations require measurement accuracies near 0.01 degrees Celsius. The current temperature measurement systems provide voltage outputs, and accuracy is limited by noise on the order of 60 millivolts. Quartz crystal thermometers use changes in crystal oscillation frequency to measure temperature. Because the output is a frequency rather than a voltage, line losses and random millivolt noise have no effect on data accuracy. This would permit temperature measurement accuracies near 0.01 degrees Celsius. A 4-level temperature/temperature differential measurement system based on quartz crystal technology would be of great interest to the Dugway Meteorology Branch and other agencies engaged in the micro meteorological measurements.

A87-196            TITLE: mm-Wave Radar for Cloud Mapping

DESCRIPTION: A record of the internal structure of smoke obscurant clouds generated during tests would be of value. Millimeter wave radar with 7.5 meter range resolution and 0.5 degree angular resolution may be an appropriate technology for this purpose. Investigation of optimum frequency, optimum generated power, and the effect of polarization on backscatter is required. Development of empirical relationships between backscatter intensity and smoke concentration for various smokes is needed.

A87-197            TITLE: Vapor or Aerosol Decontaminate for Chemical Warfare Accents

DESCRIPTION: Current methods of decontamination use strong bases or oxidizers to wash contaminated surfaces. These methods are very destructive to reactive metal surfaces. These methods are very destructive to reactive metal surfaces and to sensitive components, such as electrical and optical devices.

It is also difficult to decontaminate interior spaces with limited access. The development of an effective non-corrosive decontaminant that can be applied as a vapor or as aerosol fog and that doesn't need to be washed off is desired.

A87-198            TITLE: Aerosol Sampler for Fibers

DESCRIPTION: Materials with high aspect ratios (fibers) are being developed as obscurants. No suitable method exists where these materials can be collected on a scanning electron microscope grid for timely physical characterization. Fibers with aspect ratios of 2X10 (2 micrometers X 4 X 10mm) Must be sampled without physical damage.

A87-199            TITLE: Wind and Energy Budget Measurement System for Desert Terrain

DESCRIPTION: An innovative meteorological measurement system is needed to provide ground truth data for remote sensing of surface temperatures and energy budgets over desert terrain in support of test missions. Automated instruments for easy deployment in mountainous terrain at ten remote sites are required to measure wind speed and direction, long wave and shortwave radiation, soil temperature and moisture, air temperature and relative humidity. The system should include a two second sample frequency with on-site data storage capabilities. Data are stored in digital form on cassette tape during specified field programs and later processed on a VAX11/785 computer at a command center.

A87-200            TITLE: In-flight Vehicle Attitude Measurement

DESCRIPTION: A method of accurately measuring the attitude angles (pitch, yaw, and roll) of vehicles in flight. The types of vehicles of interest include rockets, projectiles, and fixed and rotary wing aircraft. Priority will be given to methods which do not require equipment on board the vehicles. Measurement accuracy in the neighborhood of 0.1 degree in each axis is required. Vehicles in flight will be at altitudes from near ground level to 100,000 feet. Measurements are required while the vehicles are under going tests. Velocities will range from hovering helicopters to missiles traveling at rates as high as 15,000 feet per second.

A87-201            TITLE: Real-Time Image Processing System

DESCRIPTION: Methods for performing real-time (60 frames/sec) image processing are required. Hardware architectures that process all pixels in a single raster scan in parallel is envisioned. Simultaneous multiple raster scan processing is desired to increase speed and permit the use of processing techniques such as median filtering. Processing techniques to be used with the computing hardware are required. Feasible image processing techniques that are feasible on the design hardware shall be identified. The entire system will be used to improve images that are used by an automatic target image tracking system employed for missile test range instrumentation. The image trackers are used to track missiles, rockets, and aircraft in flight.

A87-202            TITLE: Development of "Smart Robot" for Fast Burst Reactor Maintenance

DESCRIPTION: Research into the concept of remotely controlled robotics for service and maintenance of fast burst reactors. The robot would be operated in a high radiation environment.

A87-203            TITLE: Multi-Sensory Tracking Mount Control

DESCRIPTION: A test range instrumentation tracking mount will be equipped with TV, IR, millimeter wave radar, and telemetry tracking sensors. Development of a comprehensive algorithm to use outputs from all of these sensors simultaneously for tracking mount control is planned. Techniques of real-time adaptive parallel processing are desired. Algorithms, parallel processing hardware configurations, and software specifications for the final system design are needed.

A87-204            TITLE: Signal Security for Video (Television) Signals

DESCRIPTION: WSMR has a requirement to relay real-time television signals containing classified scenes from remote areas to the Range Control Center in a secure manner. A system is required to provide signal security for fiber-optic or microwave transmission of these real-time television signals. The proposed system shall have the following characteristics:

- a. Utilize and be compatible with data rates of National Security Agency (NSA) encryption devices.
- b. Provide signal security for National Television Standards Committee 60 fields/second, 525 lines/frame color video signals.
- c. The transmit end of the system shall accept a one volt peak-to-peak analog video signal as an input and provide output signal compatible with an NSA encryption device.
- d. The NSA decrypter on the receive end of the system shall accept the encrypted signal and output the original one volt peak-to-peak analog video signal.
- e. Have two 15 KHz bandwidth secure analog channels.
- f. The system may employ video compression techniques
- g. Be compatible with existing WSMR video data reduction criteria
- h. Be video scene independent
- i. Accept and process playbacks from video tape recorders that are not time base corrected.
- j. Be compatible with existing digital data range transmission standards, i.e., T1, T3, etc.

A87-205            TITLE: Real-Time Measurement of HCl Gas

DESCRIPTION: There is a need to perform real-time measurement of HCl gas in the ranges of 0.10-10.0 ppm and 1.0-100 ppm. HCl is a component of certain missile exhaust gases. In certain concentrations and durations, there is a severe health hazard to personnel. The instrument must be capable of quantifying the concentrations of HCl over short time intervals of 1-10 seconds, 1-30 seconds, and 1-60 seconds. The time for the instrument to rise to 90% of the maximum value should be less than one second.

A87-206            TITLE: Feasibility of a Mobile Drone Formation Control System (DFCS)

DESCRIPTION: Provide an analysis of duplicating, to a maximum degree, the WSMR DFCS as a fully mobile land based target control system. Provide a feasibility concept and preliminary design or such a system if practical.

A87-207            TITLE: Mobile RF Interferometer Antenna Array (2.2-2.4 GHz)

DESCRIPTION: The current interferometer antenna arrays are fixed placements and are limited to specific areas of coverage. Studies have indicated that an array that would lie within an area of 30 feet by 30 feet would provide the required accuracy for short range coverage. However, there does not exist data to support the feasibility of such a small array. Also to provide the required accuracies, the relative positions of the antennas within the array must be maintained to within 3 millimeters both in vertical and in horizontal directions. The desired result of such a study would be the design of an antenna array that would meet the mobility requirements as follows:

- a. Disconnect from receiver equipment and ready for transportation shall be less than four hours.
- b. Deployment and hookup at a new tracking site shall be less than four hours.
- c. The volume of coverage shall include the following: Azimuth – 360 degrees and Elevation 0 to 90 degrees.
- d. The array, when in the transport mode, will meet the size and load limitation requirements of the Department of Transportation of New Mexico.

A87-208            TITLE: Telemetry Digital Tracking System Research

DESCRIPTION: The thrust of this research is to determine to what extent and how the two types of telemetry tracking systems, each having two distinct servo loops, can be upgraded to purely digital tracking system. All tracking modes shall be treated. The constraints shall be as follows: Each pedestal, pedestal load, torque motors and gearboxes shall remain the same. If the analog tachometers cannot be eliminated as part of this research, the same units in each system must be used. Servo parameters needed for this research effort must be derived by the researcher using empirical methods. Performance objectives of the upgraded systems shall be as follows: The transient response of the systems and the tracking error coefficients shall be at least as good as the present systems with some improvement expected. At least an order of magnitude improvements shall be demonstrated in drift and in the frequency of adjustment of components. Other deliverables shall be as follows: Stated space simulation models used in this research effort shall be provided with full documentation and in such a form as to be executed on a Wyse PC (MS-DOS Ver.2.11) and this shall be demonstrated. A full research of components satisfying the design shall be provided with components specified in detail where commercial items are not available. A final report shall be provided presenting the development, design, simulation model, simulation results, market survey, and any specifications.

A87-209            TITLE: Microcomputer-Network Architecture for Range Instrumentation Applications

DESCRIPTION: research to date has demonstrated the feasibility and potential of the innovative concepts (1) cascable microprogrammable microcomputer modules for real-time range instrumentation control applications, and (2) retargetable automated microcode generator systems. The cascable module is a basic building block, an 8/16 bit word increment microcomputer module, which when incorporated with real-time signal processing capability can be micro programmed and serially concatenated to form a computing system up to 64-bit word. The

code generator is to automatically generate microinstructions for application programs from high level language for the cascadable modules. The utilization of modules and the code generator development tools as standardized items in the acquisition of microcomputer-based computing network/system offers not only considerable flexibility to meet processing requirements but also significant potential economic savings.

Exploratory development is now needed to study, design and develop computing network architectures, utilizing cascadable modules and code generator development tool as standardized basic items, for processing range and range rate data, real-time Kalman filtering, real-time target motion resolution (TMR) processing of MPS-36 and FPS-16 radars data, and for processing image/pattern information for real-time tracking control of optical trackers.

A87-210            TITLE: High Speed Cascadable Signal Processing Circuits

DESCRIPTION: Signal Processing Algorithms are multiply/accumulate intensive. Novel methods using advanced IC devices are needed. Radar digital signal processing and spread spectrum processing task include FFT, LMS, L, convolution and spectrum analysis. As examples, 32 X 32 multiplier, 64 X 64 multiplier, parallel multiplier and floating-point processing architecture are sought for processing speeds at 10 nanosecond. Micro programmable designs are necessary.

Clock speeds to 30 megahertz are expected with micro programmable microcomputer cascadable modules. The cascadable module is a basic building block, an 8/16-bit word increment module, which when incorporated with real-time signal processing capability can be micro programmed and serially concatenated to form an ultra-high-speed computing system up to a 64-bit word.

Exploratory development is now needed to design and develop specialized high speed cascadable signal processing circuits for cascadable modules to process range and range rate data, real-time Kalman filtering, real-time target motion resolution (TMR) processing of MPS-36 and FPS-16 radars data, and processing image/pattern information for real-time tracking control of optical trackers.

A87-211            TITLE: Digital Filtering Using Simulation Models

DESCRIPTION: real-time digital filtering algorithms frequently use simple polynomial process models. In the past, this has been necessary due to speed constraints. The advent of much higher speed computing machinery makes it possible to use a much more complex process model such as a missile flight simulation. These models tend to be vehicle specific and lacking in flexibility. Algorithms and computer architecture are needed to permit the use of missile simulation process models that are flexible, high speed, and user friendly. Data rates up to 15KHz are required. Computing systems must be small for use in fielded test range instrumentation.

A87-212            TITLE: Computer Architecture for Kalman Filtering

DESCRIPTION: apply innovative techniques to the development of a new computer architecture for real-time digital filtering using Kalman filter principles. Multidimensional filtering is required at sample rates of up to 15KHz real-time output. Parallel processing techniques are required to achieve the needed speed. Architecture using state-of-the-art chip technologies are sought for application to the next generation of instrumentation radar and telemetry equipment.

A87-213            TITLE: Development for High Intensity Solar Facilities for Simulating Thermal Nuclear Environment

DESCRIPTION: research into solar thermal facilities concepts for simulation of the nuclear thermal pulse is required. Effort should be directed toward large test areas (about 0.5 ) and high thermal fluxes (about 300 cal/cm<sup>2</sup>.sec).

A87-214            TITLE: Noise Abatement for Artillery Weapons

DESCRIPTION: Determine the feasibility of using noise abatement schemes and procedures for reducing or eliminating the effect of artillery weapons firing on nearby communities. Noise pollution is a continuing problem for all government installation generating high intensity, low frequency noises such as found in large caliber weapons firing.

A87-215            TITLE: Protective Barriers for Explosive Operations

DESCRIPTION: Develop a new equipment and method of fabricating barriers to be used between temperature conditioning units for explosive materials. These barriers would prevent the propagation of a conflagration between units in case of an accident. These barriers would improve the safety of operations in the vicinity of the temperature conditioning units.

A87-216            TITLE: Evaluation of Large Caliber Projectile Function

DESCRIPTION: devise new methods for the evaluation of the grenades in modern high explosive large caliber projectiles. The present methods are manpower intensive and contain a large element of personal risk for those involved. The present methods required that people walk upon the impact field searching for unexploded munitions and then to determine the probable failure mode for the munition. The primary risk is that of unknowingly stepping upon or distributing a dud while searching for them. The new methods must reduce risk while maintaining the ability to evaluate the performance of the round.

A87-217            TITLE: Projectile Velocity Measurement for Large Caliber Weapons

DESCRIPTION: Determine the best of the available and feasible projectile velocity measurement techniques for large caliber projectile firings.

A87-218            TITLE: Reduction of Ground Loops in Instrumentation Vans

DESCRIPTION: devise new methods and procedures for eliminating or reducing the affects of ground loops within the components of instrumentation systems. The problems are most severe with portable electronic instrumentation vans used on a variety of weapons systems tests. Many of these ground loops arise because of (1) the large distance between the measured phenomenon and the instrumentation equipment (2) the large power requirements for electrical power near and at the test site that affects the local ground potential, and (3) safety grounds requirement associated with high explosive munitions.

A87-219            TITLE: Chemical Agent Simulation in Cold Regions

DESCRIPTION: In testing NBC collective protection systems in cold environments, a chemical agent stimulants needed that has sufficient vapor pressure to be a threat at temperatures as low as -25 degrees F. The stimulant must be easily detectable and capable of being quantified by simple instrumentation that does not require laboratory support. This task would be to research and designate one or more suitable non-toxic chemical stimulants along with dispensers and the detection and quantification equipment to allow realistic chemical stimulant challenges to collective protection systems in cold environments. All stimulant dispensers and instrumentation must be simple, portable and operable down to -25 degrees F and under conditions of low absolute humidity. Instruments may be powered by either 110/220 v.a.c. power, or by low temperature batteries. This stimulant chosen should provide a reasonable simulation of a non-persistent chemical agent and have filtering characteristics to known threats agents. A stimulant detection sensitivity of at least one microgram per liter is desired.

A87-220            TITLE: Cold Regions Trafficability Kit

DESCRIPTION: A trafficability kit is needed to quantitatively measure vehicular trafficability in cold regions. The kit would allow a more accurate and objective means of establishing trafficability parameters in snow, ice and on frozen surfaces. This task would research cold regions trafficability and develop a field kit and instructions for its use.

A87-221            TITLE: Velocity Reference for Testing Inertial Systems

DESCRIPTION: Ground-based test range instrumentation has been unsuccessful at providing velocity estimates that could serve as a reference for testing state-of-the-art airborne inertial systems integrated with other navigation side (GPS, LORAN, etc.). The classic is to use a time history of position measurements from one or several sources combined in some optimal or suboptimal way to estimate first and second derivatives. Direct measurements of velocity are required to improve these estimates beyond the 0.1m/sec accuracy achievable with inertial systems. It is highly desirable to use existing range instrumentation to provide the necessary measurements. One or more Doppler measurement sources is a possible solution, provided a single scattering center can be resolved and tracked. Research testing and procedural development in required to augment existing position measurements with velocity measurements of a single scattering center on any aircraft or projectile. Velocity measurements must be good enough to allow optimal estimation algorithms to compute three-axis velocity estimates with accuracy on the order of 0.05 m/sec throughout high dynamic (up to 9g) maneuvers.

A87-222            TITLE: Parallel Output Imaging Sensor

DESCRIPTION: A highly parallel output imaging sensor is required for very high speed (2000 fps) video applications. The sensor would need to be an area type sensor coupled consisting of approximately 256 X 256 pixels in rows and columns. Charge coupled elements (or similar devices) would be used to read out all (or most) of the rows simultaneously a parallel to separate pins. To accommodate the large number of pins, it is anticipated that the device would be mounted in a pin-grid array package.

A87-223            TITLE: Parallel Solid State Video Recorder

DESCRIPTION: A highly parallel input video recorder is required to accommodate the high data rates associated with high-speed parallel output image sensors. The recorder would be similar in concept to frame grabbers with a common clock but would employ up to 256 separate inputs. Each input would require an A/D recorder and associated memory. Upon receiving a freeze command, the recorder should retain 1000 to 4000 image frames and be capable of transferring the memory contents to standard video output. Important recorder parameters would be recording speed and physical size.

A87-224            TITLE: Desert Mobility Course Slection for Correlation with Probable Operational Requirement

DESCRIPTION: World-wide desert terrains have been classified using the Waterways Experiment Station physiographic association using random sampling. It is, therefore, possible to reasonably compare one terrain region to another in terms of general cross-country mobility. The correlation for a specific route, however, is also affected by the fact that some terrains will operationally be more utilized/avoided than others and existing roads will be used to a large extent, especially by support vehicles and in mobility-restricted areas. Previous correlations have been based on examination of world-wide desert road networks, but these need to be updated based on presently existing road conditions and tactics. These correlations will be used to generate test mileages required on the existing specific desert mobility test courses to emulate the actual probably operational movement. Correlations are needed for all classes of Combat/Tactical vehicles for the major desert areas of the world.

A87-225            TITLE: Application of GPS to Ground Target Control

DESCRIPTION: The Global Positioning system, GPS, offers the ability to provide basic position information needed for remote control of ground target vehicles. Vehicles to be controlled simulate enemy tanks, trucks, and her similar targets. They will be both surplus military vehicles like M-47 tank, M113 Armored Personnel carrier, or M-880 Utility Vehicle and specially adapted commercial vehicles. Speeds will be up to 60 mph and required position repeatability should be on the order of 2 meters or less. Control systems will be two types: a completely automatic system in which the target vehicle is merely controlled over a pre-determined course (either pre-driven or designated by coordinates), or a system using the GPS of effort includes analysis of achieve accuracies and limitations of such a control system.

A87-226            TITLE: Directions in Target Performance Requirements

DESCRIPTION: Design effort which defines the “target of the future”. The projection of technology and weapon system developments in the next 20 years are analyzed to predict the trend in requirements for aerial, and ground target vehicles which are utilized to represent the threat in test and evaluation of new weapons systems. Needed technology for ancillary equipment such as control systems, recovery systems, and etc. should also be covered. Key parameters are identified and future requirements and technology needed to achieve them are predicted. This effort can concentrate on aerial targets, or both.

A87-227            TITLE: Mobile Target Near-Miss Scoring System

DESCRIPTION: A scoring system is required for remote control target vehicles which will locate and score 105 mm and larger projectiles passing within 100 feet of the system to an accuracy of 1 foot. The scoring information would be transmitted over telemetry links (either GFE or designed into the system) in real time to a display or into a GFE computer. Purpose is to have hit and near-miss information available at the firing site immediately after the round is fired. Any components mounted on the target vehicle must be rugged and no larger than 4 cubic ft in volume. On board power is available.

A87-228            TITLE: Flexible, Dynamic IR Target

DESCRIPTION: A programmable device is required to provide a realistic three-dimensional thermal target which can simulate the IR signature of various vehicles. The system should be large enough to simulate the MI tank and have a thermal resolution of approximately one degree C. and a desired cell size on the order of one inch by one inch. For example the target could be composed of individual temperatures of plus or minus one degree C. The entire structure should be capable of mounting on a one half ton pick-up truck which is driven over rough terrain by remote control power required should not exceed 40 kw.

A87-229            TITLE: MM Wave Signature Generation

DESCRIPTION: Targets are needed which can be configured to provide an mm-wave radar return which simulate various ground vehicles such as tanks, armored personnel carriers, and trucks. Such areas as he double Doppler return from tracked vehicles should be considered. Target is to be lowing cost and be able to be mounted on a one-half ton pick-up track which is driven over rough terrain by remote control.

A87-230            TITLE: Techniques for Large Scale Ground Target Presentation

DESCRIPTION: Remote control systems and staging techniques are required to provide presentations of up to 60 unmanned target vehicles over large areas. Vehicles will be in line on a road with spacing of 150 feet or less and in parallel waves over unimproved terrain. Safety requirements are to be included to prevent vehicle run-away or

collision. System concept should be portable and allow speeds up to 60 mph on paved roads with appropriately reduced speeds over rough terrain.

A87-231            TITLE: A methodology for Predicting target Requirements

DESCRIPTION: develop a methodology to predict the numbers and types of ground targets, and aerial targets for US Army test and evaluation. This technique would allow the determination of quantities and types to stock for use in system test and evaluation to avoid target production delays and at the same time minimize stockage and associated cost.

A87-232            TITLE: Radar Evaluation Handbook

DESCRIPTION: personnel who are not expecting in the field of radar are being briefed on systems which include radars. The systems may be instrumentation systems for use in testing weapons or weapon systems which include radars.

A handbook is required which, while having a firm technical basis, can be used by a person with only a general technical background as an aid in making a competent technical evaluation of a radar and of a system which uses radar.

A handbook should allow the user to determine which radar capabilities are important in the end use of the system. The user should be able to refer to the handbook to learn which radar specifications are necessary to evaluate the ability of the radar to meet its requirements. In addition, the user should be able to determine which radar specifications will be easily met, and which are of relatively high risk. Radar frequencies covered should include 10 to 140 GHz.

Included in the handbook, as appendices, should be discussions of assumptions, of theoretical and practical calculations which form the bases of the main text, tables of radar cross sections of typical targets of interest to the Army (artillery shells, ordinance, vehicles of various types), notes on radar parameters which rarely change, sensitivity analyses indicating which parameters are more important than others in affecting radar performance in the particular type of system being evaluated, and rules of thumb which can be confidently applied to the evaluation. A discussion of multi-path, its effects, and conditions under which it may be a problem should be included.

Radars which will be evaluated with the aid of this handbook will include ground-to-air instrumentation radars tracking munitions in flight, ground to ground instrumentation radars tracking low flying munitions or ground based vehicles, and air -to-ground radars seeking or tracking targets at depression angles from 20 to 90 degrees.

A87-233            TITLE: Target Area Monitoring System

DESCRIPTION: In the near future, the Army will be conducting tests in which multiple small objects will be in the air over an array of vehicles which are on the ground. A system is required which will locate and then monitor the movement of both the objects in the air and the targets on the ground. Output of this system should be trajectory data indicating the relative locations of both the objects in the air and the targets on the ground. The output need not be in real-time, however but may be the result of post-processing of data.

The vehicles may be fitted with transponders or beacons, if required. The small airborne objects have practically no space aboard for extra equipment, and nothing may be fastened to the outside, which would affect their ballistic flight paths. It is desirable that the system operate in the presence of dust, smoke from fires, modes rain rates, snow and fog.

In particular, an instrument is required to accurately measure the relative separation of several sub munitions when ejected from a rocket, or artillery shell carrier. It is desired to measure the differential position to within 0.3 meters and the differential velocity to within 0.3 meter/second for the period of time during ejection of the submunition

from the carrier, until stabilized flight is achieved. It is preferred that nothing be required to be carried in the submunition itself, but approaches using such a technique will be considered if no better method is proposed. No manned instrumentation sites are allowed within 1 km of the function point for safety reasons.

A study of how this task might be accomplished is solicited. A successful study might lead to an exploratory development effort. The study shall result in a report of investigations made and conclusions. If a candidate system is proposed, a technical discussion shall be included in the report to show why the investigator believes the system would perform the task.

A87-234            TITLE: Radiometer Beam Location System

DESCRIPTION: The Army is currently developing small munitions which include passive radiometers operating at millimeters wavelengths. These munitions search the ground using the radiometer in order to sense targets. A system is required which will locate where the radiometer is pointed at any time.

The system might be one which would respond only when it was in the field of view of the radiometer, or it might be one which would locate a radiometer's beam from afar. The system itself must not interfere with the radiometer's search for targets, nor appear as a target to the radiometer. A system which illuminated the radiometer at some frequency to which the radiometer was insensitive would be acceptable.

Output from this study shall be a report on all of the designs considered with special emphasis on system designs which may meet the requirements listed above. A technical discussion of any systems being proposed and of their capabilities shall be included. Preliminary Instrument development might be a follow-on program to this effort.

A87-235            TITLE: Bayesian Reliability Assessment Techniques with Application Examples

DESCRIPTION: The complexity of weapon systems has increased, and more functions are accomplished by various electromechanical devices. Parallel to this, development and testing costs have increased. Also, the rapid development of technology demands a shorter development cycle for new equipment. The 10- to 15- year cycle of the past results in production material that is technologically outdated by the time it is fielded. All of this results in higher levels of reliability being required of material and less test time being available to assess whether those levels have been achieved. Classical reliability testing approaches require more time and resources than are normally available. Bayesian approaches seem to offer an avenue that would better provide for quantitative assessment of reliability requirements within the constricted test time and resources available. Prior estimates could be based on expert judgment or on previous test results.

A87-236            TITLE: Lighting Threat Sensor and Disconnect System

DESCRIPTION: A 118-foot tall antenna pattern measurement facility arch offers an attractive lighting strike target. It is connected to high value instrumentation and processing equipment in a nearby shelter. There is a requirement to develop a system which will sense an imminent lighting strike and disconnect all power and data lines from the shelter. A conventional Lighting Protection System which would alter the electromagnetic characteristics of the arch is not acceptable.

A87-237            TITLE: Voice Jamming Effectiveness Evaluation

DESCRIPTION: The test and evaluation of voice communications electronic countermeasures systems requires subjective evaluation by test personnel. Test methodologies are required that will provide automated, repeatable testing of jammer effectiveness and eliminate the variability introduced by human listeners.

A87-238            TITLE: Processor-controlled Waveform Generator – To Amplifier Interfaces

DESCRIPTION: design, build and test a processor-controlled interface for application between a .1-40 GHz arbitrary waveform generator and a set of n high power amplifiers (HPA) and antenna systems. Functionally, the interface would include an n-port power divider, n band-pass filters and n automated pre-amplifiers. The interface must switch and control RF from the generator to n sets of HPAs/antennas at a microsecond rate. Pre-amplifier gain and HPA output must throttle the pre-amp gain to keep the HPAs linear at all times. The final package must be no more than 10 inches high and fit in a 19-inch wide rack.

A87-239            TITLE: AI Based Terrain Analysis Data Base Development from Multispectral Imagery

DESCRIPTION: Future Army digital topographic data base requirements include detailed terrain analysis information about the terrain surface, such as soil types, vegetation coverage, hydrology, etc. Currently available data base, such as Digital Feature Analysis Data (DFAD), do not provide these kinds of information. One potentially valuable source of raw data from which to extract at least a subset of terrain analysis features is the current generation of multispectral imagery (MSI), specifically Thematic Mapper and SPOT data. The goal of this work is to use an artificial intelligence (AI) approach to feature extraction; i.e., image understanding, to explore the automated development of digital terrain analysis data bases, or subsets thereof, to meet Army requirements. Issues to be addressed include software development for proof of concept demonstrations and in-house testing at ETL; determining what features can, and cannot, be extracted from MSI; and comparing the value of the different types of MSI (e.g., TM vs SPOT) for this work. The Phase I effort will address the issue of updating and intensifying existing DFAD data sets to meet terrain analysis specifications, including use of the DFAD as a prior knowledge. Phase II work will address the more complex problem of extracting this information from MSI when DFAD is not already available.

A87-240            TITLE: Synergistic Exploitation of SAR and Map Data for Map Update and Verification

DESCRIPTION: Before knowledge of enemy force structures and doctrine can be employed to determine worthwhile target areas on synthetic aperture radar (SAR) imagery in a broad area search operation, digital map data must be registered to the SAR image in varying degrees of precision and accuracy. The requirement under this work is to develop rules that can be enforced in a tactical environment to generate the necessary registration accuracy and precision from realistic map data. It will be assumed that the existing map data is not accurate and precision enough and that in addition to a map-to-image registration function, the analysis can make use of a SAR segmentor function capable of delineating four classes, namely fields, forests, water and urban boundaries. The analysis can also make use of smart control generator function capable of generating map control estimates on the SAR image. The purpose of this work is to develop rules and procedures for harnessing the three functions in a test bed at ETL so that an expert system can be developed to be used in conjunction with other expert system designed to detect and classify military target clusters. It is expected that the resulting expert system will be capable of verifying map data, improving resolution accuracy and precision such as sharpening the boundary between field and forest and in general, determining point, lineal and area feature locations, all upon demand of a controller.

A87-241            TITLE: Multisensor Record Registration

DESCRIPTION: develop a set of capabilities leading to the automatic registration of digital multi-sensor records to one another. Consider the situation where the images are collected within T hours of one another and where exterior and interior orientation data exists to the degree that the object space centers are within a distance D of one another. Assume that map data of resolution R is available in digital form. The symbols T, D, and R are parameters of the study. In all cases, assume that the object points of interest are imaged on the pertinent records and that sufficient common imagery exists around the object points for a geometric registration. Special consideration must be given to visible imagery as well as mid range infrared and X-band synthetic aperture radar. The resolution I of each image type are also parameters of the study. Consideration must be given to the situations where map data ranges from sufficient to nonexistent, i.e., where vision understanding methods must be used to relate corresponding image features. The purpose of the work is to develop a capability for the synergistic exploitation multisensor data for

military target identification. It is not a requirement of multisensor data for military target identification. It is not a requirement of this work to develop the exploitation capability.

A87-242            TITLE: Representation and Recognition Techniques for Synthetic Aperture

DESCRIPTION: Research and develop efficient techniques for representing segmented synthetic aperture radar (SAR image data, such as terrain boundary edges and terrain regions, in convenient list forms for implementation in a LKISP environment. Based on computer vision and pattern recognition techniques, investigations shall be conducted to develop various methods for image structure analysis using the image data representations obtained earlier as input. The results of this image structure analysis shall be used to develop automated and unambiguous recognition techniques for radar terrain features. The particular image data representations and structural analysis which lead to recognition will be determined. The segmented SAR image data, consisting of five categories of terrain features (water, forests, filed, urban areas, and airfield runway patterns), will be furnished by the government. Personnel and facilities of the prospective contractor must be cleared to the SECRET classification level by the designated security elements of the Department of Defense.

A87-243            TITLE: High Complexity Terrain Image Synthesis

DESCRIPTION: Computer image generation (CIG techniques provide unique opportunities to visualize terrestrial scenes of geographic areas represented by digital map data. To date, military applications of CIG technology have focused on development of moderate-resolution ( approx. 512 X512 pixel), real-time (30-60Hz) simulators for training; commercial CIG activities have emphasized generation of business and television graphics with a small set of vendors using CIG to generate digital special effects imagery for the motion picture industry. The objective of this initiative is to explore adaptation and extension of emerging special-purpose computer image generation systems to the problem of generating high resolution, high-complexity color perspective images depicting areas of the real world from digital map and collateral data. Desired RGB (red, green, blue) image resolutions range from 1024 X 1024 to 4096 X 4096 pixels/image; desired image complexity can be represented by on million or more projected polygon primitives per image. Anticipated data sources include conventional map data from Defense Mapping Agency and USA Engineer Topographic Laboratories which will be augmented by the contractor with additional types of data to represent three dimensional (3d) structures (i.e., buildings, bridges) and dynamic objects (i.e., vehicles, aircraft) as well as generic patterns and processes to depict terrestrial features (i.e., trees, bushes, water), backgrounds (i.e., sky, clouds) and environmental conditions (i.e., solar illumination, haze, rain, fog, snow, ice, lighting and star fields). The goal of Phase I am to formulate concepts based on use of advanced data structures, rendering processes and cost effective CIG hardware which could lead to the development of CIG systems capable of generating high complexity terrain images at a rate of at least one image per minute. The goal of Phase II will be to develop a breadboard system for terrain image synthesis with the resolution, scene complexity, data sources and speed cited above. Extensive demonstration of capabilities will be performed on government furnished data.

A87-244            TITLE: Prediction Model for Verification and Update of MC&G features

DESCRIPTION: The objective of Phase I am to develop a prediction model concept that can be incorporated into a semi-automated process for verification and update of digital MC&G (Mapping, Charting and Geodesy) databases. This prediction model would have the capability to make scene prediction model would have the capability to make scene predictions and drive verification and update processors to extract information from a variety of source materials using information residing in an MC&G database. Consideration must be given to various sensor records including optical, SAR, and IR; existing MC&G databases and database structures suitable to a verification and update scenario; and map guided feature extraction techniques based on knowledge driven computer approaches. Assume that the task of map-to-image registration has been successfully performed by another processor. The analysis shall determine a suitable database structure compatible with existing MC&G data bases that is capable of supporting verification and update functions. The analysis shall also determine the feasibility of using computer vision methods and map-guided feature extraction techniques to perform a verification and update on various sensor records. Based on the concepts developed in this phase, Phase II will be directed at finalizing concepts and developing software for the prediction model (mechanism).

A87-245            TITLE: Underground Heat Transfer Algorithms

DESCRIPTION: Currently available energy analysis programs do not have the capability of accurately evaluating the requirements of underground structures. Existing algorithms for performing underground heat transfer calculations are too detailed for inclusion in hourly energy analysis programs. The purpose of this research is to develop algorithms which can accurately predict the heat transfer of underground heat transfer surfaces and which are suitable for inclusion in current detailed hourly energy analysis programs such as BLAST. The algorithms would have to utilize readily available input data for the building and surrounding earth temperatures.

A87-246            TITLE: Application of Robotics to Energy Conservation

DESCRIPTION: There is currently a high degree of interest and application of robotic technology in the manufacturing industry. It may be possible to extend the application of this technology to the area of energy conservation. Some types of systems which could be envisioned are robotic inspection of roofs and walls for heat loss. Other possible uses are inspection of energy destruction systems and even robotic meter reading systems. It is not known, however if these systems are feasible and it is necessary to define the potential for energy conservation, and the technology requirements of these systems. Areas of research interest are robotic navigation with and without beacons, safety aspects of robotic navigation in a community environment, and advanced robotic sensor technology.

A87-247            TITLE: Developing Slurry Fuel from Anthracite Coal

DESCRIPTION: Coal water slurries show significant potential as an innovative near term approach to coal firing in industrial boilers. At the present time, slurry activities have been directed almost exclusively to the use of high volatile, low ash, bituminous coal. A study to evaluate the potential of anthracite coal as a coal slurry boiler fuel is needed. This study should include the following elements: (1) anthracite coals ability to remain in suspension in a slurry mixture, (2) the ability to atomize and maintain a stable flame when combusting the slurry mixture, (3) supplemental fuel requirements necessary to start and maintain a stable flame and, (4) an economic evaluation concerning anthracite in a slurry as an industrial (5,000 – 80,000 pounds steam per hours) boiler fuel.

A87-248            TITLE: Simplified Joining Techniques for Polymer Composite Structural Shapes

DESCRIPTION: The potential for use of polymer composite materials in constructing space station environments appears to have merit due to the low payload weight involved in moving materials from the Earth. Realization of this potential depends, in part, upon the capability of assembling components into a structure in space. Joints must be simple to make, stable and highly reliable. Techniques used on Earth may not be appropriate or may be highly over designed. Research should address the various materials, joint design, appropriate assembly techniques, potential problems including thermal cycling, stability, reliability and the like.

A87-249            TITLE: Conductive Coatings for Impressed Current Cathodic Protection

DESCRIPTION: Conventional cathodic protection is often not feasible for complex structures and in splash zones. Confined areas and irregular surfaces make proper placement of anodes difficult. Conventional cathodic protection utilizes water as a conductor. The splash zone is often the area of maximum coating and substrate degradation for an immersed steel structure. Conductive coatings are available in the commercial market, however, their potential value as the anode for the cathodic protection system has not been evaluated. It is therefore desired that protective coating systems be evaluated to determine the practicality of protecting steel structures by the use of a standard (non-conductive) coating plus a conductive topcoat to act as the anode for cathodic protection system.

A87-250            TITLE: Internal Pipe Corrosion Management System

DESCRIPTION: Establish quantitative model (which includes establishing equations for relationships between physical parameters) to establish the corrosion management system which will contain the following elements for gas piping, potable water piping, and condensate return piping which will include the elements:

- a. Incorporation of physical parameters into quantitative model.
- b. Recordkeeping capabilities of an installation's piping network including location, dimensions and status.
- c. Ability to predict the average life of a piping system based on physical and environmental factors.
- d. Ability to rank (in descending order) piping systems according to their corrosion status and need of repair.
- e. Perform economic analysis comparing alternatives such as replacement or rehabilitation of piping systems.
- f. Optimize available maintenance money to determine which piping system should be repaired first to maximize cost savings.

A87-251            TITLE: Potable Water-Pipe Corrosion/Scaling Water and Water Chemistry Sensor

DESCRIPTION: The objective of this research effort is to identify new sensor technologies for in situ continuous corrosion/scaling monitoring of potable water pipe systems. The monitoring systems will include detection of onset of pitting and changes in water chemistry. The monitoring techniques will have the following minimum requirements:

- a. Minimal system perturbation
- b. IR drop effects due to the low conductivity electrolyte need to be properly compensated.
- c. The Tafel slopes,  $B_a$  and  $B_c$  should be obtained from the  $R_p$  measurement
- d. Capable of automation

A87-252            TITLE: Photolysis Rates and Byproduct Formation from Industrial Solvents Discharged from Air Stripping Towers

DESCRIPTION: Industrial solvents such as trichloroethylene (TCE) have been found on numerous occasions in groundwater which serve as potable supplies. A common technology to remove these materials from water is air stripping, however, regulatory agencies are beginning to question the advisability of transferring these materials to the atmosphere without collection and treatment. Many of these components are light sensitive and are not stable in the atmosphere. The need for alarm at their discharge into the atmosphere would be unfounded if the rates of breakdown in the atmosphere were great enough to keep the concentrations low and limit the migration of a contaminant plume to within property boundaries at the air stripping site. The purpose of this research will be to define the photolysis rate of the more common industrial solvents (tri- and tetra- chloroethylene, methylene chloride, etc.) and to determine the end products of this breakdown. These rates will then be used to predict the potential for air pollution based on the operating characteristics of a water treatment plant.

A87-253            TITLE: Investigation of a Single Indicator as an Index to the Levels of Many Indoor Air Pollutants

DESCRIPTION: To determine if monitoring the level of one gas can reliably indicate the levels of several other pollutants, particularly in indoor training areas. As energy conservation and insulation techniques become better, the concentrations of unwanted gases become higher since there is less infiltration of outside air for dilution. Some activities, e.g. indoor firing ranges, produce a significant amount of noxious gases. The development of algorithms linking the concentration of these gases to the concentration of another, easily monitored gas would allow the determination of the overall air quality by tracking only a single gas. Of particular interest is analysis of gases in an indoor firing ranges.

A87-254            TITLE: Real-Time Lead Monitor for Indoor Firing Range Personnel

DESCRIPTION: Development of a personal, lightweight lead monitoring device which reflects lead and/or lead oxide dosage levels on an hourly basis. Direct-read-out capability with accuracy to 1pm is necessary.

A87-255            TITLE: Creation of As-Built Drawings in CAD Systems

DESCRIPTION: Often during facility and space management activities, one needs as-built drawings (typically a plan view) of existing buildings. Frequently, drawings of floor plans do not exist, are lost or are out of date. To create such drawings people measure rooms, workstations or buildings components and make pencil sketches that are converted into drawings. This is an expensive, labor intensive and slow process. What is needed is an easy-to-use, portable instrumentation which allows someone to walk through a facility and collect as built data that can be converted into CAD drawings automatically. The instruments should sense distances and other information, record it, allow for transmittal to CAD software on micro or larger computers and be converted into as built drawings. The user of the portable instrumentation may need to input additional information which the equipment cannot sense. Software to interface programs is also needed. At minimum, the system should be able to produce line drawings relating rooms to each other, establish wall thickness and locate objects on drawings is also desirable. Direct sensing and automatic drawing creation from data is essential. Skill, knowledge and labor on the part of the system user should be minimized.

A87-256            TITLE: A Physical Process Visualization Technique for Generating Activity Networks

DESCRIPTION: To develop a technique for representing the cognitive mental models that underlies the visualization of a physical process. Much of the Artificial Intelligence (AI) work in plan generation has been based on goal-directed search paradigms which use operations to go from one state to another. The problem with this approach is that the underlying rationale for the action is imbedded in the procedure. For this lesson, "look ahead" is tough and often backtracking is required. Furthermore, the domain independence of these approaches for complex spatiotemporal problems is highly questionable. It is hypothesized that a computational model of process visualization could greatly improve plan generation.

A87-257            TITLE: A Knowledge Representation Scheme for Construction Task Formalisms

DESCRIPTION: To design and test a knowledge representation (KR5) scheme for building construction knowledge. The scheme should allow for pattern recognition and the identification of task formalisms. A task formalism (TF) is an abstract construction task (e.g., "build a 2-door garage"). The next step would be to collect and test a small knowledge base of TFs. This research is motivated by the "action-macro" concept from intelligent-robotics research. They are yet to develop a KRS for test abstractions in domains as complex as building construction.

A87-258            TITLE: A Computer Algorithms for the 3-D Conceptualization of 3-D Building Design Drawings

DESCRIPTION: To develop a computer algorithms for studying a 2-D figure and developing a 3-D (conceptual) representation. A lot of work in machine vision has been done on recognizing objects viewed from arbitrary directions under arbitrary lighting. Results of such research has been encouraging but commercial applications are few and limited. It is hypothesized that, by incorporating design knowledge in a system, one would be able to perform 2-D to 3-D conversation more effectively.

A87-259            TITLE: Identifying Physical Building Components from Graphical Representations

DESCRIPTION: Investigate the feasibility of developing an automated system with the capability of scanning construction drawings and producing a detailed bill of materials. Work should include techniques for using plans and evaluations to create three dimensional images of each building component for the purpose of identifying the

type of material and its related quantity. The long range goal is to develop a system to translate construction drawings into material data for cost estimating and for project management.

A87-260            TITLE: Optical Device to Measure Liquid Water Content (LWC) of Clouds and Fogs (liquid Water Content Meter)

DESCRIPTION: Liquid water content (LWC) of fogs and clouds is a fundamental parameter in studies of cloud physics, acid precipitation, electromagnetic wave propagation and structure icing. The measurement of LWC is extremely difficult. Accurate values of LWC can be obtained from mechanical sampling techniques, however, the frequency of measurement is very low. Impaction techniques such as the hot wire approach are suited for aircraft operation but achieving collection efficiency using this technique is very difficult. What is needed is a passive optical device, using well-known light scattering properties of water droplets, which could remotely and continuously monitor the changes in the LWC. The ability to differentiate between liquid and frozen state of these droplets would be useful, but any simple reliable LWC indicator would be valuable. The device should not rely on transmission measurement over an extended path, rather it should be a point measurement device. Since it is a passive optical device it should not have any moving parts and must be able to operate at sub-freezing temperatures.

A87-261            TITLE: Relative Humidity Sensor

DESCRIPTION: A simple, relatively inexpensive device is needed that will make either absolute humidity or relative humidity measurement between 90% and 100% RH and at temperatures from minus forty degrees Celsius (-40) to zero degrees Celsius (0 C). Accuracy of 1% RH or better is required. This device should be designed so that it can be read electronically by interfacing with standard commercially available data loggers or mini computers. It should be capable of unattended operation in a typical winter field environment. Proposals should include a description of the methodology that the proposer would use to verify the precision and accuracy of any proposed device.

A87-262            TITLE: Graphical Animation for Postprocessing of Computer Program Results

DESCRIPTION: The Corps of Engineers is very active in using numerical systems such as finite elements or finite differences, to model many two-and three-dimensional dynamic phenomenon. These applications include estuaries and coastal hydrodynamics, constituent transport, sediment transport, environmental effects, soil-structure interaction, and structural behavior. Computer programs, such as TABS, BOND0 and many others, have been developed and are used regularly in much of the corps work. Graphical presentations of time-series output have proven to be invaluable in the interpretation of numerical model results. Current capabilities are limited to low-level black and white hardcopy plotting and simple color plots. Animated graphics output is required on both color video tape and film. Proposals should address both software and hardware requirements as well as the use of multi-level distributed computing which includes supercomputers, microcomputers, microcomputers, and a variety of output devices.

A87-263            TITLE: Improvement in Standard Penetration Test (SPT) Apparatus

DESCRIPTION: The SPT is widely used in foundation investigations for military construction of all types. A major shortcoming in the SPT is in the variability of test results caused by differences in operator technique and in design for a drive system that is suitable for Corps-wide adoption. Requirements are: (1) The system should use a mechanical release mechanism to eliminate operator error; (2) Safety should be at least as good as in currently used "safety hammers"; results should be highly repeatable; (4) Results should be comparable to existing data base; (5) Design would preferably conform to ASTM standard.

A87-264            TITLE: Large-Scale Soils Laboratory Stress Cell

DESCRIPTION: develop concept for, design and construct a large-scale stress cell and its complement of auxiliary equipment to simulate insitu stress conditions in the soils laboratory environment. The apparatus will be of sufficient size to permit near full-scale or prototype in situ tests e.g., cone penetration, standard penetration, pressuremeter, dilatometer, borehole shear, stepped blade, vane shear, plate load, pressure cell, etc., in the laboratory. The stress cell will be used for developing interpretative guidelines for in situ soils tests and improving soil sampling and testing techniques.

A87-265            TITLE: Construction of Model Armor Units

DESCRIPTION: Construct scale model armor units of specified size, shape and density for use in Coastal Model Investigation of Breakwater Stability. Model units are usually made by (1) machining or carving a casting unit of the particular shape desired; (2) making rubber or babit molds; and (3) casting production units by properly selecting and controlling mixtures of materials that will result in a specified density. Density normally desired is 146.25 pc for a specific gravity of 2.34. Approximately 2000 units each of 3 different sizes of 3 shapes (18000 units) are initially needed with additional orders dependent on shapes to be investigated.

A87-266            TITLE: Real-Time Satellite Reporting Tide Gage

DESCRIPTION: A need exists for a real-time or near real-time satellite reporting tide gage. The gage should be configured to eliminate the need for surface floats, stilling wells, mechanical clocks, separate atmospheric pressure compensation, and external power. The gage should have switch selectable sampling intervals and sufficient non-volatile internal memory to permit a minimum of one month's data accumulation in the event of up-link transmitter failure. The selected sensor should have long-term stability and linear response characteristics and either require no temperature compensation or, if required, have it contained internally.

A87-267            TITLE: Advanced Sensors for Close Proximity Robotic Mine Detection/Neutralization Platform

DESCRIPTION: A system of sensors integrated with AI microprocessor to detect, recognize and identify precise location of buried land mines. System could include optical, infrared, acoustic, magnetic, RF, microwave, etc., sensors to provide positive detection of mine with minimum phantom signal return. A minimum of three independent sensor types is anticipated for enhanced verification. Signals would be integrated and analyzed by AI microprocessor and verified against pre-programmed mine response signatures. Sensor system would be integral component of advanced robotic signatures. Sensors system would be integral component of advanced robotic platform roving the ground surface in close proximity to the emplaced mines.

A87-268            TITLE: High Range Dynamic Particle Velocity Gage

DESCRIPTION: High range (=300 m/sec) transducer with small physical size, low mass to accurately measure explosively-induced free-field particle motions in earth media. The gage must be able to withstand shock levels on the order of 10,000 g's or greater. The gage must produce continuous data from incidence of motion throughout the entire motion history.

A87-269            TITLE: High Shock Environment Data Acquisition and Storage Module (100 kg)

DESCRIPTION: Develop a high-speed compact, rigged, signal-channel data acquisition system capable of withstanding 100,00g shock waves (NOTE: An interim capability of 5,000g's would also be acceptable). The system should be as small as possible (typically 3-1/2 in. maximum dimension). It should require no external wiring (completely self contained). It should collect analog data from an integral sensor at selectable stable rates (possibly as high as 4 megahertz) and store it in internal memory of a mega word (where each word is 16 bit). The data should

consist of 12 bits of A/D data, a synchronization bit, and 3 dynamic gain bits (i.e., floating point A/D converter). The sampling should have several modes of trigger activation (such as continuous sampling until trigger, then fill ¾ more of memory and stop). Triggering should be selectable from communicated signal or threshold level of analog input. There could be a radio link (or some other nonphysical path) with the “can” for communication. Communication should be coded so as prevent false interpretation of noise, should allow retrieval of information while can is still buried under the earth and should allow reset and trigger signals to be input to the can. The can should internal batteries capable of operating the circuitry for at least two weeks standby (1 day active) with remote activation.

A87-270            TITLE: Development of Portable Direction Indicator for Hydraulic Data Collection

DESCRIPTION: The over-the-side equipment used to obtain discrete samples from a boat consists of a current meter, direction indicator, and weight all suspended by a wire rope, Plus remote readout devices and support frame. The assembly is mounted on a boat that moves from station to station collecting data. The current meter is vertical axis, cup type meter (Gurly Model 665) with remote, direct-reading speed indicator. The present direction indicator consists of a remote-reading magnet compass mounted just above meter in a waterproof cylindrical housing. Suspended below the meter is a finned, streamlined weight (fish) that holds the sensors in a vertical attitude facing into the flow. The sensor assembly is supported by a 1/8in. wire rope from a portable support frame that is equipped with a winch to raise and lower the assembly. An indicator on the winch shows the sensor’s depth below the water’s surface.

An inexpensive, lightweight portable direction indicator for use with WES current meters for “over-the-side” prototype data collection surveys needs to be developed to replace until mentioned above. The unit should be for use in freshwater/saltwater environment, very durable, and easy to mount on steel capable suspended over the side of boats. Current directions need to be read on board by digital readout or equivalent.

A87-271            TITLE: Rugged Weight Field Dental Chair

DESCRIPTION: There is a need for a lightweight, low cube field dental chair for patients. Requirements of the new chair are: Weigh less than ten pounds; allow stand-up and sit-down dentistry; be rugged; be easily cleanable; and sold to a small volume.

A87-272            TITLE: Nonmetal Dental Instruments

DESCRIPTION: A need exists to develop nonmetal instruments that can withstand repeated sterilization. These instruments should be light weight, durable and maintain edge strength.

A87-273            TITLE: Electromagnetic Pulse (EMP) Hardening of Medical ISO-Shelters

DESCRIPTION: Military field hospitals use a line of expandable iso-shelters (managed by Natick Research and Development Center) for various purposes. These shelters are made of aluminum and intrinsically offer about 1db of shielding to electronic devices inside. There is an offer need to develop a retrofit kit that will increase the shielding offered by these shelters up to the 20 db level. The retrofit should require minimal upkeep throughout the life of the shelter and must not significantly increase the set-up to take down time of the shelter, or reduce it’s utility when it is in use.

A87-274            TITLE: Diagnostic Test Strip for Salivary Cholinesterase

DESCRIPTION: There is a need to develop a test strip that can measure cholinesterase levels in small amounts (20-200 micro liters) of saliva. The test strip should work in less than five minutes and differentiate between the following levels: Less than 0.25 units/liter; 0.25-0.5 units/liter; 0.50-1.0 units/liter; 1.0-1.5 units/liter 1.5-2.0

units/liter; and greater than 2.0 units/liter. (One unit of acetylcholinesterase activity – one micromole of acetylcholine hydrolyzed/minute).

A87-275           TITLE: Improved Wound Dressing Material

DESCRIPTION: A need exists for new wound dressing materials that will simultaneously protect wounds from the outside environment (i.e., noxious agents as in chemical warfare), enhance healing and combat infection. The material should be comfortable, conformable to body topography, and should adhere well to the intact skin to form an imperable seal. A minimum five-year shelf life is desirable.

A87-276           TITLE: Small, Light-Weight Dental Sterilizer

DESCRIPTION: A small (less than one cubic foot), light weight (less than 15 pounds), low power autoclave is needed for field use. The autoclave must be able to operate from 28 VDC or 120 VAC power sources. The method of sterilization should require no, or only small amounts, of water or other chemicals. Present cold sterilization of instruments requires large volumes of chemical and longer sterilization times.

A87-277           TITLE: Self Development Dental X-Ray Film

DESCRIPTION: Current field dental films require standard dental processing techniques. Because of this, a large bulk of chemicals and daylight developing machine must be transported by field dental units. Development of self-developing dental x-ray films would greatly reduce the logistical demands on current field dental units. Self-developing dental x-ray films should have the following characteristics: Be completely compatible with current dental x-ray machines; come in per apical, bitewing, and occlusal film size; and exhibit long shelf life. The film speed should be comparable to modern "E-speed" films.

A87-278           TITLE: Pattern Recognition of Digital Radiographic Images

DESCRIPTION: Use of artificial intelligence techniques to identify discontinuities in digital radiographic images could assist the physician in interpreting radiographs in the field. A thorough literature search and feasibility assessment, performed as a SBIR effort, would be a logical first step toward developing such a system.

A87-279           TITLE: Characterizing Soldier Response to Irritant Cases (Basic Research)

DESCRIPTION: Irritant gases (HCL, NH<sub>3</sub>, Formaldehyde, etc.) associated with weapon systems exhaust emissions are known to produce performance decrements under certain circumstances. Human response to an irritation threshold is complicated principally by the duration of the exposure at a given concentration, intermittency of the exposure, acclimation, and the definition of a performance decrement. The proposal should address the feasibility of defining through animal and human testing a military –unique task potentially affected by the irritant properties of at least three gases, establishing a concentration-time relationship, if appropriate, and evaluating the role of acclimation, annoyance tolerance, and intermittency on the selected task.

A87-280           TITLE: Antidotes and Pretreatments Against Radiation and Chemical Warfare Agents

DESCRIPTION: There is a need for drugs which are useful as protectants against ionizing radiation from nuclear weapons. There is also a need for treatment of prophylactic drugs against the threat of chemical warfare agents. These chemical agents are organophosphate nerve agents; cyanides or vesicants. Synthesis of such potential drugs requires basic understanding of drug development in addition to strong background in organic synthesis. A strong biological/biochemical rationale is needed in support any synthesis proposal in this area. Three to five gram

quantities will be required for accomplishment of biological testing by the MRDC. Structural classes other than those containing oximes and/or phosphorothioates should be explored.

A87-281            TITLE: Workload Prediction and Evaluation Techniques for Health Hazard Assessment

DESCRIPTION: A requirement exists to determine which workload prediction and evaluation techniques are most appropriate for use in three phases of the Army Materiel Acquisition Decision Process (MADP) in which Health Hazard Assessments must be performed. The objective is to identify which workload prediction and evaluation techniques have been developed and are best suited for use in the evaluation of crew workload in a system during the concept exploration, demonstration and validation, and full scale development phases of the MADP. The techniques considered to be most appropriate for each phase (e.g. Projective Subjective Workload Index (W/IND) for the concept exploration phase) are to be compared and evaluated with the strengths and weaknesses of each technique identified.

A87-282            TITLE: Blood Substitute

DESCRIPTION: A requirement exists for a safe, efficacious emergency blood substitute for human use when whole blood is unavailable. Any proposed substitute should provide acceptable volume expansion as well as tissue oxygenation delivery capacity without requiring oxygen enriched breathing mixtures. Prolonged room temperature storage of the dehydrated material is desirable for logistic purposes.

A87-283            TITLE: Blood Preservatives

DESCRIPTION: A requirement exists to develop a new blood preservative that allows red cells to be stored at ambient temperatures for 5-7 days while maintaining at least 80 percent of their original 2,3 diphosphoglycerate.

A87-284            TITLE: Physiologic Stabilization after Trauma

DESCRIPTION: A general requirement exists to provide improved field care after traumatic injury when evacuation is delayed. The overall aim of this research and development is to provide treatment under adverse conditions that maximize salvage ability and recovery once definite care becomes available. Contemplated efforts cover a wide technological spectrum from state of the art applications designed to improve and simplify first aid and resuscitative methods on the field to basic scientific investigations designed to explore unusual and innovative technical means for temporarily suspending or stabilizing pathophysiologic processes after traumatic

A87-285            TITLE: Improved Production of Artemisinin by Artemisia Annu Under Experimental Conditions

DESCRIPTION: The anti malarial drug artemisinin (quighaosu) is obtained in very low yield from the leaves of the plant Artemesia Annu. Investigation is required such as cell culture, hydroponics and through the use of soil for the more economic production of the drug.

A87-286            TITLE: Research in Simulator/Device Mix Methodologies

DESCRIPTION: As technology expands in the area of simulation for training, the Army must determine the most effective and least costly methods of mixing devices to support training in operational units. A methodology for clustering critical tasks and sequencing the skill acquisition process across part and full task trainers would be extremely useful. Techniques are needed for examining existing and proposed simulators for their unique "niche" in the overall unit training program.

A87-287            TITLE: Optimal Presentation Strategies for Computer Based Instruction

DESCRIPTION: The combination of optimal control theory, quantitative models of learning and memory, and computer based instruction remains a promising approach to the use of technology in instruction. However, early work to develop optimal instruction based on the one-element model, the incremental model, and the random –trial increments model has not been pursued despite recent development of improved techniques for parameter estimation and more powerful models of learning and memory. We need to devise optimal approaches to instruction that capitalize on these recent developments. These approaches should be demonstrated to be either locally or (preferably) globally optimal using formal means and to be genuinely powerful instructional techniques using empirical means.

A87-288            TITLE: Developing the concepts for a Comprehensive Suite of Human Component Models Applicable for use with Meaningful Categories of Soldiers

DESCRIPTION: Computer modeling should be helpful in predicting soldier and manned system performance. However, for such models to have the most utility, they should be driven by objectively developed data rather than the opinions of experts. The purpose of this effort is to analyze human characteristics into a suite of component characteristic clusters that would, taken together, be a total model of human performance. Existing modeling and data universes need to be identified. The possibility of acquiring the data required to create new models needs to be assessed and appropriate new model development undertaken. Component models should be applicable for use with existing meaningful categorizations of Army soldiers.

A87-289            TITLE: Methods for Assessing Human Performance in Large, Complex Organizations

DESCRIPTION: Large, complex organizations, such as military combat units at the Corps level and above, involve the interaction of a multitude of physical, organizational and psychological variables. Here, a great number of systems, goals, resource, constraints, cultures and processes interact to confound the influence of individual components on overall organizational performance. As a result, it is often difficult to project the real-world impact of specific combat development initiatives on combat unit effectiveness.

A87-290            TITLE: Measurement and Models of Employment Decision Making

DESCRIPTION: Each year the Army must enlist and reenlist thousands of soldiers. In order to recruit and retain high performing soldiers, it is important to be able to understand, measure, and model the variables considered by individuals in making their decisions to join the Army or reenlist. These variables are also important in terms of the decision to enroll and continue in ROTC and to make a career as an officer in the Army.

A87-291            TITLE: Research in Artificial Intelligence for Non-Communications Electronic Warfare Systems

DESCRIPTION: In the Non-Communication EW Mission, there are several application areas that appear as likely candidates for the use of Artificial Intelligence (AI) techniques. Some of these include: ELINT System Management, Jammer Power Management, Threat Warning, Management of Unmanned Systems, Simulation, Maintenance, Training and Management of Integrated Aircraft Survivability Equipment (ASE). In each of these areas, there is a significant need for human expertise in terms of background, experience, and judgment. The primary goal in the application of AI techniques to EW systems is to capture the knowledge of experts and replicate it for use by non-experts. An extension of this goal is to replace the human operator, especially when logistic or hazardous considerations make replacement appropriate.

A87-292            TITLE: Integrated Aircraft Survivability Equipment Effectively Model

DESCRIPTION: develop a computer simulation program to evaluate the effectiveness of both on board and off-board aircraft survivability equipment (ASE). The data base should include generic radar/IR threats and existing ASE responses. Inputs should include a variation of the data base as well as new countermeasures (CM). The timing and sequence of the ASE should be variable. The effectiveness of the ASE should be measured in threat break lock or missile miss distance. The program should be compatible with a VAX 11/730 Computer.

A87-293      TITLE: Aircraft Multi-Spectral Radio Pregnancy/Electro-Optical/Infrared Countermeasures (CM).

DESCRIPTION: Analysis needs to be performed to determine how to counter weapon systems that have integrated RF/EO/IR target acquisition and tracking systems. Successful jamming of these systems may require integrated Multi-Spectral Countermeasures.

A87-294      TITLE: Advanced Infrared (IR) Source

DESCRIPTION: Infrared Countermeasures (IRCM) require the efficient generation of radiation in the 3-5 micron and 8-12 micron spectral region in order to develop compact, lightweight systems. The proposed task will explore novel materials/devices for eventual application to IRCM systems.

A87-295      TITLE: Energy-Compensated Detector and Front End Electronics for Radiometer

DESCRIPTION: Solid state (e.g., Silicon) detectors show promise of suitability for nuclear radiation survey meter applications, particularly with regard to small size and modest power demand. In the pulse counting mode of operation, however, their response is rather non-uniform, when exposed to equal dose-rates of radiation at various quantum energies. Energy compensating shielding and/or electronic techniques for charge averaging is required to ensure more uniform energy response, suitable for a compact, low-power/cost radiometer.

A87-296      TITLE: Research on Radio chronic Leuko Dye Solutions

DESCRIPTION: Radio chromic Leuko dye solutions make an excellent core materials for Radio-Chromic Optical Waveguide Dosimeters. An occasional problem is that some batches of the mix turn yellow with time without exposure to nuclear radiation. It is thought that the problem may be due to contaminants in the synthesis of the dye or peroxides in the contaminants or peroxides is needed or at least to discover a stabilizer.

A87-297      TITLE: Eagle Scanner for a Radar Cues

DESCRIPTION: Phase I (approx. \$50k) would provide for the design of a unidirectional electronic scanning antenna for a microwave radar. Phase II (approx. \$250k) would provide for the fabrication and demonstration of the antenna. The radar would be designed within the system, whose supplication would be to detect targets out of 5km and cue an existing EW system to a selected target. The Eagle scanner is an effective lower cost alternative to the more conventional individual phase shifter-per radiating element design. This project could be done by a small business antenna facility and completed within 18 months.

A87-298      TITLE: MET Balloon Improvements

DESCRIPTION: Meteorological (MET) Balloons currently in production suffer from reliability and shelf-life problems, and offer reduced performance (e.g., rate-of-ascent) relative to balloons manufactured years ago. The principal factor that induced this degradation is the fact that about 5 years ago, Government safety agencies (EPA and OHA) removed a number of hazardous chemicals from potential use, resulting in cutting off the supply of some key chemicals that had previously been used in the manufacture of MET balloons. The purpose of this task is to investigate possible areas for improving balloon manufacturing processes and materials, with the objective of

increasing MET balloon reliability and performance, and decreasing unit cost. Even a small improvement in reliability would yield a large cost savings because: (1) the Army uses a large number of MET balloons each year; and (2) the MET radiosondes carried aloft by these balloons, which are far more expensive than the balloons themselves, would enjoy a greater utilization factor.

A87-299            TITLE: Reusable Software

DESCRIPTION: As the demand for complex software increases, new technologies are being investigated to reduce the development and maintenance costs. Software reusability is one such technology which can provide significant cost reduction in both areas. Research is needed in the areas of domain analyses, methodologies, environments and libraries. The objectives include, the development and testing of prototype methodologies and tool sets for the development of reusable software modules as well as classification schemes, retrieval techniques and tools for the operation of a reusable software library.

A87-300            TITLE: Artificial Intelligence for Command and Control

DESCRIPTION: The tactics and doctrine of the modern battlefield dictate the need for intelligent machines to assist human operators. The technology associated with encapsulating knowledge and techniques used in AI to capture the reasoning process that human experts perform promises to provide a significant impact on future computer system for the military. Future military systems will be required to be self-learning and interactive. Self learning systems are systems that are able to make significant changes in their internal processing logic in response to user commands or based on demands which have been placed on the system in the past. These systems are extremely important in the military environment because they create significant operational capabilities across a diverse set of applications. They are fundamentally superior and inherently more reliable than the conventional rigid systems because they can be made more fault tolerant and possibly can be given limited properties of self-diagnosis and self repair.

In addition to self-adapting systems, the following AI technology Advances are required to insure the adequacy of future military systems:

- (1) improved man/machine interfaces
- (2) the ability to represent and reason with data that is imprecise, incomplete, not totally reliable, and varying in time.
- (3) Improved methods for knowledge acquisition
- (4) Database access strategies to include Database Management services for expert AI systems
- (5) Methods for maintaining/enhancing expert systems once they are fielded out

A87-301            TITLE: EM Propagation in Un-Ionized Media – State of the Art Assessment

DESCRIPTION: The Army 21 concept as related to real time battle field communications has underscored the need for reliability, insured connectivity and enhanced survivability of strategic, operational and tactical reciprocal communications modes (links) among national command authority, theater commanders and the battlefield arena. Electromagnetic propagation in an adverse electronic environment is an integral part of the communication network, and it impacts directly on these needs. In particular, the following specific EM propagation considerations are of interest:

1. Propagation media characteristics (ground , troposphere)
2. Techniques for assessment of media state
3. Attenuation and scattering by precipitation and other atmospheric particulates on microwave/mmwaves.
4. Propagation in vegetated environment
5. Propagation in urban/suburban environment
6. Atmospheric interface characteristics (near ground, near water, reflection, refraction, ducting)
7. Natural/man made propagation media modification
8. Diffraction and shadowing effects

9. Propagation aspects of digital signals across the electromagnetic spectrum (multipath, fading, etc.)
10. Radio noise (natural, man made and intentional)
11. Propagation aspects of satellite/earth communication (especially atmospheric & ground effects at low elevations)
12. Scatter Communications
13. Optical propagation (guided and unguided)

The objective of the task is to perform state-of-the-art assessment of the above subjects with a view towards the relation of these to the Army's goal of real time, reliable, continuous and survivable communications goal. Gaps of knowledge in these fields which need addressing to meet the Army's requirements should be identified.

A87-302            TITLE: Advanced Facilities to Expedite Design and Evaluation of Communications Systems

DESCRIPTION: Facilities are needed which will significantly reduce the time and cost to design, test, evaluate Army Communications systems. These facilities must provide the ability to quickly create realistic test cases to predict and evaluate system performance in a way that could be easily understood by combat developers as well as communications engineers. The dynamics of the battlefield must be easy to represent in an accurate manner, including air and ground vehicle motion, propagation effect in densely foliated and rough terrain based on Defense Mapping Agency data, threat systems and strategy, and user communications traffic needs. Communications systems must be easy to represent to the degree of accuracy desired, including adaptive antennas, wire and glass cable, signal processors using various spread spectrum techniques, messages and voice processors, virtual circuit and packet switches, concentrators, network controllers/managers, etc. The ease with which these items can be represented and modified for quick reaction use, and shared by many organization is paramount.

A87-303            TITLE: Software Product Assurance Cost Estimates Model

DESCRIPTION: Experience has shown that DoD must independently monitor software development/maintenance performed by contractor or government personnel in order to insure a reliable and maintenance system. However, estimating the resources required for a thorough software quality assurance and independent verification and validation effort is a difficult task. Estimating models exist which predict total product cost, schedule and personnel requirements but no known tool adequately addresses external product assurance resource estimate.

The goal of this solicitation is to develop and demonstrate the "real world" accuracy of a computerized model that predicts resource requirements for independent external product assurance coverage, The model must maximize the use of input and/or output parameters used in the DODs currently accepted version of total project software cost estimating model (i.e., SECOMO). This will eliminate redundant efforts in generating inputs or duplicating calculations.

A87-304            TITLE: Automated Tools for the Analysis or Real-Time Multiprocessor Software Design

DESCRIPTION: In order to assure that military Real-Time multiprocessor software is reliable, maintainable, testable, portable and efficient, standard practice requires a development contractor to perform a top-level and detailed design prior to code implementation. This design effort is basically defined as the allocation of requirements to a hierarchical structure of modules and the specification of intermodular data flow.

The analysis of the documented design by an independent monitoring agency is a subjective and skill/manpower intensive effort. The objective of this solicitation is to adapt existing techniques and develop new techniques which result in a more objective and automated methodology for analysis of real-time multiprocessor software design. The design evaluation variables would include software engineering principles such as cohesion, coupling, complexity, metrics for modules and subsystems, scope of effect/control and information hiding . The tool should facilitate appropriate analyses for different design methodologies and stages or levels of design. The goal of this automated methodology is to identify design problem areas such as poor structure and modularity of inefficient allocation of

functions to processors. The prototype tool would be applied to an actual military project to assess the feasibility of its widespread use.

A87-305            TITLE: Parametric Analysis of MAP Data

DESCRIPTION: Future weapons systems are expected to employ DMA map data to enhance their performance. Map data may be useful for an aid in scene feature recognition as well as autonomous navigation. An analysis should be made relating the information content in a multiple frame "Panarama" FLIR image with map information and various degrees of assumed appropriate knowledge. The degree to which a correlation can be made between map data and a sensed image should be determined for combinations of the following:

- Accuracy of known sensor parameters location, look angle, altitude, resolution
- Degree of map resolution
- Amount of map variations (i.e., number of changes and rate of change of altitude information)

This should be determined first of all for map elevation data only. Secondly, an analysis should be made as to the added usefulness of map cultural features. Although mostly a theoretical study, considerations should be made as to testing procedures with actual FLIR imagery.

A87-306            TITLE: Non-Destructive Testing of Infrared Materials, Diodes

DESCRIPTION: Development of non-destructive, non-contact techniques for evaluating the important materials parameters of infrared semiconductors used for infrared photodiode detectors. The measurements should directly relate to the ultimate diode performance and allow prediction of the properties, sensitivity, noise characteristics, responsivity at different wavelength and electrical characteristics. The methods should be applicable to cadmium mercury telluride sensitive to 12 microns radiation.

A87-307            TITLE: Automated Minimum Resolvable Delta Temperature (MRT) Test Development

DESCRIPTION: The work shall involve an analysis of a hypothetical time series of video frames of a 4-bar, 7:1 aspect ratio target to arrive at a relationship between observer probabilities of target detection and recognition and the amplitude and frequency content of the video input electrical signals and noise.

A87-308            TITLE: Integrated Multi-Wavelength Band Calibrated Digital FLIR

DESCRIPTION: Explore recent advances in IR Technology to design and perform critical experiments for radiometric simultaneous 3-5 and 9-12 micron measurements of target signatures.

A87-309            TITLE: New MOVPE-Grown FIR Detector Materials

DESCRIPTION: Fabrication of new FIR detector materials via organo-metallic vapor phase epitaxy (MOVPE), for use in the 8-14 micron spectral range. Low temperature techniques will be emphasized in these processes to off-set interface diffusion problems.

A87-310            TITLE: Epitaxial IR Materials Technology for High Performance 2<sup>nd</sup> Generation Systems

DESCRIPTION: To improve the HgCdTe epitaxial growth techniques and related substrate (CdZnTe) growth method and processing. The research must systematically attack the unknowns in the HgCdTe epitaxial growth techniques and the nature of the defects in HgCdTe and their methods of formation: their ionization energies when they act as defect dopants: and how best to grow and process detectors where the adverse effects of material defects are

minimized. Moreover, to ultimately tailor both the HgCdTe epitaxial growth method and the CdZnTe substrate growth method to the appropriate quality for high performance IR detectors.

A87-311            TITLE: Long Wavelength Infrared Detector Arrays

DESCRIPTION: Large (greater than 5000 element) Infrared detector arrays, sensitive to radiation in the 3-14 micrometer spectral region, are required for second generation FLIR target acquisition sensors. Device fabrication concepts include heterojunction diodes, metal insulator semi-conductor devices, charge injection devices, or Schotky barrier detectors. Background limited device operation, uniformity of response, and a low noise power spectral density are salient operational requirements of the array. Fabrication processes, which minimize damage to the material and provide a high yield in production are necessary to reduce array cost and to produce arrays in the desired quantities. Non-destructive in-process test methods to evaluate detector quality at interim process steps are important features of array fabrication.

A87-312            TITLE: Tunable Solid State Laser Source

DESCRIPTION: laser sources, which are tunable or can be produced to generate various wavelengths in the visible (400 nm to 700 nm), are needed for various applications. These sources must be solid state or semiconductor, efficient, reliable, and compact and capable of producing high peak powers operation. Possible sources are solid optical materials pumped by flash lamps or laser diode arrays; bulk semiconductors electrically excited by tunneling or avalanche processes, or efficient frequency up-conversion techniques combined with currently available lasers.

A87-313            TITLE: Infrared to Visible Upconversion

DESCRIPTION: Material research is sought to provide improved response, operational bandwidth, quantum efficiency, sensitivity (both magnitude and wavelength range) for the up conversion of infrared radiation to visible. Phosphors and photo-luminescent materials which can detect and display infrared radiation in reflective and transmittive modes are desired. Possible applications include the writing of information with laser diodes and displaying it in the visible for reading, and for detection of incident infrared laser radiation.

A87-314            TITLE: MID Infrared Laser

DESCRIPTION: Development of efficient methods for generation of both pulsed and continuous output laser radiation in the 3.8 to 4.2 micron spectral band. Electrical to optical output efficiency of over one percent is desired.

A87-315            TITLE: Laser Diode Array Fabrication

DESCRIPTION: The Army needs gallium aluminum arsenide laser diode arrays to pump solid state lasers such as Nd-YAG for high efficiency laser systems. Currently, these high power arrays are expensive with a cost of \$100.00 per watt of output in long pulse operation. A program to reduce the cost of producing these arrays including MOCVD growth, wafer processing, linear array bonding, and linear array testing is required. Individual contractors could address one or all of these processes to reduce costs.

A87-316            TITLE: Broadband Emitting Cathode Ray Tube

DESCRIPTION: Developmental work to produce a television cathode ray tube that will provide broadband emissions between .4 and .12 microns including appropriate electronics that will allow RS-170 and RS343, 875 line video inputs. This device must produce broadband television rate imagery without artifacts caused by thermal lag (decay time).

A87-317            TITLE: Helicopter Night Pilotage System

DESCRIPTION: a concept and demonstration is needed of a wide angle (45 degrees vertical by 90 degrees horizontal) pilotage system which is a fixed in the helicopter frame of reference. An 8 to 12 micron FLIR views the area forward of the aircraft and displays the image to pilot via a projection/display system in the cockpit. The infrared sensor should use standard components such as bobbin scanner (normally used in line scanners), Common Module detector, imager and cooler. Critical issues are display design and integration to sensor and aircraft.

A87-318            TITLE: Sharing Tactical Knowledge Across Brittle Expert System Domains

DESCRIPTION: Background: The recent flurry of expert system development has reached the point of diminishing returns, where a moderate increase in performance requires an incommensurate level of effort. Part of the problem stems from the so-called "brittleness" of an expert system, or a lack of real world knowledge beyond its constrained, narrow domain of expertise. There is a hope, however. Suppose for a moment that two brittle expert systems were to be interfaced with a tool which understands how the two might be related in the context of some larger system. Of course the two expert systems must possess some degree of commonality; for example it would make little sense to conjoin Prospector and Mycin because mineral exploration and infectious disease diagnosis and convincingly different domains. Fortunately, battlefield functional activities don't have that problem: They depend upon one another.

Assume the existence of a token-passing ring of 12 battlefield expert systems, which are willing to share knowledge across their boundaries, but have not yet been implemented to do so. There are 66 (12 objects taken 2 at a time) possible interfaces among the dozen expert systems when pair wise compared. This number at first glance seems prohibitive, but it is compensated by the generally smaller size of the required interface versus the size of the two individual expert systems being conjoined. Currently, lexicons and closed-world natural language parsers have been designed and implemented for the following set of functions: infantry, armor, artillery, air defense, engineers, logistics, signals, radio electronic combat, reconnaissance, aviation, and chemical-biological-radiological types of activity.

Task: Conceptualize, design and implement the 66 pair wise interfaces among the 12 battlefield functional expert systems. As an example, consider the interface between aviation and engineers. Engineers might clear an airstrip for aircraft during maneuvers: aviation might provide air cover for engineers during a firefight. The aviation-engineers interface would need to contain this kind of knowledge.

Bidders must possess tactical battlefield expertise (the government does not have the resources to train anyone); have unlimited access to their own dialect of Lisp (preferably Interlisp, otherwise Common Lisp, Zetalisp, or Franz Lisp); have their own computing facility (due to other commitments, the government cannot provide a computer); have a demonstrable track record in innovative artificial intelligence research focused on natural language; document a talent for not only developing new concepts but also implementing them in Lisp software just short of the advanced development level.

Desired deliverables include a final scientific/technical report, quarterly progress reports (containing entries which describe objective, approach, and progress), Lisp source code, software installation manual user's guide, and documentation.

A87-319            TITLE: Cooperating Distributed Expert Systems

DESCRIPTION: Category: Exploratory Development Independently function expert systems are now beginning to find their way to be analyst/operator workstations. Tomorrow's systems will require that these independent expert systems in a synergistically beneficial manner. To accomplish this, issues of "Knowing of Others", "Knowledge Masters", "Knowing the limits of knowledge", "Common knowledge access, and conduct of expert system transactions, among others, need to be investigated and documented. This transactions, among others, need to be investigated and documented. This effort seeks to define how small independent expert systems with distributed knowledge and functionally need to be constructed in order to cooperate and interact with each other. This effort

will require research into fundamental Expert System constructs, tools, and overall architecture to define a prototype of such an expert system. This effort will then require an implementation of a prototype networked system to be built as a proof of principle. The IBM-PS family of computers using Common Lisp/Prolong will be required vehicles for the prototype system development. This configuration closely embodies the characteristics expected in the first generation of personal expert system analyst/operator workstations that will be fielded.

A87-320            TITLE: Integrated Power Circuits

DESCRIPTION: Jammer amplifier and transmitter circuits need to be lighter and cheaper. Integrated circuit technology has made low power analog and digital circuits extremely cheap. It is desired to perform similar integration on power circuits, handling 100-400 W output power per basic power module. These power modules would be in the HF and VHF bands, e.g., 1-100 MHz, 80-400 MHz. The basic power modules would be used alone or in assemblies to make up a large transmitter. The use of integrated circuit concepts should increase reliability and decrease costs. The circuits substrate could be used for a cooling surface and the circuit could be designed mechanically to have modular, self aligning cooling passages for liquid or air cooling when assembled in large transmitters.

A87-321            TITLE: Automated Collection Management

DESCRIPTION: During a tactical engagement the collection manager is responsible for the development of an intelligence sensor collection plan, called a collection plan, which when enacted will potentially develop the necessary intelligence sensors currently available to him. This management process nominally considers a variety of factors to include target nomination and threat, a knowledge of the target operating characteristics, sensor nomination and expected accuracy, sensor vulnerability, possible effects of weather terrain, and the type/types of intelligence information sought. In addition, the collection manager will frequently attempt to merge two or more differing collection plans into a single collection plan which will potentially satisfy all of the intelligence requirements more efficiently.

Historically, those paradigms which have been developed to automate this collection management process have been inadequate primarily due to two design deficiencies. First, they have been overly simplistic. They make a series of simplifying assumptions which make the paradigm tractable but result in an uninteresting and insensitive analysis process which is generally considered inaccurate and not usable. Second, they make complex modeling assumptions which are only relevant and factual for a unique set of battlefield conditions. This type of approach (usually an artificial intelligence expert system approach) results in an algorithm which is domain-sensitive and not effective within other dissimilar tactical domains.

Due to the complexity of this collection management problem, recommend that the selected offeror prepare a scientific and technical report which should contain the following two sections. First, a thorough and scholarly review and discussion should be made of the available algorithms which could possibly be used to automate the collection management process as described. This section should contain a comprehensive bibliography and references and should demonstrate concise, logical thought and reasoning. The second section of this document should contain a persuasive description of innovative research performed by the offeror and his solution to the collection management problem. Again, this discussion must be thoroughly supported in an academic manner and must convincingly demonstrate and support the algorithms theoretical innovation, while possessing none of the critical weaknesses of those algorithms discussed in the first section of this document.

A87-322            TITLE: Expert System Design/Redesign Capability

DESCRIPTION: Today's expert systems are being individually tailored to accomplish a specific domain task. These systems do not allow for or accommodate orderly redesign as a result of change or growth from learning. Additionally, these systems do not allow for a user to tailor a generic package of a specific domain requisite functionalities/tools to design an expert system fitted to his requirements in that domain. Tomorrow's system must

be constructed in a manner to allow them to be dynamic in nature. The software maintenance costs of modification/tailoring individually specific expert systems will be too great to make them feasible on a large scale. The knowledge of how to build/modify an expert system for a specific domain learned during development must be incorporated into the systems of tomorrow. This knowledge which was learned by the original knowledge engineer must be encapsulated and passed forward and not be lost in the sands of time. This effort will require research into expert system modular structuring constructs, learning from user interrogation, conceptual system modeling, other related topics. The results of these investigations need to be documented and to define a prototype of a system concept. A small bounded implementation of the prototype system will be required for proof of principle. The IBM-PC family of computers using common Lisp/Prolog will be the required vehicles for the prototype system development. This configuration closely embodies the characteristics expected in the first generation of personnel expert analyst/operator workstations.

A87-323            TITLE: Analytic Support for Fire Support (Artillery) Robotics

DESCRIPTION: Perform analysis of the potential for the force multiplication, risk reduction (to friendly troops) and/or operation and support cost reduction through tactical employment of telerobotic fire support robotic systems for artillery. Analysis should assess opportunities to employ these systems in the current force structure through projected force structure through 2010 and should address, as a minimum, requirements for:

- Weapons system characteristics
- Platform mobility (if a mobile system)
- Level of system autonomy specifically addressing fire control
- Approaches to system command and control (including data links)
- New tactical employment options
- System expendability trades
- Sensor system and processing requirements

A87-324            TITLE: Analysis for Combat Support Robotics

DESCRIPTION: Perform analysis of the potential for the force multiplication, risk reduction (to friendly troops) and/or operation and support cost reduction through tactical employment of telerobotic and robotic manipulator systems for combat support. Analysis should assess opportunities to employ these systems in the current force structure through projected force structure through 2010 and should support, as a minimum, requirements for:

- Obstacle and minefield breaching
- Bridging
- Platform characteristics
- Manipulator characteristics (if any)
- System through put requirements
- Platform characteristics
- Manipulator characteristics (if any)
- System expendability trades
- Command and Control approaches (include data links issues)
- Sensor system and processing requirements
- Utilization in conjunction with unmanned aerial vehicles for applications such as mine detection

A87-325            TITLE: Analytic Support for Combat Service Support Robotics

DESCRIPTION: Perform analysis of the potential for the force multiplication, risk reduction (to friendly troops) and/or operation and support cost reduction through tactical employment of telerobotic and robotic manipulator systems for combat service in the current. Analysis should assess opportunities to employ these systems in the current force structure through projected force structure through 2010 and should support, as a minimum, requirements for:

- Explosive ordnance disposal
- Tactical Logistics
- System through put requirements
- Platform characteristics
- Manipulator characteristics (if any)
- System expendability trades
- Command and control approaches (include data links issues)
- Sensor system and processing requirements
- Utilization in conjunction with unmanned aerial vehicles
- For applications such as mine detection

A87-326            TITLE: Demonstration of High Lift to Drag Ratio Parafoils

DESCRIPTION: Demonstrate remotely controlled parafoil unpowered flight at a system required L/D ratio greater than six for at least 30 continuous seconds of each of three flights, with automatic soft landing of 500 pound rectangular rigid payload streamlined by inflated fabric and provide drawings and fabrication specifications sufficient to enable the Army to duplicate units and repeat test results.

A87-327            TITLE: Demonstration of High Lift to Drag Ratio Rogolo Wing

DESCRIPTION: Demonstrate remotely controlled rogolo wing unpowered flight at a system required L/D ratio greater than six for at least 30 continuous seconds of each of three flights, with automatic soft landing of 500 pound rectangular rigid payload streamlined by inflated fabric and provide drawings and fabrication specifications sufficient to enable the Army to duplicate units and repeat test results.

A87-328            TITLE: Analytic Support for Lightening the Force

DESCRIPTION: develop an analysis program using LOTUS 1-2-3 spread sheet for detailed weight analysis at the battalion level. Methodology to enable “what if” exercises wherein changing one major part of an equipment item such as track for the M-1 tank, will interactively relate the track weight, mileage life, speed limitations, O&O plan, vehicles maintenance, spaces requirement, fuel requirements, support requirements, etc., for a deep battle operation of 1, 3, 5, 7, 15, 30, days to enable evaluation of impact of such a change on total weight of different made up ballations for the selected scenarios.

A87-329            TITLE: Analytic Support for Infantry Robotics

DESCRIPTION: Perform analysis of the potential for the force multiplication, risk reduction (to friendly troops) and/or operation and support cost reduction through tactical employment of telerobotic infantry anti-armor systems for close combat light. Analysis should assess opportunities to employ these systems in the current force structure through projected force structure through 2010 and should address, as a minimum, requirements for:

- Weapons system characteristics
- Platform mobility (if a mobile system)
- Level of system autonomy specifically addressing fire control
- Approaches to system command and control (including data links)
- New tactical employment options
- System expendability trades
- Sensor system and processing requirements

A87-330

TITLE: Analytic Support for Anti-Armor heavy Robotics

DESCRIPTION: Perform analysis of the potential for the force multiplication, risk reduction (to friendly troops) and/or operation and support cost reduction through tactical employment of telerobotic anti-armor systems for close combat heavy. Analysis should assess opportunities to employ these systems in the current force structure through projected force structure through 2010. Analysis should address, as a minimum, requirements for:

- Weapons system characteristics
- Platform mobility (if a mobile system)
- Level of system autonomy specifically addressing fire control
- Approaches to system command and control (including data links)
- New tactical employment options
- System expendability trades
- Sensor system and processing requirements