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Defense Advanced Research Projects Agency



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DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1984

PROGRAM SOLICITATION
Number 84.1
Small Business
Innovation Research
Program

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SBIR Program Manager

Washington, D.C. 20301



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DOD PROGRAM SOLICITATION FOR
SMALL BUSINESS INNOVATION RESEARCH

1.0 PROGRAM DESCRIPTION

1.1 Introduction

The Department of Defense (DOD) and its Components (Army, Navy, Air Force, Defense Advanced Research Project Agency (DARPA), and Defense Nuclear Agency (DNA), (hereafter referred to as DOD Components) invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Appendix D are encouraged to participate. Subject to the availability of funds, DOD and its Components will support high quality research or research and development proposals on innovative concepts related to important defense-related scientific or engineering problems.

Objectives of the DOD-SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DOD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DOD-supported research or research and development results.

The Federal SBIR Program is mandated by public law, but the scope and intent have a solid foundation in DOD. The Department of Defense committed itself, with the inception of the Defense Small Business Advance Technology (DESAT) Program in 1981, to encourage and marshal the ingenuity and technological capability of the nation's small businesses to address problems of importance to DOD. Under DESAT, over 1000 proposals were reviewed resulting in 97 awards, totalling \$4.73 million. The commitment to encourage small business continues in the DOD SBIR program, the basic design of which is in accordance with the Small Business Administrative (SBA) National Directive, #65-01. The DOD program presented in this solicitation brochure strives to encourage scientific and technical innovation in areas specifically identified by DOD components. The guidelines presented in the next section incorporate and exploit the flexibility of the SBA National Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DOD, rather than proposals focused on and built around a specific dollar level. As in DESAT, and in accordance with the National Directive, the DOD-SBIR Program is a three phase program as described in the text that follows.

1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Innovation Development Act of 1982, Public Law 97-219. Under Phase I, DOD Components anticipate making awards during fiscal year 1984 to small businesses typically of one-half to one man-year effort over a period generally not to exceed six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under

the SBIR program. Proposals should concentrate on that research or research and development which will significantly contribute to proving the scientific or technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DOD support in Phase II.

Subsequent Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Phase II awards will typically cover 2 to 5 man-years of effort over a period generally not to exceed 24 months, subject to negotiation. The number of Phase II awards will depend upon Phase I results and availability of funds. Phase II is the principal research or research and development effort; it will require a more comprehensive proposal which outlines the proposed effort in detail.

Under Phase III, non-Federal capital is expected to be used by the small business to pursue commercial applications of the research or development. Also, under Phase III, Federal agencies may award nonSBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies.

Both Phase I and II contracts may include a profit or fee.

This solicitation is for Phase I proposals only. Any proposal submitted under SBIR solicitation DOD 83.1 will not be considered under this solicitation. However offerors who were not awarded a contract in response to a particular topic under SBIR solicitation DOD 83.1, are free to submit the same or modified proposal if it is responsive to any of the topics listed in Appendix D hereto.

For Phase II, no separate solicitation will be issued as only those sources will be considered which were awarded Phase I contracts (see 5.3 and 6.1).

DOD is not obligated to make any awards under either Phase I, II or III. DOD is not responsible for any monies expended by the proposer before award of any contract.

1.3 Follow-on Funding

In addition to supporting scientific and engineering research and development, another important goal of the solicitation is the conversion of DOD supported research or research and development into technological innovation by private firms. Therefore, on an optional basis, the DOD program includes an incentive for proposers to obtain a contingent commitment for private follow-on funding prior to Phase II to continue the innovation process where it is felt that the research or research and development also have commercial potential.

Proposers who feel that their research or research and development has the potential to meet market needs, in addition to meeting the DOD objectives, are encouraged to obtain non-Federal follow-on funding to pursue the development phase. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent on the DOD supported research or development meeting some specific technical objectives in Phase II which,

if met, would justify non-Federal funding to pursue further development for commercial purposes in Phase III. When several Phase II proposals are evaluated as being of approximately equal merit, proposals that demonstrate such a commitment for follow-on funding will receive extra consideration during the evaluation process.

The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or II, subject to the patent policies as stated in this solicitation.

1.4 Eligibility and Limitations

Each proposer must qualify as a small business for research or research and development purposes as defined in Section 2.0 and certify to this on the cover sheet (Appendix A) of his proposal. In addition, a minimum of two-thirds of each SBIR project must be carried out by the proposing firm. For Phase II a minimum of one-half of the effort must be performed by the proposing firm. For both Phase I and II the primary employment of the principal investigator must be with the small business firm at the time of award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Deviations from these requirements must be approved in writing by the contracting officer.

For both Phase I and Phase II the research or R&D work must be performed by the small business concern in the United States. "United States" means the several states, the Territories and possessions of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the District of Columbia.

Joint ventures and limited partnerships are permitted, provided the entity created qualifies as a small business in accordance with the Small Business Act, 15 USC 631, and the definition included in this solicitation.

Conflicts of Interest. Awards made to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees in violation of the Ethics in Government Act of 1978 (P.L. 95-521, as amended by P.L. 96-19 and P.L. 96-28). Such proposers should contact the cognizant Ethics Counsellor of the DOD component for further guidance.

2.0 DEFINITIONS

The following definitions apply for the purposes of this solicitation:

- 2.1 Research or Research and Development - Any activity which is (A) a systematic, intensive study directed toward greater knowledge or understanding of the subject studied; (B) a systematic study directed specifically toward applying new knowledge to meet a recognized need; or (C) a systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including

design, development, and improvement of prototypes and new processes to meet specific requirements. In DOD's R&D Program the definitions A, B, and C above correspond respectively as follows: (A) Basic Research, (B) Exploratory Development, and (C) Advanced Development or Engineering Development.

2.2 Small Business. A small business concern is one that, at the time of award of a Phase I or Phase II contract:

- (1) Is independently owned and operated and organized for profit, is not dominant in the field of operation in which it is proposing, and has its principal place of business located in the United States;
- (2) Is at least 51 percent owned, or in the case of a publicly owned business, at least 51 percent of its voting stock is owned by United States citizens or lawfully admitted permanent resident aliens;
- (3) Has, including its affiliates, a number of employees not exceeding 500, and meets the other regulatory requirements found in 13 CFR Part 121. Business concerns, other than investment companies licensed, or state development companies qualifying under the Small Business Investment Act of 1958, 15 U.S.C. 661, et seq., are affiliates of one another when either directly or indirectly (A) one concern controls or has the power to control the other; or (B) a third party or parties controls or has the power to control both. Control can be exercised through common ownership, common management, and contractual relationships. The term "affiliates" is defined in greater detail in 13 CFR 121.3-2(a). The term "number of employees" is defined in 13 CFR 121.3-2(t). Business concerns include, but are not limited to, any individual, partnership, corporation, joint venture, association or cooperative.

2.3 Minority and Disadvantaged Small Business - A small business that is:

- a. At least 51% owned by one or more minority and disadvantaged individuals; or, in the case of any publicly owned business, at least 51% of the voting stock of which is owned by one or more minority and disadvantaged individuals; and
- b. Whose management and daily business operations are controlled by one or more of such individuals.

While these individuals and small concerns will be required to compete for SBIR on the same basis as all other small business, attention will be given to a special outreach effort to ensure that minority and disadvantaged firms will have notice of this solicitation.

A minority and disadvantaged individual is defined as a member of any of the following groups: Black Americans; Hispanic Americans; Native Americans; Asian-Pacific Americans; or Asian-Indian Americans.

2.4 Women-Owned Small Business

A small business that is at least 51 percent owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

3.0 TECHNICAL TOPICS

3.1 Phase I Topic List

Topics for each DOD Component are listed and numbered separately. Topics and topic descriptions are provided in Appendix D.

4.0 PHASE I PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

4.1 Proposal Requirements

A proposal to any DOD component under the SBIR program is to provide sufficient information to persuade the DOD Component that the proposed work represents a sound approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

A proposal should be self-contained and written with care and thoroughness. Each proposal should be reviewed carefully by the offeror to ensure inclusion of all data essential for evaluation.

The scientific or technical merit of the proposed research or research and development is the primary concern for all research and development supported by the DOD. A proposal must respond to only one of the topics listed in Appendix D. An organization may submit separate proposals on different topics or different proposals on the same topic but each proposal must be limited to one topic. Where similar research and development is discussed in more than one topic description, the proposer should choose that topic the description of which appears most relevant to the proposer's technical concept.

The quality of the scientific or technical content of the proposal will be the principal basis upon which proposals will be evaluated. The proposed research or research and development must be responsive to the DOD program objectives, but can also serve as the base for technological innovation, new commercial products, processes, or services which benefit the public.

If a proposal substantially the same as the one submitted in response to this solicitation has been previously funded or is either funded by, pending with, or about to be submitted to another Federal agency or another DOD Component, or to the same DOD Component as a separate action, the proposer must so indicate and provide the information required by Section 4.4(12).

4.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 6.7.

4.3 General Content

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal of no more than 25 pages, (no type smaller than elite on standard 8 1/2" x 11" paper) including proposal cover sheet (Appendix A), Project Summary (Appendix B) and Cost Proposal (Appendix C) and any enclosures and attachments. Promotional and non-project-related discussion is discouraged. Cover all items listed below in the order given. The space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity, no additional attachments, appendices or references beyond the 25-page limitation will be considered in proposal evaluation, and proposals in excess of the 25-page limitation will not be considered for review or award.

The proposal must address the research or research and development proposed on the specific topic chosen. It is not necessary to provide a lengthy discourse on the commercial applications in the Phase I proposal except to discuss them briefly as described in Section 4.4, items 2 and 8.

4.4 Phase I Proposal Format

All pages shall be consecutively numbered.

- (1) Cover Sheet - Photocopy and complete the form in Appendix A as page 1 of each copy of each proposal.
- (2) Project Summary - Photocopy and complete the form identified as Appendix B as page 2 of your proposal. The technical abstract should include a brief description of the project objectives, and description of the effort. Anticipated benefits and commercial applications of the proposed research or research and development should also be summarized in the the space provided. The Project Summary of successful proposals will be submitted by DOD to SBA for publication and, therefore, should not contain proprietary or classified information.
- (3) Identification and Significance of the Problem or Opportunity - Define the specific technical problem or opportunity addressed and its importance. (Begin on page 3 of your proposal.)
- (4) Phase I Technical Objectives - Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

- (5) Phase I Work Plan - This section must provide an explicit, detailed description of the Phase I approach. The plan should indicate not only what is planned but how and where the work will be carried out. Phase I efforts should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.
- (6) Related Work - Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, by the proposing firm, consultants, or others, how it interfaces with the proposed project, and any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic.
- (7) Relationship with Future Research or Research and Development.
 - a. State the anticipated results of the proposed approach if the project is successful.
 - b. Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.
- (8) Potential Post Applications. Briefly describe:
 - a. Whether and by what means the proposed project appears to have potential commercial application.
 - b. Whether and by what means the proposed project appears to have potential use by the Federal Government.
- (9) Key Personnel - Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A resume of the principal investigator, including a list of publications (if any), must be included.
- (10) Facilities/Equipment - Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Appendix C) shall be justified under this Section.
- (11) Consultants - Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If such involvement is intended, it should be described in detail and included in Appendix C (if appropriate). For Phase I, the total of all consultant fees, facility leases or usage fees and other sub-contract or purchase agreements may not exceed 33% of the total contract price or cost, unless otherwise approved in writing by the contracting officer.
- (12) Current and Pending Support - If a proposal substantially the same as the one submitted in response to this solicitation has been previously funded or is either funded by, pending with, or about to be submitted

to another Federal agency, or another DOD Component or to the same DOD Component in a separate action, the proposer must provide the following information:

- a. The name and address of the agency(s) or DOD Component to which a proposal was submitted, or will be submitted, or from which an award is expected or has been received.
 - b. Date of proposal submission or date of award.
 - c. Title of proposal.
 - d. Name and title of principal investigator for each proposal submitted or award received.
 - e. Title, number, and date of solicitation(s) under which the proposal was submitted or will be submitted or under which award is expected or has been received.
 - f. If award was received, state contract number.
 - g. Specify the applicable topics for each pending SBIR proposal submitted or award received.
- (13) Cost proposal - complete the cost proposal in the form of Appendix C for the Phase I effort only. Under the direct labor category, list all key personnel by name as well as by number of hours dedicated to the project. (See also Section 6.8).
- (14) Bindings - Do not use special bindings or covers. Staple the pages in the upper left hand corner of each proposal.
- (15) Submission - in accordance with Section 7.

5.0 METHOD OF SELECTION AND EVALUATION CRITERIA

5.1 Introduction

Phase I proposals will be evaluated on a competitive basis. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. Those found to be relevant will then be evaluated using the criteria listed in Section 5.2. Final decisions will be made by the DOD Component based upon these criteria and consideration of other factors, including possible duplication of other research, and program balance. A DOD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any evaluations. There is no commitment by the DOD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been selected for contract award, a government contracting officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be necessary will be conducted between the offeror and the government contracting officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to a technical review process similar to Phase I. Final decisions will be made by DOD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research, development, program balance, and budget limitations.

5.2 Evaluation Criteria - Phase I

The DOD components plan to select for award those proposals offering the best value to the Government with approximately equal consideration given to each of the following criteria, except for number one which will receive twice the value of any other item:

- (1) The scientific/technical quality of the Phase I research or research and development proposal and its relevance to the topic description, with special emphasis on its innovation and originality.
- (2) Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.
- (3) Anticipated benefits of the research or research and development to the total DOD research and development effort.
- (4) Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

Where technical evaluations are essentially equal in merit, cost to the Government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referred-to experiments. Relevant supporting data such as journal articles, literature, including government publications, etc., should be identified in the proposal.

5.3 Evaluation Criteria - Phase II

A Phase II proposal can be submitted only by a Phase I awardee. Phase II is not initiated by a solicitation. Detailed instructions regarding Phase II proposal submission will be sent by DOD Components to all Phase I award winners. Listed below are some of the principles upon which those instructions can be expected to be based.

A Phase II proposal can be submitted at any time when progress attained under Phase I is deemed sufficient to justify the effort to be proposed for Phase II. (But see Section 6.1.) It must contain enough information on progress accomplished under Phase I by the time of Phase II proposal submission to enable an evaluation of the project's promise if continued into Phase II. The Phase II proposal will be reviewed for overall merit based upon the criteria below. Each item will receive approximately equal weight, except for item one, which will receive twice the value of any other item:

- (1) The scientific/technical quality of the proposal, with special emphasis on its innovation and originality.
- (2) The qualifications of the principal investigator and other key personnel to carry out the proposed work.
- (3) Anticipated benefits of the research or development to the total DOD research and development effort.
- (4) Degree to which the Phase I objectives were met at the time of Phase II proposal submission.
- (5) The adequacy of the Phase II objectives to meet the problem or opportunity.

Phase II proposal evaluations may include on-site evaluations by Government personnel of the Phase I effort.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the Government.

In the case of proposals of approximately equal merit, the provision of a follow-on Phase III funding commitment for continued development from non-Federal funding sources will be a special consideration. The follow-on funding commitment must provide that a specific amount of Phase III funds will be made available to or by the small business and indicate the dates the funds will be made available. It must also contain specific technical objectives which, if achieved in Phase II, will make the commitment exercisable by the small business. The terms cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The funding commitment shall be submitted with the Phase II proposal.

6.0 CONTRACTUAL CONSIDERATIONS

6.1 Awards

The number of Phase I awards will be consistent with the agency's RDT&E budget, the number of anticipated awards for interim period Phase I modifications, and Phase II contracts.

No Phase I contracts will be awarded until all qualified proposals (received in accordance with section 7.2) on a specific topic have been evaluated. Phase I selectees are expected to be notified no later than June 30, 1984. DOD Components will announce the names of those firms receiving awards.

The number of the Phase I awardees that will receive Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. Phase II is to further develop ideas explored under Phase I. Specific instructions for the preparation of Phase II proposals will be sent to Phase I awardees by the DOD Components. Those Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days prior to the expiration date of the Phase I contract and should identify in their proposal the work to be performed for the first four months of the Phase II work and the costs associated therewith.

Offerors for Phase II work who do not elect to submit a proposal 30 days prior to the expiration date of the Phase I contract, have the option to submit a proposal after the completion of the Phase I contract. The final date for receipt of a Phase II proposal will be not later than 90 calendar days after the completion of the Phase I contract.

The period of performance under Phase II will depend upon the scope of the effort, but generally will not exceed 24 months. Phase II award decisions will be based upon evaluation of progress attained under Phase I and of the Phase II proposal. Phase II awards will typically cover 2 to 5 man-years effort, depending upon the scope of research or development.

6.2 Reports

Six copies of a final report on the Phase I project must be submitted to the DOD Component in accordance with the negotiated delivery schedule. This will normally be within thirty days after completion of the Phase I effort. The final report shall include a single-page project summary as the first page identifying the purpose of the work, a brief description of the work carried out, the findings or results, and potential applications of the effort. The summary may be published by DOD and therefore must not contain proprietary or classified information. The balance of the report should indicate in detail the project objectives, work carried out, results obtained, and estimates of technical feasibility.

To avoid duplication of effort, language used to report Phase I progress in a Phase II proposal, if submitted, may be used verbatim in the final report with changes only to accommodate results obtained after Phase II proposal submission, and modifications required to integrate the final report into a self-contained, comprehensive and logically structured document.

6.3 Payment Schedule

Payments will be made in accordance with a payment schedule agreed to by the Contracting Officer. Requests for progress payments or advance payments based upon demonstrated need will be considered. The offeror shall include his cash flow requirements as part of the cost proposal submission for Phase I.

6.4 Technical Data

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this solicitation shall remain with the contractor, except that the Government

shall have the limited right to use such data for Government purposes and shall not release such data outside the Government without permission of the contractor for a period of two years from completion of the project from which the data was generated unless the data has already been released to the general public. However, effective at the conclusion of the two-year period, the Government shall retain a royalty-free license for Government use of any technical data delivered under an SBIR funding agreement whether patented or not.

6.5 Copyrights

With prior written permission of the contracting officer, the awardee normally may copyright (consistent with appropriate national security considerations, if any) material developed with DOD support. DOD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

6.6 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patentholder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the Government will not make public any information disclosing a Government-supported invention for a two-year period to allow the awardee a reasonable time to pursue a patent.

6.7 Markings of Proprietary or Classified Proposal Information

The proposal submitted in response to this solicitation may contain technical and other data, including trade secrets and/or privileged or confidential commercial or financial information, which the proposer does not want disclosed to the public or used by the Government for any purpose other than proposal evaluation.

Information contained in unsuccessful proposals will remain the property of the proposer. The government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to existing statutory and regulatory requirements.

If proprietary information is provided by a proposer in a proposal which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security, it will be treated in confidence, to the extent permitted by law, provided this information is clearly marked by the proposer with the term "confidential proprietary information" and provided the following legend appears on the title page of the proposal:

"For any purpose other than to evaluate the proposal, this data shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to this proposer as a result of or in connection with the

submission of this data, the government shall have the right to duplicate, use, or disclose the data to the extent provided in the contract. This restriction does not limit the government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in pages _____ of this proposal."

Any other legend may be unacceptable to the government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The government will limit dissemination of properly marked information to within official channels.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

"Use or disclosure of the proposal data on lines specifically identified by asterisk (*) are subject to the restriction on the cover page of this proposal."

The government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information he will be requested to expeditiously submit to the DOD Component a detailed listing of all information in his proposal which he believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DOD Component pursuant to the Act is properly determined.

Those proposers that have classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DOD 5220.22M) procedures for marking and handling classified material.

6.8 Cost Proposal

A firm fixed price or cost plus fixed fee Phase I proposal must be submitted in detail in the format shown in Appendix C. Some items of Appendix C may not apply to the proposed project. If such is the case, there is no need to provide information for each and every item. What matters is that enough information be provided to allow the DOD Component to understand how the proposer plans to use the requested funds if the contract is awarded. Both Phase I and II contracts may include a profit or fee.

(1) Special Tooling and Test Equipment, and Material

Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed.

The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. They may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired for the Government will be vested with the DOD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DOD Component.

(2) Travel

Cost for travel funds must be justified and related to the needs of the project.

(3) Cost-Sharing

Cost-sharing is permitted for proposals under this solicitation; however, cost-sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

6.9 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

- (1) Standards of Work. Work performed under the contract must conform to high professional standards.
- (2) Inspection. Work performed under the contract is subject to Government inspection and evaluation at all reasonable times.
- (3) Examination of Records. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.
- (4) Default. The government may terminate the contract if the contractor fails to perform the work contracted.
- (5) Termination for Convenience. The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.
- (6) Disputes. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.
- (7) Contract Work Hours. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).

- (8) Equal Opportunity. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
- (9) Affirmative Action for Veterans. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.
- (10) Affirmative Action for Handicapped. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
- (11) Officials Not to Benefit. No member of or delegate to Congress shall benefit from the contract.
- (12) Covenant Against Contingent Fees. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bonafide employees or commercial agencies maintained by the contractor for the purpose of securing business.
- (13) Gratuities. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.
- (14) Patent Infringement. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
- (15) Military Security requirements. The Contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.

7.0 SUBMISSION OF PROPOSALS

Five (5) copies of each proposal or modification will be submitted, in a single package, as described below.

7.1 Address

Proposals (5 copies) and modifications thereof must be addressed to that DOD Component address which is identified for each topic in each Component's section of Appendix D to this solicitation.

One copy must be an original signed by the principal investigator and an official empowered to commit the proposer. Other copies may be photocopied.

The name and address of the offeror, the solicitation number and the topic number for the proposal must be clearly marked on the face of the envelope or wrapper.

Mailed or handcarried proposals must be delivered to the address indicated for each topic. Secure packaging is mandatory. The DOD Component cannot be responsible for the processing of proposals damaged in transit.

All copies of a proposal should be sent in the same package. Do not send separate "information" copies or several packages containing parts of the single proposal.

7.2 Deadline for Proposals

Deadline for receipt (5 copies) at the DOD Component is 2:00 p.m. local time, 12 January 1984. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before an award is made, and: (1) it was sent by registered or certified mail not later than January 5, 1984; or (2) it was sent by mail and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation; or (3) it is the only proposal received.

The only acceptable evidence to establish (1) the date of mailing of a late received proposal sent either by registered mail or certified mail is the U.S. Postal Service postmark on the wrapper or on the original receipt from the U.S. Postal Service. If neither postmark shows a legible date, the proposal shall be deemed to have been mailed late. The term "postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U.S. Postal Service. Therefore, offerors should request the postal clerk to place a hand cancellation bull's-eye "postmark" on both the receipt and the envelope or wrapper; (2) the time of receipt at the Government installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation.

Proposals may be withdrawn by written notice or a telegram received at any time prior to award. Proposals may also be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal prior to award. (NOTE: the term "telegram" includes mailgrams.)

Any modification or withdrawal of a proposal is subject to the same conditions outlined above. Any modification may not make the proposal longer than 25 pages. Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

8.0 SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE

DOD Technical Information Services Available

Recognizing that small businesses may not have strong technical information service support, the Defense Technical Information Center (DTIC) is prepared to give special attention to the needs of DOD SBIR Program participants. Persons preparing SBIR Program proposals to DOD can strengthen them by contacting DTIC for bibliographic citations of unclassified technical reports

that have resulted from prior DOD-funded R&D, for copies of the technical reports which are cited in these bibliographies, and for information about DOD-sponsored work currently in progress in their proposal topic areas.

As the central source of scientific and technical information resulting from and describing R&D projects that are wholly, or partially, funded by DOD, DTIC searches this information for registered requesters. Reasonable quantities of paper or microfiche copies of requested documents are available for SBIR Program proposal preparation.

DTIC also manages nine DOD-sponsored Information Analysis Centers (IACs) which provide informational and consultative services performed by specialists doing R&D in subject and mission areas assigned to the IACs. DTIC SBIR service will include information about these and other DOD sponsored IACs.

DTIC assistance also will include references to other sources of scientific and technical information needed to prepare SBIR Program proposals to DOD. Call or visit DTIC at the following location which is most convenient to you.

All written communications with DTIC must be made to the Cameron Station, Alexandria, Va, address.

Defense Technical Information Center
ATTN: DTIC-SBIR
Building 5, Cameron Station
Alexandria, VA 22314
(800) 368-5211 (Toll free)
(202) 274-6902/03 (Commercial for
Virginia, Alaska and Hawaii)

DTIC Boston On-Line Service Facility
AFGL Research Library / SULL
Building 1103, Hanscom AFB
Bedford, MA 01731
(617) 861-2413

DTIC Los Angeles On-Line Service Facility
Defense Contract Administration Services Region
11099 South La Cienega Blvd.
Los Angeles, CA 90045
(213) 643-1108

Use reference A at the back of this solicitation to request background bibliographies and descriptions of work in progress related to those topic areas which you plan to pursue under this solicitation. DTIC will return the material you request, annotated with a temporary User Code. This User Code is to be used by you when requesting additional information or when ordering documents cited in a bibliography until the solicitation closing date.

Because solicitation response time is limited, submit your requests for DTIC'S information services as soon as possible.

9.0 CONTACT WITH DOD

9.1 Oral Communications

Oral communications with DOD Components regarding this solicitation during the Phase I proposal preparation period are prohibited for reasons of competitive fairness, with the exceptions as stated in Sections 1.4, 8.0 and 9.7

9.2 Questions Pertaining to This Solicitation

Questions pertaining to this solicitation should be addressed in writing to the address listed at the beginning of each DOD Component listing of topics (See Appendix D). No telephone requests will be accepted except as stated in Section 9.1.

9.3 Requests for Additional Copies of This Solicitation

Additional copies of this solicitation can be ordered from the Defense Technical Information Center, DTIC/SBIR, Attn: Reference Section, Cameron Station, Alexandria, Virginia 22314; (telephone (202) 274-7633.)

9.4 Information on Proposal Status

Evaluation of proposals and award of contracts will be expedited but no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

9.5 Debriefing of Unsuccessful Offerors

After final award decisions have been announced a debriefing may be provided to unsuccessful offerors, on their proposals only, upon written request.

9.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the SBIR solicitation number, specific topic number and be addressed to the DOD Component whose address is associated with each topic number.

9.7 Counseling Assistance Available

Small business firms interested in participating in the SBIR Program may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Administration Services (DCAS) activities throughout continental United States. These specialists are available to discuss general administrative requirements to facilitate the submission of proposals and ease the entry of the small high technology business into the Department of Defense marketplace. The small and disadvantaged business utilization specialists are expressly prohibited from taking any action which would give an offeror an unfair advantage over others, such as discussing or explaining the technical requirements of the solicitation, writing or discussing technical or cost

proposals, estimating cost or any other actions which are the offerors responsibility as outlined in this solicitation. (See reference C at the end of this solicitation for a complete listing, with telephone numbers, of Small and Disadvantaged Business Utilization Specialists assigned to DCAS Activities.)

9.8 Notification of Proposal Receipt

Proposers desiring notification of receipt of their proposal must complete and include a self addressed and stamped envelope and a copy of the notification form (reference B) in the back of this brochure. If multiple proposals are submitted, a separate form and envelope is required for each. Notification of receipt of a proposal by the government does not by itself constitute a determination that the proposal was received on time or not. The determination of timeliness is solely governed by the criteria set forth in section 7.2.

10.0 ADDITIONAL INFORMATION

10.1

This Program Solicitation is intended for informational purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting SBIR contract, the terms of the contract are controlling.

10.2

Before award of an SBIR contract, the Government may request the proposer to submit certain organizational, management, personnel and financial information to assure responsibility of the proposer.

10.3

The Government is not responsible for any monies expended by the proposer before award of any contract.

10.4

This Program Solicitation is not an offer by the Government and does not obligate the Government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

10.5

The SBIR program is not a substitute for existing unsolicited proposal mechanisms. Unsolicited proposals will not be accepted under the SBIR program in either Phase I or Phase II.

10.6

If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by any agency of the Federal government.

10.7

If classified material is requested or classified work is proposed and involved, the Offeror to this solicitation must have security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DOD 5220.22M).

Proposal Cover Sheet

DEFENSE SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

Topic Number: _____ Army Navy Air Force DARPA DNA

Proposal Title: _____

Submitted By: Firm _____

Address _____

City _____ State _____ Zip Code _____

Submitted to: (Activity identified with the topic) _____

Address _____

City _____ State _____ Zip Code _____

Small Business Certification:

The above firm certifies it is a small business firm and meets the definition stated in the Small Business Act 15 U.S.C. 631 and in the Definition Section of the Program Solicitation.

"The above firm certifies that it _____ does _____ does not qualify as a minority or disadvantaged small business as defined in the Definition Section of the Program Announcement."

The above firm certifies that it qualifies as a woman-owned small business firm :
Yes _____ No _____

Disclosure permission statement as follows:

All data on Appendix A is releasable information. All data on Appendix B, for an awarded contract, is also releasable.

"Will you permit the Government to disclose the information on Appendix B, if your proposal does not result in an award, to any party that may be interested in contacting you for further information or possible investment?"

Yes _____ No _____

Number of employees including all affiliates (average for preceding 12 months): _____

Proposed Cost (Phase I): _____

Proposed Duration: _____ months (not to exceed six months).

Project Manager/Principal Investigator		Corporate Official (Business)	
Name _____	_____	Name _____	_____
Title _____	_____	Title _____	_____
Signature _____	_____	Signature _____	_____
Date _____	_____	Date _____	_____
Telephone _____	_____	Telephone _____	_____

For any purpose other than to evaluate the proposal, this data shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a funding agreement is awarded to this proposer as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the funding agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in pages _____ of this proposal.

**U.S. DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH PROGRAM
PHASE 1—FY 1984
PROJECT SUMMARY**

Topic No. _____

Military Department/Agency _____

Name and Address of Proposer

Name and Title of Principal Investigator

Proposer's Title

Technical Abstract (Unclassified) (Limit To Two Hundred Words)

Anticipated Benefits/Potential Commercial Applications of the Research or Development

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COST PROPOSAL

DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

Background: The following items, as appropriate, should be included in proposals responsive to the DOD Solicitation Brochure. As an alternative to the following items, the DD Form 633 (Department of Defense Contract Pricing Proposal) may be used.

Cost Breakdown Items (in this order, as appropriate)

1. Name of offeror
2. Home office address
3. Location where work will be performed
4. Title of proposed effort
5. Topic number and topic title from DOD Solicitation Brochure
6. Total Dollar amount of the proposal (dollars)
7. Direct material costs
 - a. Purchased parts (dollars)
 - b. Subcontracted items (dollars)
 - c. Other
 - (1) Raw material (dollars)
 - (2) Your standard commercial items (dollars)
 - (3) Interdivisional transfers (at other than cost) (dollars)
 - d. Total direct material (dollars)
8. Material overhead (rate ___%) x total direct material = dollars
9. Direct labor (specify)
 - a. Type of labor, estimated hours, rate per hour and dollar cost for each type.
 - b. Total estimated labor overhead (dollars)
10. Labor overhead (specify company cost center)
 - a. For each cost center identify overhead rate, the hour base and dollar cost.
 - b. Total estimated labor overhead (dollars)
11. Special testing (include field work at Government installations)
 - a. Provide dollar cost for each item of special testing
 - b. Estimated total special testing (dollars)
12. Special equipment
 - a. If direct charge, specify each item and cost of each
 - b. Estimated total special equipment (dollars)
13. Travel (if direct charge)
 - a. Transportation (detailed breakdown and dollars)
 - b. Per Diem or subsistence (details and dollars)
 - c. Estimated total travel (dollars)
14. Consultants
 - a. Identify each, with purpose, and dollar rates
 - b. Total estimated consultants costs (dollars)
15. Other direct costs (specify)
 - a. Total estimated direct cost and overhead (dollars)
16. General and administrative expense
 - a. Percentage rate applied
 - b. Total estimated cost of G&A expense (dollars)

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17. Royalties (specify)
 - a. Estimated cost (dollars)
18. Fee or profit (dollars)
19. Total estimate cost and fee or profit (dollars)
20. The cost breakdown portion of a proposal must be signed by a responsible official, and the person signing must have typed name and title and date of signature must be indicated.
21. On the following items offeror must provide a yes or no answer to each question.
 - a. Has any executive agency of the United States Government performed any review of your accounts or records in connection with any other government prime contract or subcontract within the past twelve months? If yes, provide the name and address of the reviewing office, name of the individual and telephone/extension.
 - b. Will you require the use of any government property in the performance of this proposal? If yes, identify.
 - c. Do you require government contract financing to perform this proposed contract? If yes, then specify type as advanced payments or progress payments.
 - d. Do you now hold any contract for the same or similar work called for by this proposed contract? If yes, identify.

ARMY SMALL BUSINESS INNOVATION RESEARCH PROGRAM
SUBMITTING PROPOSALS ON ARMY TOPICS

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

Topics #1 through #3

Commander
Armaments Research and Development Center
US Army Armament Munitions and Chemical Command
Building One
ATTN: DRSMC-RAM(D)
SBIR Program
Dover, NJ 07801

Topic #4

Commander
Chemical Research and Development Center
AMC Command
ATTN: DRSMC-CLY-L(A)
Building E5101
SBIR Program
Aberdeen Proving Ground, MD 21010

Topics #5 through #9

Commander
Aviation Research and Development Command
ATTN: DRDAV-PD
Building 105
SBIR Program
4300 Goodfellow Blvd
St Louis, MO 63120

Topics #10 and #11

Commander
Communications and Electronics Command
Technical and Industrial Liaison Office
ATTN: DRSEL-PDD-PI
Building 2700
SBIR Program
Ft Monmouth, NJ 07703

Topics #12 through #20

Commander
Electronics Research and Development Command
ATTN: DRDEL-CT-R (J. Johnson)
SBIR Program
2800 Powder Mill Road
Adelphi, MD 20783

Topics #21 through #27

Commander
Mobility Equipment Research and Development Command
ATTN: DRDME-PM
Building 314
SBIR Program
Ft Belvoir, VA 22060

Topics #28 through #36

Commander
US Army Missile Command
ATTN: DRSMI-ICDA
Building 4488
SBIR Program
Redstone Arsenal, AL 35898

Topics #37 through #41

Commander
US Army Tank-Automotive Command
ATTN: DRSTA-RGI
SBIR Program
Warren, MI 48090

Topics #42 through #45

Director
Army Materials and Mechanics Research Center
ATTN: DRXMR-PP
SBIR Program
Watertown, MA 02172

Topic #46

Commander
Human Engineering Laboratory
ATTN: DRXHE-SS
SBIR Program
Aberdeen Proving Ground, MD 21005

Topics #47 through #58

Commander
US Army Natick Research and Development Laboratories
ATTN: DRDNA-EPT
Building Four
SBIR Program
Kansas Street
Natick, MA 01760

Topics #59 through #65

Commander
Construction Engineering Research Laboratory
ATTN: CERL-PP
Plans and Programs Office
P.O. Box 4005
Champaign, IL 61820

Topics #66 through #67

Commander
Engineering Topographic Laboratories
ATTN: ETL-PRO
Plans & Programs Office
Building #2592 Room AG
Ft Belvoir, VA 22060

Topics #68 through #76

Commander
Waterways Experiment Station
ATTN: WESVB
Building 1000
Box 631
Vicksburg, MS 39180

Topics #77 through #105

Commander
US Army Medical Research and Development Command
ATTN: SGRD-RMA
Ft Detrick, Frederick, MD 21701

Topics #106 through #110

Commander
US Army Research Institute for the Behavioral and Social Sciences
ATTN: PERI-PO
Room 6E06
5001 Eisenhower Avenue
Alexandria, VA 22333

Topic #111

Commander
BMD Systems Command
ATTN: Small and Disadvantaged Business Utilization Office
P.O. Box 1500
Huntsville, AL 35807

Army Research Topics for FY84 SBIR Solicitation

1. TITLE: Millimeter Wave and Submillimeter Wave Technology

DESCRIPTION: A need exists for development of improved radar fire control capability involving lightweight compact radar for low-angle track and response to arm threats, and advanced signal processing techniques.

2. TITLE: Automatic Recognition

DESCRIPTION: A need exists for development of a means of recognition of military targets which may be partially or wholly obscured by clouds, smoke, or dust and without known range to target, for improved fire control sensing and signal processing.

3. TITLE: Armament System Software Quality

DESCRIPTION: Field Maintenance Test Sets (FMTS) Acceptance - The software (Test Program Set (TPS)) is the crucial component of FMTS, because it determines diagnostic and fault isolation capabilities. The current practice of validating TPSs through fault insertion requires research in developing a statistical foundation to make accept/reject decisions using sampling techniques. Software Module RAM Measures - The advent of ADA and the Military Computer Family offers a chance to utilize standard, proven software components, or modules, as a means to improve system development in terms of Reliability, Availability, and Maintainability (RAM). To take advantage of this, software modules will not only have to be catalogued in Army-wide libraries, with excellent descriptive documentation, but will also have to be assessed and measured as to their RAM (or analogous) characteristics. Software Test Driver Design - There is need for developing design techniques which are well founded in statistics and mathematics to minimize test cost but maximize logic path coverage. Requirement Analysis Measures - The critical task in developing software is the incorporation of design requirements into computer code. The correct implementation into code of requirements such as message traffic load capacity, navigational error tolerance, etc., is assessed by analyzing the requirements in terms of completeness (adequacy of the requirements achievable and measurable statements which describe the design objectives clearly); traceability (clear relationships between component tolerance and system functional baseline); and consistency (avoidance of contradictory requirements). These terms, or attributes, must be evaluated before coding takes place. There is a need for measuring these attributes in a consistent way on all software development programs to assure that the project is ready for coding. SQAM Knowledge Engineering Data Base -Software Quality Assessment and Measurement is the control loop to the software development process. There is need for an artificial intelligence, knowledge engineering, and data base to offset what will continue to remain a critical shortage of qualified SQAM personnel in the Army.

4. TITLE: Biological and Toxin Detection and Sampling

DESCRIPTION: The US Army has need for innovative technology to collect and detect biological (pathogen) and toxin aerosols (0.1 - 10 size). Detection limits of 1 - 100 particles per liter of air are desired. Emphasis should be on technology that could result in small, lightweight detectors operating on batteries. Proposals should consider novel approaches to aerosol sampling as well as detection.

5. TITLE: Lightweight Sling Length Adaptor for Helicopter External Cargo Sling

DESCRIPTION: A need exists to conceive, design, fabricate and test a method of adjusting the length of the individual legs of nylon or Kevlar rope sling sets. An adjustor will be used with each of four external cargo sling legs which attach to the helicopter hook and terminate with a 2½- to 3-inch inside diameter loop. A 2½- to 3-inch inside diameter lift-eye or other hoisting provision is provided for attachment at the payload. Discrete adjustments in the distance between the rope sling leg loop and the payload lift-eye of between 1 and 6 feet are required. Sling length adjusters should be sized for use with 10,000-, 25,000-, and 40,000-pound sling sets and should have ultimate strength capabilities of 20,000, 40,000, and 60,000 pounds per leg, respectively. The adjustment method should allow the rigger to adjust the length in the dark basically by feel, provide positive locking, and be significantly lighter than comparable-strength metal chains and hooks.

6. TITLE: Helicopter Cockpit Ergonomics

DESCRIPTION: The aircrew of future helicopters such as the LHX will be the critical limitation in mission performance and effectiveness. Advanced technology and avionics can provide more capabilities, systems, and displays than the crewmembers can possibly exploit. Much of the proposed automation will not reduce the workload, but will simply shift it from hands-on flying to supervisory control and decisionmaking. Workload, performance, and even training must be considered in the initial design phase of future helicopter cockpits. There is a need for concentrated research to develop a predictive methodology which relates the human pilot to the proposed systems in advance of commitment to hardware development.

7. TITLE: Woven Fabric Reinforcements for Composites

DESCRIPTION: Present fabrics used in the manufacture of composite structures do not exploit the inherent multidirectional capabilities of weaves for greater fracture toughness, resistance to interlaminar stresses, and isotropy in individual plies. Innovative approaches to the systematic development of woven fabrics incorporating modern weave technology could produce improved composite structures for specific applications such as minimum gage structure, bolted joints, and thick sections.

8. TITLE: 3-D Viscous Code for Flow-Through Turbomachinery Diffusers

DESCRIPTION: Accurate correlations do not exist between design predictions and experimental performance of diffusers of centrifugal compressor stages in gas turbine engines. New approaches are required to predict the performance of high mach number diffusers for maldistribution of flow ahead of the diffusing section. The protection capability should be applicable over a broad flow range to allow the development of high-efficiency compressors.

9. TITLE: Helicopter Rotor Data Transfer System

DESCRIPTION: Current helicopter research and flight test instrumentation requires the use of mechanical slip rings or expensive, unreliable transmitter/receiver systems to transfer information such as loads and pressures measured on the rotor hub and blades to the nonrotating environment of the airframe. An innovative device for inexpensively and reliably transferring data from the rotating to fixed system is required for research and test applications and for future application to advanced rotor/control concepts.

10. TITLE: Artificial Intelligence Techniques for Tactical Decision Aids

DESCRIPTION: Current and planned C³ systems provide basic information, hopefully in a format that eases decisionmaking or the planning process itself. By applying AI techniques, the system could be given a war-gaming capability such that the system could play a scenario by treating the input of a WHAT IF . . . input. This allows the user to access the consequences of his potential commands before they are actually brought into effect. We call the particular knowledge base that is used to bring about this capability a Tactical Inference Model (TIM), as it is a model of the resources on a battlefield with the ability to infer facts from the model. The question that must be answered is: Can such a TIM with a useful decision-aiding capability be constructed in a useful form for the operation that it is designed to support?

A more advanced type of TIM would be one that adjusts its knowledge model based on feedback from its user; that is, it can consider its user as an expert, if the user so desires. This type of system suggests a response and allows the user to rate the "soundness" of the response. The system then rates the user and his response and "improves" its knowledge base accordingly. This type of system can initially be quite "dumb" and acquire the necessary knowledge through use. The major barrier for which there are not as yet practical solutions with this type of system is that consistency checks must be done on the fly.

11. TITLE: Conceptual Approaches to Novel Netted Communication Systems

DESCRIPTION: Distributed-Survivable Tactical Communications are required for the development of dispersed, survivable command and control nodes with application down to the small-unit level. The ultimate objective of this thrust is to provide systems to integrate battlefield information from all

assets on the battlefield and provide what is needed to each commander. This can be accomplished through conceptual approaches to novel netted communications systems, exploiting technological breakthroughs in microprocessors to yield orders of magnitude improvement against electronic and physical threats.

12. TITLE: Material Processing and Fabrication Techniques for Passive Millimeter Wave Devices

DESCRIPTION: Develop new and improved ferrite and dielectric materials for millimeter wave applications in order to produce high-performance, low-cost millimeter-wave devices such as phase shifters, switches, and circulators operating in the 26 GHz through 140 GHz frequency range.

13. TITLE: Aerosol Modification Techniques

DESCRIPTION: Identify and establish feasibility of methods to modify the natural and battlefield-induced aerosol components of the atmosphere in order to alter visibility for tactical advantage. Investigate and evaluate available and projected methods for altering the properties of the atmospheric aerosol to enhance or decrease its propagation characteristics. Determine the feasibility of the techniques for use on scales applicable to the battlefield.

14. TITLE: Vertical Profile Measurements of Atmospheric Turbulence

DESCRIPTION: At present the path-weighted vertical profile of atmospheric optical turbulence is being measured with a stellar scintillometer at night. Seven regions from 2.2 to 18.5 km are delineated. The need exists for new techniques that would provide better height resolution and extended ranges, as well as daytime operation.

15. TITLE: Research in ELINT/ESM

DESCRIPTION: Highly accurate, realtime detection, identification, and location of noncommunication threats across the entire battlefield area is a primary concern. Antenna, receiver, and signal processing research is required for application to intelligence, VISTA targeting, and responsive countermeasure activation.

16. TITLE: Research in Support of Electronic Warfare

DESCRIPTION: The major concern in this technology thrust area is jammer power management. Techniques applicable to standoff, high-power jammers and very lightweight penetration jammers are of interests.

17. TITLE: Research in Self-Protection Countermeasures

DESCRIPTION: This thrust is concerned with advanced countermeasures research in detection, location, and identification of radar, heat-seeker, and electro-optical threats and techniques and countering these threats.

18. TITLE: Research in Electronic Counter-Countermeasures (ECCM)

DESCRIPTION: The area of technology addresses concepts for reducing the vulnerability of electronic US Army Communications-Electronics Weapon Systems.

19. TITLE: Research in Artificial Intelligence Applied to Electronic Warfare Systems

DESCRIPTION: Techniques to improvements of EW sensors, jammers, and interactive EW systems.

20. TITLE: Signature Data Base Development

DESCRIPTION: Provide application programs that can access System 2000 data base through its procedural language interface. Provide software to generate synthetic imagery by inserting targets into different background images. Augment the information in this data base by entering target coordinates, target type, and performance statistics.

21. TITLE: Urban Warfare Explosive Detector

DESCRIPTION: Future military operations in most areas of the world will involve fighting in urban terrain. High-speed, portable devices are required to detect and locate the explosive contents of mines, booby traps, demolition charges, and remotely activated munitions concealed within this terrain. Devices which employ bioelectronic principles are of particular interest since techniques of this nature offer promise of both high specificity and high sensitivity. The term "bioelectronic" is not specifically intended to refer to attempts to synthesize in vivo physiological systems by means of electronic devices, although such approaches are not to be excluded from consideration. A strict definition of bioelectronic is withheld herein to allow bidders to exercise considerable latitude in research protocols.

22. TITLE: Research in Advanced Composites

DESCRIPTION: Feasibility of using ultrasonic excitation to enhance the liquid resin infiltration of glass fiber and graphite fiber in the preparation of organic matrix composites. An analogous study could be undertaken for the infiltration of molten metal into tows of graphic fiber and silicon carbide fiber in the making of metal-matrix composites.

23. TITLE: Thin Thermal Infrared Reflecting Materials

DESCRIPTION: Thin flexible materials (tenths to hundredths of a micron thick) are needed that reflect over 90 percent of incident thermal radiation (2.5-5.5, 7.5-14) and transmit over 90 percent of incident microwave radiation (5-250 GHz).

24. TITLE: Thin Microwave (5-250-GHz) Attenuating Materials

DESCRIPTION: Thin flexible materials (25-100 thick) are needed that absorb over 50 percent of incident microwave radiation and transmit less than 10 percent of incident microwave radiation. Emphasis should be given to the frequencies 5-20 GHz.

25. TITLE: Clarification of Turbid Natural Water by Centrifugation

DESCRIPTION: Investigate the feasibility of using centrifugation to reduce the size and weight of the clarification equipment (multimedia filter and cartridge filters). Used in Army water purification units.

26. TITLE: Destruction of Toxic Chemical Agents in Natural Water by Use of Enzymes

DESCRIPTION: Investigate the feasibility of using enzymes to destroy various toxic chemical agents in natural water being treated to produce potable field Army water supplies. Current state-of-the-art treatment requires the absorption of these agents on powered activated carbon or granular carbon columns. The simple addition of enzymes to the water purification unit feedwater could possibly provide improved water purification technology for the treatment of field Army water supply sources contaminated with chemical warfare agents.

27. TITLE: Automated Container Acquisition Systems

DESCRIPTION: Within the Logistic-Over-the-Shore (LOTS) scenario, there is the requirement to transfer containers from non-self-sustained container-ships to landing craft while in open seas. Presently, the ability to transfer at elevated sea states is impossible. Operations in other than calm seas is life threatening. In order to provide an effective interface at elevated sea states, technologies must be explored which address relative motion compensation and remote container acquisition.

28. TITLE: Automatic Acquisition Algorithms and Processors

DESCRIPTION: There is a need for automatic acquisition algorithms which process imaging data from television and infrared seekers. These algorithms should be capable of operating without gunner (operator) assistance in the adverse battlefield environment. The primary targets are tactical vehicles such as tanks, personnel carriers, and air defense guns/missile launchers. The missile system employing these sensors may be launched either from the ground or air platforms. Innovative research is needed to develop algorithms and processors which will operate in real time. Those of specific interest are given below:

a. Moving Target Algorithms - A good moving target algorithm is needed that is independent of the sensor platforms motion, operates over the whole image, detects slowly moving targets with a low false alarm rate, and operates without external input from the carrier.

b. Passive Ranging - A simple passive ranging technique is needed which will provide an estimate of range to any point in the scene without relying on inputs relative to the sensor platform orientation.

c. Prescreening/Segmentation - Algorithms are needed for this high-throughput section of the processing which can isolate the potential target areas while maintaining a balance between missed detections and excessive false alarms.

d. Processor Architecture - Unique architectural designs which can implement selected image processing functions with an increased throughput that will permit realtime operation are needed.

29. TITLE: Long-Range Fiber Optics Guidance Transmission Technology

DESCRIPTION: A need exists to investigate critical optical fiber communication and fiber payout techniques required for long-haul missile applications. Communication involves research into the components needed for long-range, wide band data links. Specific issues to be addressed include single-mode fiber, sources and detectors, and modulation techniques. Payout system concerns are winding loss evaluation, spool design, payout at missile velocity, and storage and fabrication. Results would include demonstrations of a prototype system in the laboratory environment.

30. TITLE: Evaluation of Optical Modulation Techniques for Fiber Optics Imaging Links

DESCRIPTION: A need exists to develop theoretical analysis and experimental evaluation of the modulation/encoding techniques which are applicable to any fiber optics imaging link. The transmission of video data from an imaging sensor in a missile such as the Fiber Optic Guided Missile (FOG-M) requires an encoding/decoding process for imaging data. Since the fiber link also attenuates the video signal, optimum encoding/decoding techniques are needed to preserve the signal-to-noise ratio and the signal bandwidth. Practical limitations of the fiber, modulators, and receivers also affect the quality of the image.

31. TITLE: Radio Frequency Simulation Technology

DESCRIPTION: In order for hardware-in-the-loop (HWIL) simulators to be able to effectively test and evaluate current and future state-of-the-art Army missile systems, the capabilities of current simulators must be modified and improved, and proposed simulators must be designed with cost effective, innovative simulation tools and techniques. The current concept for Radio Frequency (RF) environmental modeling requires the utilization of general-purpose computers to implement realtime models of such phenomena as clutter, multipath, and targets. This approach works well for non-high-resolution missile systems, but lacks the ability to provide a realistic environment to high-resolution systems cost effectively. There is, however, a potentially cost effective solution: Very Large Scale Integration/Very

High Speed Integrated Circuits (VLSI/VHSIC). There exists a need to investigate the compatibility of the environmental modeling requirements with VLSI/VHSIC technology and determine its applicability to implementing "algorithmic chips."

32. TITLE: Millimeter Wave Simulation Technology

DESCRIPTION: In order for hardware-in-the-loop (HWIL) simulators to be able to effectively test and evaluate current and future state-of-the-art Army missile systems, the capabilities of current simulators must be modified and improved and proposed simulators must be designed with cost effective, innovative simulation tools and techniques. Currently known HWIL simulation techniques such as the matrix array, ellipsoidal reflector, and passive reflector array have fundamental limitations in displaying the electromagnetic environmental phenomenology to millimeter wave (MMW) missile systems. A wide field of view matrix array is cost prohibitive; the ellipsoidal reflector suffers from chamber reverberations; and the passive reflector array provides only passive track in the end-game. The requirement is to investigate cost effective solutions that will provide a wide instantaneous field of view to MMW seekers and sensors continuously from detection through acquisition, track, guidance, and active/passive terminal.

33. TITLE: Multispectral Simulation Technology

DESCRIPTION: In order for hardware-in-the-loop (HWIL) simulators to be able to effectively test and evaluate current and future state-of-the-art Army missile systems, the capabilities of current simulators must be modified and improved, and proposed simulators must be designed with cost effective, innovative simulation tools and techniques. With the advent of multispectral (RF/IR or MMW/IR) seekers and sensors, simulators must be able to provide simultaneous RF and IR or MM and Infrared (IR) energy to the device under test in a single chamber. The current concept (at RF) for providing this capability requires utilization of two materials each with unique properties. The first material must be translucent to RF and reflective to IR and the second must be translucent to both and act as a lens at IR wavelengths. The requirement is to investigate the properties of a variety of materials to determine which have potential of fulfilling these properties.

34. TITLE: Pursuit Engagement Error Methodology

DESCRIPTION: The essential guidance input to establish an intercept is the pursuer's angular tracking of the target. If the tracking is corrupted by quasi-optical imperfections of the electromagnetic window, the radome of the tracking antenna, the pursuit guidance is disturbed. Such disturbances can be described statistically as the stationary spatial function of the boresight error in dependence of the look angle of the tracking antenna. During the homing engagement, this spatial function is mapped into the time domain as a noise function whose spectrum is a function of the pursuit geometry as it evolves. At the same time, the evolution of the pursuit engagement depends on the corruptive influence of the noise spectrum. Given a

spatial distribution of boresight errors (obtained via laboratory measurements) and a set of initial conditions of a pursuit engagement, the need exists for analytical methods to trace the influence of the spatial boresight error functions on the homing performance.

35. TITLE: Optimal Multimode, Real-Time Message Transmission Path Analyses

DESCRIPTION: A typical Command and Control System can have upward of 400 transmit/receiver nodes when operating in a tactical battlefield environment. The selection of an optimal multinode transmission path to achieve the highest probability of the transmission message being received is a major task in achieving effective command and control systems operations in a dynamic battlefield environment. Using expert system problem-solving methodology or knowledge base representation, the need exists to develop an efficient automated strategy for determining optimum multinode, realtime message transmission paths in a large array of receiver/transmitter nodes operating in a dynamic tactical battlefield environment. Included in this need is the requirement to keep the problem-solving methods separate from the domain-specific knowledge.

36. TITLE: Missile Flowfield Measurement Instrumentation

DESCRIPTION: There exists a need to develop instrumentation to measure the flowfield of a missile. Two critical problem areas must be solved before this can be accomplished:

Submicron Particulate - In the determination of the flowfield about a missile, physical devices that are placed in the flowfield alter the very flowfield that one is attempting to measure. In order to correct this instrumentation deficiency, nonintrusive techniques have become a necessity for missile flowfields. This is particularly necessary in the interaction regions such as the base, in the vicinity of control surfaces, and at expansion and compression regions. The technique that currently shows a tremendous amount of promise is the use of a Laser Doppler Velocimeter (LDV) to make these nonintrusive flow measurements. The limiting factor to the accuracy of the LDV is the ability of the particulate to follow the gaseous flow stream. The ability to follow the flow is dependent directly on the size of the particulate used to seed flow. There exists a need to develop a submicron particulate that can be utilized as a flowfield seed. This requires that the particulate be in the range of 0.3 micrometer or smaller. This particulate must not agglomerate in the gas flow stream.

Fluorescent Particulate - There are instances in the determination of the flowfield of a missile which require that multiple seeding of a flowfield be employed. This is particularly necessary in the base region of a missile where three distinct flow regions exist. In this mixing region there exists a need to develop a seeding technique by which a determination could be made as to the origin of the seed. One way to accomplish this is to utilize a fluorescent particle which will fluoresce in the fringe volume of an LDV. The operating conditions for the measurement tool range up to

supersonic velocities as high as mach number 3.5. This fluorescent particle must be in a size range below approximately 0.3 micrometer and must fluoresce for a period long enough to be within the LDV fringe volume. Additionally, the signal level must be measurable.

37. TITLE: Vehicle Onboard Water Generation

DESCRIPTION: Develop an onboard water generating system for a combat vehicle to eliminate the present water-carrying requirement for the extended battlefield scenario. As an example, this could be accomplished by chemical processing of air, purification of the human liquid elimination, or extraction from the engine combustion process.

38. TITLE: Vehicle Onboard Oxygen Generation

DESCRIPTION: Develop an onboard oxygen-generating system for a combat vehicle to provide a necessary amount of oxygen for the breathing need of humans. In the chemical warfare situation, at present, the breathing air is supplied to the individual after filtration of the outside air. This process needs some type of power and also creates logistical problems for providing filters.

39. TITLE: Vehicle Waste Disposal System

DESCRIPTION: Develop a method of elimination and disposal of human waste for a combat vehicle crewman dressed in chemical protective clothing. In the chemical warfare situation, it is impossible for a combat soldier to eliminate human waste due to restriction of protective clothing. A system is needed to allow elimination of human waste without complete removal of the protective clothing. If in the combat vehicle, then disposal of this waste is also a problem.

40. TITLE: Nondestructive Evaluation of Rubber-to-Metal Bond Strength

DESCRIPTION: The Army uses several parts in tank suspension systems (road-wheels, track pads and shoes, etc.), in which rubber, bonded to metal for vibration isolation, is subject to high loads which causes peeling when bond strength is marginal or low. Current ultrasonic procedures can detect unbonded rubber, but have not yet proven successful for detecting below-specification bond strength. Currently, the only method used for establishing bond strength is destructive sampling in which a percentage of the lot is destroyed, while the remaining portion of the lot goes uninspected.

A nondestructive method for determining quantitative values of bond strength is needed. Such a method would permit inspection of all rubber-to-metal bonds and eliminate asset loss due to destructive testing.

41. TITLE: Measure of Actual Tensile Closure Forces in Bolted Joints

DESCRIPTION: Currently, all military vehicles are assembled to specified torque values since torque can readily be measured. Two problems exist

with tightening to torque values: one, significant and varying amounts of torque are required to overcome a potentially wide range of bolt frictional forces in the thread and head areas resulting in a loss of torque available to generate bolt tension, and two, tightened bolts cannot be inspected without disturbing the bolted joint.

Ultrasonic measurement of bolt stretch during assembly is not acceptable because of the bolt cost and the attendant cost of record-keeping on bolt lengths.

A rapid, simple method is required for measuring bolt tensile stress through the ends of the bolt.

42. TITLE: Joining Technology

DESCRIPTION: A greater effort is needed in the development of joining technologies for combinations of materials in present and planned Army systems. Such materials would include aluminum armor, ultra-high hardness steel sheet and plate, metal-matrix composites, and bulk ceramic/metal combinations. Developments in joining technologies should address not only feasibility but also the probability for use in an industrial environment at normal production rates.

43. TITLE: Lightweight Materials and Material Systems with Improved Armor Capability

DESCRIPTION: Primary threats to structured armor systems include small-, medium-, and large-caliber high-density bullets as well as chemical energy warheads. These threats have shown a steady growth in lethality such that protection with conventional armor requires prohibitively high weights. New materials concepts are needed incorporating a capability of defeating selective munitions, surviving multiple hits, yet retaining structural capability at the lowest possible weight.

44. TITLE: Hard Coating for Optical Systems

DESCRIPTION: 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 reproducibly in a production mode.

45. TITLE: Manufacturing Methods for the Economic Fabrication and Structural Application of Fiber-Reinforced Organic Matrix Composites

DESCRIPTION: Effort would include demonstrating the feasibility of manufacturing techniques for producing components from fiber-reinforced organic matrix materials for those structural applications in which high-strength/weight or high-stiffness/weight ratios are required. Innovative

manufacturing techniques dealing with hybrids of reinforcements/polymers (thermoset or thermoplastic)/core materials are sought. Innovations may include variations of injection molding, RIM molding, resin transfer molding, including improvements in adaptive in-process controls as well as use of robotics in part/material handling. Manufacturing techniques for high service temperature polymers such as PEI, PEEK, PPQ are of interest. Manufacturing techniques for some of the new versatile structural foam materials on the market (PU, PMI, syntactic) for molding homogeneous foam cores for a variety of densities (2-8 lbs/ft³), yet maintaining structural integrity of a nomex-type core material are also of interest. Manufacturing techniques for producing ambient-temperature, rapid-cure (2-4 hour) repair kit resins including prepegs with chemical and physical properties approaching those of 350°F cure high-performance epoxies would also be applicable.

46. TITLE: Robotics

DESCRIPTION: Robotics is the topic of significant activity within the Department of the Army and DARCOM. Results of 2 years of effort in this technical area have led to an emphasis on combat service support/material handling issues as areas of maximum near-term leverage for robotics. The specific areas of technical interest include soldier-machine interface in the robotics context, high payload-to-weight manipulator structures, sensor-equipped end effectors, and passive sensing systems for field robotic application.

47. TITLE: New Lightweight, High-Tensile, Durable Small-Tent Fabric

DESCRIPTION: The Army has a need for one-man and two-man tents that are manportable, lighter, and smaller than those currently used. New tent fabrics are needed to meet these requirements as well as to provide protection against the effects of high altitude, cold weather, and light penetration.

48. TITLE: Standardization Program to Develop Standard Grade Rule (Body Growth of Garment) for Similar Clothing Items

DESCRIPTION: Extensive anthropometric data have been generated as a basis for design and sizing of clothing. Lack of standardized rules for grading similar clothing items has hindered the effective use of these data. An automated system is needed to standardize grading procedures.

49. TITLE: Novel Individual Cooling Concepts

DESCRIPTION: The Army has a need for development of novel individual cooling units which are lightweight, manportable, and would provide 1200 BTU/hr of cooling for a minimum of 6 hours, independently of any other cooling source.

50. TITLE: Regulation of Soldier Body Heat in Hot and Cold Environments

DESCRIPTION: Develop data leading to methods for regulating body heat of soldiers in extreme hot and cold environments.

51. TITLE: Thermal Radiation Suppression of Hands, Face, and Feet

DESCRIPTION: To develop a means of providing the same level of thermal camouflage for the hands, face, and feet as is provided by the soldier's uniform.

52. TITLE: Lower Emission Pollutants from Burners Using Diesel Fuel

DESCRIPTION: Burners using diesel fuels liberate about 25% more pollutants than burners using gasoline in terms of $N(O)_x$, CO, and formaldehyde. A means of reducing the amount of pollutants liberated is required.

53. TITLE: Nonpowered Automatic Controls for Use in Diesel Burners

DESCRIPTION: The burners used in military field feeding are self-contained and nonpowered. Automatic control of ignition, fuel and air mix, and flame height is needed, but they have to be nonpower operations. The design should have an allotted fuel tank with remote fuel tank operational capability.

54. TITLE: Collapsible Food Service Bowls

DESCRIPTION: Develop collapsible bowls that are sturdy, impermeable to water and oil, and can be extended to $\frac{1}{2}$ -liter capacity (slightly more than one pint). These are needed for serving stews and casseroles in remote sites.

55. TITLE: Development of an Individual Water Cooler/Heater for Combat Field Rations

DESCRIPTION: Develop a water cooler/heater for individual combat field rations capable of being transported by an individual or mounted on a vehicle.

56. TITLE: Carbon Reactivation in C P Garments

DESCRIPTION: Develop a practical means of reactivating carbon powder and fiber in a CP garment which has been subjected to vapor poisoning, without damaging the structural properties of the fabric.

57. TITLE: Portable Device for Determining Sorption of Chemical Protection Garment Materials in the Field

DESCRIPTION: A device is needed for field testing of chemically protective overgarments. Miniaturization of standard carbon tetrachloride or agent penetration devices is acceptable. Refer to MIL-C-43858A for procedures.

58. TITLE: Critical Configuration of Active Carbon from Maximum Sorptivity

DESCRIPTION: Design a method for detection of activated carbon (powder or fiber) in or on a substrate and its ability to prevent agent vapor penetra-

tion through the substrate. Also determine "filtration efficiency" of various carbon arrangements and attempt to identify critical configuration in terms of weight or packing density.

59. TITLE: Resource Leveling Technique in Construction Network Analysis

DESCRIPTION: The objective of this research is to determine if a simulation program such as "SLAM" can be used in conjunction with a network analysis program, such as PERT, to solve the resource-leveling problems associated with the use of PERT networks. The research should be done in two phases. In Phase I, the basic concept would be demonstrated in a pilot model using simple, nonprobabilistic networks (CPM networks). In Phase II, the techniques would be extended to complicated networks having probabilistic completion times (PERT networks).

60. TITLE: Construction Technology Forecasting

DESCRIPTION: The objective of this research is to develop a technology forecast of emerging trends in the construction industry. The forecast should identify any and all emerging technologies that have the potential to significantly affect building acquisition, design, and construction. The identified technologies should be ranked by the significance of their impact and by the time at which their impact will be felt. Methods and procedural changes required to exploit the new technologies should be delineated.

61. TITLE: Technologies for Diagnosing Building Energy Inefficiencies

DESCRIPTION: Over the last several years, many individual technologies have been developed to analyze various aspects of building energy efficiencies (i.e., infrared scanners, blower door test, tracer gas test, etc.). These various techniques have been mainly applied to residential buildings. Also, the integration of these techniques into an overall method for the analysis of an entire building's energy efficiency is missing. This research looks to develop new approaches to building diagnostics (particularly those which can be applied to large buildings) and to the integration of energy diagnostic techniques to give an overall building evaluation program.

62. TITLE: Advanced Technologies for Control of Heating, Ventilating, & Air Conditioning (HVAC) Systems

DESCRIPTION: This research project involves the development of optimal control equipment and strategies for HVAC systems which minimize energy and maintenance costs. Strategies must be adaptive and may involve artificial intelligence/expert system technologies. Furthermore, schemes must be capable of being implemented and maintained by relatively unskilled staff and able to diagnose system faults on equipment performance degradation.

63. TITLE: Protective Coatings for Underwater Applications

DESCRIPTION: The Corps of Engineers has many hydraulic structures which are in constant immersion in either fresh or sea water. Many of the structures include pipes, sheet pile, and other steel members which must be painted for corrosion protection; however, dewatering the structure to apply the paint is costly if not impossible. It is desired that a paint be developed which can be easily applied to these underwater structures to provide long-term corrosion protection.

64. TITLE: Portable Fuel Analysis System for Determining the Composition and Combustion Characteristics of Coal

DESCRIPTION: The proposed system would consist of a set of sampling and analytical procedures for measuring the most common composition and combustion characteristics of coal. Typical composition characteristics would be coal sizing, ash content, and sulfur content. Typical combustion characteristics would be volatile matter and fixed carbon, moisture content, free swell index, ash fusion temperature, and heat content. The procedures should be designed so that they can be adequately handled by a technician at a typical industrial-scale boiler plant. The fuel analysis system should be "portable" in that it does not involve sampling or analytical procedures which require large or complex pieces of equipment that are difficult to relocate.

65. TITLE: Testing Procedures for Asbestos in Military Facilities

DESCRIPTION: The Toxic Substances Control Act (TOSCA) prohibits the use of asbestos in new buildings and requires that old buildings such as schools be inspected for asbestos. There is a need for asbestos identification techniques that can be used in the field by technician-type personnel. The identification techniques should be specific enough to satisfy the requirements of TOSCA and be acceptable to the EPA.

66. TITLE: Soft-Copy Stereoviewing Device

DESCRIPTION: Currently there exists no integrated off-the-shelf soft-copy stereoviewing system. Stereoviewing is accomplished for the most part by using anaglyphic or polarization techniques, which are not popular with the typical operator. Optical systems in use are awkward and inefficient. Phase I will consist of an analysis of stereoviewing soft-copy techniques, which concentrates on resolution and operator comfort, and development of a design plan for such a device. Phase II will consist of fabrication and testing of a prototype device. Design goals include a resolution of at least 20-30 line pairs per mm and an ultimate production cost similar to the cost of two 1024x1024 black and white computer display devices.

67. TITLE: Consensus Theory and Expert Systems

DESCRIPTION: New strategies in decisionmaking may be needed to measure confidence associated with results derived from computer production rules

in expert system programs. The basic question here is: Are the concepts associated with fuzzy set theory and theories of evidence, such as G. Shafer's, more in keeping with what is meant by the expert's imprecise statements than are the generally used Bayesian concepts? Is it possible to develop a consistent consensus theory using the appropriate theory from probability, fuzzy sets, belief functions, resolution, and relaxation methods? Can such a consensus theory be utilized to expedite decisionmaking in expert systems as well as produce more reliable decisions?

68. TITLE: Concrete Armor Unit Instrumentation

DESCRIPTION: The purpose of this effort would be to develop a design for a low-cost, disposable, self-contained, embeddable instrument and data storage package (IDSP) and an external, portable data retrieval unit (DRU) for measuring and recording strain histories inside concrete breakwater armor units. The IDSP would be programmable prior to embedment for sampling rate and interval. The DRU would be connected to each IDSP only during data retrieval. The IDSP would be able to survive environmental conditions such as: (a) heat generated by curing; (b) impact loadings due to breaking waves and collisions between moving armor units; and (c) moisture from uncured concrete and from surrounding water entering microcracks in concrete.

69. TITLE: Terrain Signature Characterization for Mine/Minefield Detection Based on Spectral and Textural Analysis

DESCRIPTION: This effort would address the feasibility of detecting surface mines within a variety of backgrounds using high-resolution digital data presently available at the Waterways Experiment Station. The data were acquired with a multispectral scanner (MSS) system. The spectral characterizations available are: (a) 0.38 - 1.1 m (visible - near infrared) and (b) 8.5 - 12.5 m (thermal infrared). The proposed research will concentrate on investigating the ability of spectral and textural analysis based on algorithms to enhance surface mine detectability.

70. TITLE: Development of Dynamic Airblast Gage for 80,000 psi Explosive Environment

DESCRIPTION: The intended use for the gage is to measure airblast and impulse (i.e., actual impulse per unit area or the time integral of the airblast) from explosive detonations. Proposed gage should have a resonant frequency of not less than 400 kHz, be less than 3 x 3 x 3 inches, be acceleration hardened and compensated to greater than 150 kilo g's, and have a full-scale output of not less than 200 mv. The physical dimensions are critical evaluation criteria. Signal conditioners not hardened for the intended explosive environment can be no closer to the transducer than 500 feet and connected to the transducer with off-the-shelf instrumentation cable.

71. TITLE: Develop Biochemically Produced Cement

DESCRIPTION: The objective is to develop a biochemically produced cement that could be substituted for conventional portland cement. The production of portland cement is a high-energy-consumption industry. Biochemically produced cement will reduce this energy consumption and can make small, portable-scale cement-producing plants possible. The initial steps would be to develop an organism that can digest raw materials and produce as a part of its byproduct a substance that is cementitious.

72. TITLE: Development of an Ultrasonic Pulse Echo System for Evaluation of Concrete

DESCRIPTION: The repair of locks and dams will be expensive. No ultrasonic pulse echo system is commercially available for evaluating concrete like other materials. Eight years of research by Ohio State University, 3 years of research by the Army Corps of Engineers, and work by others has shown that a system is feasible. A nondestructive device is urgently needed to assess the condition of concrete in various structures.

73. TITLE: Software to Convert FORTRAN IV (CDC 6600 Computer System) Programs to FORTRAN 77 Compatible with the Harris 500 Computer System

DESCRIPTION: A number of programs written in FORTRAN IV and operating on a CDC 6600 computer system are needed on the Harris 500 computer system. Conversion is time consuming and a conversion program to automatically convert FORTRAN IV code to FORTRAN 77 code would save considerable time and cost.

74. TITLE: Software to Convert FORTRAN IV (Honeywell Computer System) Programs to Fortran 77 Compatible with the Harris 500 Computer System

DESCRIPTION: A number of programs written in FORTRAN IV and operating on a Honeywell DPS-1 computer system are needed on the Harris 500 computer system. Conversion is time consuming and a conversion program to automatically convert FORTRAN IV code to FORTRAN 77 code would save considerable time and cost.

75. TITLE: Software to Convert FORTRAN IV or FORTRAN 77 to Microsoft FORTRAN 80

DESCRIPTION: A number of programs written in FORTRAN IV and operating on a CDC 6600 computer system and in FORTRAN 77 and operating on the Harris 500 computer systems in CE Districts can be used on microcomputers with a CP/M operating system and Microsoft FORTRAN 80. Conversion will be time consuming and a program to automatically convert the existing programs to FORTRAN 80 would save considerable time and money.

76. TITLE: Automatic Computer Picking of Seismic Events from a Digitized Seismic Record

DESCRIPTION: The proposer should develop a rationale and a computer code (FORTRAN V or equivalent) for the automatic picking of a discrete seismic event (i.e., first arrival of the P-wave or S-wave) embedded in the received seismic signal. The method developed must be capable of working in a low signal-to-noise ratio environment and must discriminate to at least 0.5 milliseconds. The algorithm must be self-verifying in that it is indeed an event as opposed to a random noise spike. The rationale for selecting event start-up times and distinguishing events from noise spikes must be well documented. The computer code must be verified by demonstrating its performance on data provided by the Earthquake Engineering and Geophysics Division of the Geotechnical Laboratory, WES.

77. TITLE: Subunit Vaccines for Military-Important Diseases

DESCRIPTION: Subunit vaccines are those composed of key portions of killed microorganisms. The aim of this effort is to rid the killed microorganism of undesirable components by utilizing the techniques of microbial engineering and identifying just those parts of an organism that are able to produce immunity without side effects and to utilize genetic engineering to produce these purified antigens in large quantities.

78. TITLE: Individual Blast Overpressure Dosimeter

DESCRIPTION: There is a need for an individual blast overpressure dosimeter which will measure a 10-150-psi blast wave. The size should be the same or smaller than the present-day individual radiation dosimeter and should be able to be read without electronic equipment.

79. TITLE: Bone Substitute

DESCRIPTION: Biocompatible synthetic materials or despeciated bone are required for repair/replacement of bone to eliminate secondary surgical procedures to obtain autogenous bone for grafting.

80. TITLE: Wound Dressing

DESCRIPTION: Due to delayed evacuation for definitive treatment, a field bandage is required which can control hemorrhage, infection, and pain.

81. TITLE: Field Equipment

DESCRIPTION: Surgical, medical, and dental diagnostic and treatment items and equipment systems used by units deployed in forward combat areas must meet the following requirements: small cubic size, light weight (individual items must be one/two person portable), energy and resource efficient, and resistant to moisture or chemical agent contamination. Electronics, where required, must have a multisource capability, be electron magnetic, pulse resistant, and capable of modular replacement.

82. TITLE: Cleansing

DESCRIPTION: A non-water-requiring bathing system that does not dry the skin is required for soldiers' personal hygiene as well as nonirritating depilatory.

83. TITLE: Drugs

DESCRIPTION: A short-acting (onset within 30 minutes and duration of 6 hours) nonsedating anxiolytic that does not interfere with mentation is needed in treatment of psychiatric battle casualties.

84. TITLE: Tissue Adhesive(s)

DESCRIPTION: There is a need for an adhesive(s) for treatment of hard and/or soft tissue. The adhesive(s) should have the following characteristics: be hemostatic; can be applied to surface and/or visceral tissue; can be applied in presence of tissue fluid/blood; application system must permit delivery to a precise location; prevent seepage of fluid or cause deformation of tissue; be totally biodegradable within 90 days; its components and biodegradation products must be tissue compatible so as not to interfere with wound healing or have subsequent sequelae; can be removed with a biocompatible solvent; be quick setting; not require special storage conditions; and have a long shelf life.

85. TITLE: Dental Anesthesia

DESCRIPTION: There is a need for a rapid (approximately 5 minutes for effect) noninvasive method or agent for selective anesthesia in individual teeth. The method or agent must be able to be used by semiskilled dental auxiliary personnel in the field. An agent must be biocompatible, not require special storage conditions, and have a long shelf life.

86. TITLE: Dental Restorative Material

DESCRIPTION: There is a need for a dental restorative material for rapid treatment of dental caries in a field environment. The material should be compatible with dental and oral tissues; be adhesive/adherent to require minimal or no cavity preparation; not require etching procedures; be technique insensitive in terms of application and manipulation; can be applied in the presence of moisture; maintain cavosurface margin and functional integrity for 12-18 months; not require special storage conditions; have a long shelf life; and remain stable over a wide range of temperature/humidity conditions.

87. TITLE: Design and Synthesis of Novel Compounds as Pretreatment, Prophylaxis, and Antidotes for Chemical Warfare (CW) Agents

DESCRIPTION: New compounds based on rational scientific premise are required for evaluation to protect and/or treat personnel exposed to CW agents.

These agents include the nerve agents, hydrogen cyanide, mustard, and lewisite. Effectiveness, toxicity, ease of synthesis, and scale-up potential are important considerations in the design of these compounds.

88. TITLE: Innovative Approaches for Decontamination and Detoxification of CW Agents on Skin

DESCRIPTION: The rapid inactivation and/or removal of toxic CW agents from skin is an important consideration in the event of chemical exposure. New approaches compatible with human use and having the potential of meeting FDA guidelines are required for evaluation as potential skin decontaminants.

89. TITLE: Mechanisms of Action of Mustard

DESCRIPTION: The vesicant agent, mustard, produces a high morbidity for unprotected personnel. Little is known of the mechanism of action of mustard so that effective protection and/or treatment can be developed. Studies should attempt to define the etiology of mustard poisoning to aid in the development of effective countermeasures.

90. TITLE: Patient Dosimetry

DESCRIPTION: There is a critical need for innovative research and ultimate development of dosimetry methodology to: (1) determine exposure to chemical agents, including type of agent; (2) determine exposure dose; and (3) determine adequacy of decontamination. While the ultimate goal is a single device to accomplish required functions, innovative ideas addressing one or more required functions are required.

91. TITLE: Design and Synthesis of Novel Compounds as Prophylactic/Treatment Drugs for Radiation Injury

DESCRIPTION: New compounds based on rational, scientific premises are required for evaluation to protect and/or treat personnel exposed to radiation from nuclear weapons and/or fallout. Protection from both gamma and neutron radiation is needed, and a potential protectant must show efficacy when administered orally. Effectiveness, toxicity, stability, ease of synthesis and scale-up potential are important considerations in the design of these compounds.

92. TITLE: Miniature Performance Assessment Battery

DESCRIPTION: The human Performance Assessment Battery (PAB) currently being used by the US Army Medical Research and Development Command is a microcomputer-based testing device used to monitor changes in soldier mood and cognition. It is implemented in an Apple II Plus (6502) microcomputer with floppy disk. While suitable for laboratory use, it is not adequately militarized, miniaturized, or flexible enough to be suitable for large-scale data collection in a field setting. The requirement exists for construction of 50 small, portable, microprocessor-based test devices which emulate

the existing PAB device but which also are capable of being clustered about larger, data management microcomputers (Apple II Plus).

93. TITLE: Multisensor Chemical Detector and Measurement System

DESCRIPTION: This system is to be used in profiling gases encountered in the helicopter environment. The instrument should be able to analyze the air within an aircraft with a realtime readout of five component gases such as ammonia, carbon monoxide, total hydrocarbons, oxides of nitrogen, and hydrogen chloride. It must be portable, powered by battery, and capable of storing the data derived on magnetic tape for future reduction. Such an instrument would be used for the assessment of work environments that may be presented with the hazards of toxic gases from engine exhaust and/or gun gases.

94. TITLE: In-Flight Blood Pressure Monitor

DESCRIPTION: A blood pressure monitor that utilizes pulse wave velocity would be an asset to the physiological assessment of personnel in flight. At the present time, most blood pressure monitors utilize a manometer and sound detector to perform the analysis; however, due to the high noise and vibratory environment in aircraft (mainly helicopters), it is almost impossible to perform a blood pressure determination. Use of the pulse wave velocity, which equates the speed of the pulse wave over a standard distance with a manometer blood pressure, would be immune to the high noise and vibrations encountered in the aircraft.

95. TITLE: Miniaturized Pocket Portable Defibrillator

DESCRIPTION: Present defibrillation systems, although portable, do not interface well with medical aviation aircraft and are cumbersome when in ground ambulance and emergency rooms. This small system would be required to generate 400 watts of DC current instantaneously and possess the capacity to recycle at least three times before being recharged.

96. TITLE: Wireless 12-Lead Cardiac Monitoring System for Pulmonary Stress Testing

DESCRIPTION: Because of the continuous activity during active cardiopulmonary stress testing, electrode retention, motion noise, and AC interference can cause unacceptable lead tracing and thus difficult diagnoses. The proposed system would be required to provide the means of collecting 12-lead information through telemetry and computer sampling techniques. Computer-buffered storage of lead data would be required such that it would be reproducible for 12-leads suitable for hard copy.

97. TITLE: Literature Review and Critique of Methods to Assess Human Performance in Dynamic Vehicle/Operator Setting

DESCRIPTION: Human performance limitations are increasingly important to the US Army as increasing levels of technology and stress make human performance the weak link in weapon systems. Increasingly, operators of vehicles

are being pressed into service as weapons technicians, with an example being the decision to arm single-pilot Scout helicopters. The tasks being given to operators are often mentally absorbing and usually secondary to safe vehicle operation. A literature review and critique of methods to assess human performance in a dynamic, multitask vehicle operation setting is required to reduce duplication of effort and facilitate development of tests suitable for military vehicles and operational settings.

98. TITLE: Wind Velocity/Vector Measurement System for In-Flight Research

DESCRIPTION: The ability to measure operator (pilot) control inputs and machine (helicopter) response has progressed to the point that variations in operation (flight), due to the influence of wind force and vector, mask subtle indicators of fatigue and strain. Wind vector and force need to be determined at rates up to 20 times a second and fed to onboard computers in order that corrections for wind vector can be made and response to dynamic wind forces be documented. Such a device would be required to operate free of rotor wash artifact and operate in extremes of temperature and vibration. Ease and reliability of calibration are a must.

99. TITLE: Impact Headform Development

DESCRIPTION: The existing state of the art is the Wayne State University (WSU) "humanoid" headform. The headform has a very weak neck attachment. A headform is desired to simulate the mechanical response of the human head in a similar manner to the WSU headform, but also provide a durable neck attachment at the C2-C3 level.

100. TITLE: In-The-Ear Talk-Through Hearing Protection

DESCRIPTION: The objective is to develop a prototype device (concept evaluation) incorporating talk-through communication capability and noise limiting circuitry into earplug hearing protectors. High attenuation along with broadband-limiting characteristics are required. Research is anticipated to include technology assessment, design, prototype development, and appropriate testing and evaluation.

101. TITLE: Miniaturized Communication Transducers

DESCRIPTION: The objective is to develop miniature speakers and microphones for use in hearing protection and communication systems, in order to reduce the overall risks of noise-induced hearing loss. The principle followed is to reduce the noninformation noise components. Desired products include design specifications, prototype devices, and test and evaluation data.

102. TITLE: Survey of Contact Lenses

DESCRIPTION: The objective is to evaluate all available extended-wear contact lenses for potential use under combat aviation conditions. Laboratory test procedures (chemical and physical evaluation) would most likely be

used to quantitatively characterize each lens. Clinical and field tests may be necessary for operational evaluation. Using criteria specified by the Army, the various lenses would be compared in terms of suitability for combat use. The lenses should correct for astigmatism, be field aseptisizable (preferably chemically), be tear resistant, have favorable high oxygen permeability, be capable of being worn in a flight environment for 24 to 48 hours without removal, have a high refraction consistency during manufacture, and will not uptake or concentrate toxic materials or fumes. Based on the comparative evaluations, one or two lenses would be recommended for field evaluation by the Army.

103. TITLE: Survey of Vision Tests

DESCRIPTION: The objective is to catalog all available and developmental tests of human visual functions. Clinical and research, psychophysical and physiological procedures are all of direct interest, with a definite emphasis on objective, quantitative techniques. Once identified and described, selected tests could be given limited evaluation. The resulting catalog with supporting data base is to be used in developing new vision standards for Army aviation. The various aspects of vision to be addressed include: spatial vision, including static/dynamic visual acuity and contrast sensitivity; movement perception, including moving targets; color vision; retinal sensitivity, including adaptation and incremental change; binocular vision, including ocular rivalry; peripheral vision and perimetry; depth perception; ocular pursuit; and oculo-vestibular interactions.

104. TITLE: Dynamic Visual Acuity Tester for Field Use

DESCRIPTION: The objective is to develop a field-hardened prototype of a US Army Aeomedical Research Laboratory-developed system for testing dynamic visual acuity. The basic system provides an image on a rear-projected screen, derived from a high-resolution target projected by a two-axis scanning system controlled by integrated circuits to accomplish rotary and linear motion in four axes. The system should include a fixed viewing distance, an operator viewing port, monocular and binocular test modes, a second stationary projection system to vary the background, and be easily transportable by two persons. Developmental efforts will focus on ruggedness, portability, and reliability. Desired projects include design specification, a prototype device, and test and evaluation data.

105. TITLE: Computer Graphics Control System

DESCRIPTION: The objective is to develop software programs for controlling computer graphics displays which will be used for research in visual psychophysics and visual physiology. General and special-purpose programs are required for an existing in-house system which consists of a color tachistoscope in which color, form, and movement can be controlled independently. The major component of the system is a Genisco-3000 graphics display system (color) which can be controlled by either a PDP 1134 or LSI 11/23 control system. Desired products include computer-ready programs which are user-

compatible, programs documentation (including flow diagrams and operating manuals), and installation and debugging.

106. TITLE: Research in Leadership Development

DESCRIPTION: Research support is required for a comprehensive progressive sequential leader development program from the perspective of the total Army system. Of particular interest are: decisionmaking and decision support systems; cognitive skills assessment and development; the relations between leadership, unit/organizational effectiveness, and productivity; and senior leadership requirements.

107. TITLE: Research in Developing Optimum Methods for Measuring Job Performance

DESCRIPTION: The Army is designing a total selection and classification system that involves predictor measures (to help select the right people and place them in appropriate jobs) and performance measures (to tell us how well the soldiers perform after joining the Army). Four types of performance measures are of great importance to the Army: (1) training measures, i.e., measures of progress in the training situation; (2) MOS-specific measures, i.e., measures of actual performance on the job; (3) Army-wide measure, i.e., measures of "good soldiering" or soldier effectiveness that cut across all jobs; and (4) measures of unit effectiveness. The primary research need is for new approaches to performance assessment in each of these categories.

108. TITLE: Research in Projecting Manpower and Skill Level Requirements Early in Weapon System Development

DESCRIPTION: Historically, the system acquisition process has been driven by cost, adherence to schedule, and hardware/software performance. Recently, increased emphasis has been given to early identification of the human resources needed to operate and maintain the new systems. Accurate estimates of the number of individuals and the skills they must possess provide a basis for: (a) comparisons with estimated future supply; (b) identification of system changes to reduce operator and maintainer requirements; and (c) selection among competing systems. Innovative techniques which can be used to generate quantitative and qualitative estimates of operator and maintainer requirements on the basis of information available during concept development are needed. Procedures for estimating ability requirements are especially desired.

109. TITLE: Research in the Application of Artificial Intelligence Techniques to the Generation of Options in Planning

DESCRIPTION: It is anticipated that in tactical situations a decade or more in the future, decisionmakers and those planning large actions will be flooded with data which will have to be compiled, evaluated, and analyzed for use. Efforts are needed to determine optimal use of the computer to

assist in such operations. Current planning algorithms implemented on computers today do not provide options for the planner or decisionmaker and are not sensitive to changing constraints or environmental conditions, nor do they provide anticipated outcomes with associated probability values. Research towards the development of such systems is urgently needed.

110. TITLE: Research on Cognitive Processes in Decisionmaking Under Uncertainty and Time Stress

DESCRIPTION: Commanders, intelligence analysts, and others are often required to make decisions under conditions of uncertainty and severe time stress. Uncertainties may be associated with missing, incomplete, or ambiguous information, or with future outcomes that are unknown. Research is needed to: (1) better understand the cognitive processes (e.g., memory, judgment, or problem-solving) of the decisionmaker under such conditions, and (2) suggest approaches for supporting the cognitive processes so that the overall quality and timeliness of decisions made under uncertainty and time stress are enhanced.

111. TITLE: Algorithm Analysis and Test

DESCRIPTION: Using ballistic missile defense (BMD) effectiveness methodology, evaluate selected candidate software algorithms to establish sensitivities and performance bounds of software requirements. Algorithms to be evaluated are portions of those being developed by prime contractor for Sentry BMD system. This evaluation shall include the assessment of the generic nature of candidate algorithms to verify their adaptability to various threats, missions, and basing modes.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM
Submitting Proposals on Navy Topics

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

Topics #1 through #9

Office of Naval Research
800 North Quincy Street
BCT#1, Room 528
Arlington, VA 22217
Attn: Code 400 SBIR Program, Topic No. ____

Topics #10 through #14

Mail Address:

Commanding Officer
Naval Medical Research & Development Command
Bethesda, MD 20814
Attn: Code NMC-NCR SBIR Program, Topic No. ____

Handcarry Address:

Commanding Officer, Naval Medical Research & Development Command
Bldg. 142, Taylor Street
Bethesda, MD
Attn: Code NMC-NCR SBIR Program, Topic No. ____

Topics #15 though #31

Mail Address:

Headquarters, Naval Electronic Systems Command
Department of the Navy
Washington, D.C. 20363
Attn: Code OOK SBIR Program, Topic No. ____

Handcarry Address:

Headquarters, Naval Electronic Systems Command
Room 1E58, National Center #1
2511 Jefferson Davis Highway
Arlington, VA
Attn: Code OOK SBIR Program, Topic No. ____

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Topics #32 through #35

Mail Address:

Joint Cruise Missiles Project Office
Director of Contracts
Washington, D.C. 20363
Attn: Code JCM-28 SBIR Program, Topic No. _____

Handcarry Address:

Joint Cruise Missiles Project Office
Director of Contracts
Room 11W22, National Center #1
2511 Jefferson Davis Highway
Arlington, VA
Attn: Code JCM-28 SBIR Program, Topic No. _____

Topics #36 through #41

Mail Address:

Naval Supply Systems Command
Washington, D.C. 20376
Attn: Code SUP-033 SBIR Program, Topic No. _____

Handcarry Address:

Naval Supply Systems Command
Research and Technology Division
Room 602, Crystal Mall #3
1931 Jefferson Davis Highway
Arlington, VA
Attn: Code SUP-033 SBIR Program, Topic No. _____

Topics #42 through #52

Mail Address:

Headquarters, U.S. Marine Corps
Washington, D.C. 20380
Attn: Code LBC-2 SBIR Program, Topic No. _____

Handcarry Address:

Headquarters, U.S. Marine Corps
Room 604B, Commonwealth Building
1300 Wilson Blvd.
Arlington, VA
Attn: Code LBC-2 SBIR Program, Topic No. _____

Topics #53 through #65

Mail Address:

Commander
Naval Sea Systems Command
Department of the Navy
Washington, D.C. 20362
Attn: Code NAVSEA-0035 SBIR Program, Topic No. _____

Handcarry Address:

Commander
Naval Sea Systems Command
Room 850, Crystal Plaza #6
2221 Jefferson Davis Highway
Arlington, VA
Attn: Code NAVSEA- 0035 SBIR Program, Topic No. _____

Topics #66 through #93

Mail Address:

Naval Surface Weapons Center, White Oak
Silver Spring, MD 20910
Attn: Code S-02 SBIR Program, Topic No. _____

Handcarry Address:

Naval Surface Weapons Center, White Oak
New Hampshire Ave., Bldg. #1, Reception Room
Silver Spring, MD
Attn: Code S-02 SBIR Program, Topic No. _____

Topics #94 through #95

Mail Address:

Commander
Naval Weapons Center
China Lake, CA 93555
Attn: Code 005 SBIR Program, Topic No. _____

Handcarry Address:

Commander
Naval Weapons Center
Room 22
515 Blandy Avenue
China Lake, CA
Attn: Code 005 SBIR Program, Topic No. _____

Topics #96 through #97

Mail Address:

Naval Underwater Systems Center
New London Laboratory
New London, CT 06320
Attn: Code 10 SBIR Program, Topic No. _____

Handcarry Address:

Naval Underwater Systems Center
New London Laboratories
Bldg. 80, Room 2081
Smith Street Entrance
New London, CT
Attn: Code 10 SBIR Program, Topic No. _____

Topics #98 through #100

Mail Address:

David Taylor Naval Ship Research & Development Center
Bethesda, MD 20084
Attn: Code 003 SBIR Program, Topic No. _____

Handcarry Address:

David Taylor Naval Ship Research & Development Center
Bldg. 2, Room 113
MacArthur Blvd. & George Washington Parkway (Maryland)
Bethesda, MD
Attn: Code 012 SBIR Program, Topic No. _____

Topic #101

Mail Address:

Commanding Officer
Naval Coastal Systems Center
Panama City, FL 32407
Attn: Code 401 SBIR Program, Topic No. _____

Handcarry Address:

Commanding Officer
Naval Coastal Systems Center
Room 2C10, Bldg. 110 (Main Administrative Bldg.)
Panama City, FL
Attn: Code 401 SBIR Program, Topic No. _____

Topic #102

Naval Ocean Systems Center
271 Catalina Blvd.
Bldg. A-33, Room 1602W
San Diego, CA 92152

Topic #103 through #109

Mail Address:

Commanding Officer
Naval Weapons Support Center
Crane, Indiana 47522
Attn: Code 605 SBIR Program, Topic No. _____

Handcarry Address:

Commanding Officer
Naval Weapons Support Center
Bldg. 2917
Crane, Indiana
Attn: Code 605 SBIR Program, Topic No. _____

Topics #110 through #115

Mail Address:

Naval Training Equipment Center
Orlando, FL 32813
Attn: Code N-6 SBIR Program, Topic No. _____

Handcarry Address:

Naval Training Equipment Center
Bldg. 2005, Reception Area
Orlando, FL
Attn: Code N-6 SBIR Program, Topic No. _____

Topics #116 through #117

Mail Address:

Commanding Officer
Navy Personnel Research and Development Command
Bldg. 329
San Diego, CA 92152
Attn: Code 201B SBIR Program, Topic No. _____

Handcarry Address:

Commanding Officer
Navy Personnel Research and Development Command
Bldg. 329
Catalina Blvd. & McClellan Street
San Diego, CA
Attn: Code 201B SBIR Program, Topic No. _____

Topics #118 through #147

Mail Address:

Headquarters, Naval Air Systems Command
Department of the Navy
Washington, D.C. 20361
Attn: Code AIR-303 SBIR Program, Topic No. _____

Handcarry Address:

Headquarters, Naval Air Systems Command
Department of the Navy
Room 424 Jefferson Plaza #1
1411 Jefferson Davis Highway
Arlington, VA
Attn: Code AIR-303 SBIR Program, Topic No. _____

1. TITLE: MultiAperture Optical System Research

CATEGORY: Research

DESCRIPTION: Research is sought on optical system concepts providing object directional information via multiaperture systems such as fly-eye systems. The systems of interest would be in the 3-5 and 8-12 micrometer range, must have flexibility in shape for installation, must have potential for low cost, and must be easily manufactured and installed. Concepts for system materials and manufacturing techniques are also of interest. Performance trade offs must be made on system parameter selection.

2. TITLE: Electronics Research

CATEGORY: Research

DESCRIPTION: Proposals are solicited for basic research in electronics. Specific areas of interest include the following: (i) Solid state electronics, with emphasis on electronic materials preparation and characterization, fundamental studies of novel device structures, new fabrication processes, investigation of physical mechanisms applicable to ultra-small electronic components or interconnections between components; (ii) Algorithms and architectures for future VLSI.

3. TITLE: Energetic Cathodes for Rechargeable Lithium Batteries

CATEGORY: Research

DESCRIPTION: The purpose of this work is to explore options for improving cathodes and cathode performance in high energy density rechargeable lithium batteries. Research objectives should include the identification, preparation and characterization of cathode materials more energetic than titanium disulfide. Specific interest is in materials compatible with 2-methyltetrahydrofuran solutions, although research is not limited to these. Candidate materials need not be limited to inorganics; polymer-based materials are of interest.

4. TITLE: Solid State Electrolytes

CATEGORY: Research

DESCRIPTION: Proposals describing research on several aspects of solid state electrolytes are invited. Techniques and approaches to the synthesis and characterization of solid state materials (e.g. polymers) in which ionic conduction is high are sought. Research can include the development of techniques for preparing and processing of solid state ionically conducting materials, investigations of solid-solid interfacial phenomena which control ionic motion across such interfaces, and the formulation and exploration of potential applications of solid electrolytes. Specific materials of interest include polymers, glasses and anionic conductors.

5. TITLE: Sensing of Atmospheric Variable Constituents and Properties

CATEGORY: Exploratory Development

DESCRIPTION: Proposals are being invited addressing observational approaches to marine boundary layer problems. Techniques and ideas are sought for in-situ instrumentation for moisture, aerosols, visibility and/or remote sensing instrumentation for glide slope visibility and cloud base height. Instrumentation should be adaptable to shipboard and/or other locations. Proposals submitted should also give consideration to rapid processing and readout and effective display of data.

6. TITLE: Ocean Instrumentation

CATEGORY: Research

DESCRIPTION: Proposals are being solicited in support of new developments in ocean instrumentation. Emphasis will be on work related to devices which measure physical, geophysical, biologic and acoustic features both in-situ and remotely, and on devices which, if feasible, are expendable. Examples of such devices, and the properties to be measured are: (a) an in-situ device to measure fluctuations in the temperature and velocity microstructure of the ocean volume, (b) an efficient high power (200 dB), low frequency (125 Hz), broadband (50 Hz) acoustic source deployable on moorings up to 2 Km below the ocean surface to examine acoustic paths and mesoscale and basin-wide physical features of the ocean volume by acoustic tomography, (c) an in-situ biological sorter to examine the macrozooplankton of the ocean volume, and (d) an ultra high capacity (100 megabyte), low power, digital remote device for ocean bottom use in measuring seismic, acoustic, or other ocean bottom signals. In addition, new navigational techniques which can enhance all of the above measurements with accuracy and precision appropriate to each, are to be considered.

Emphasis will be on device production where a complete system is proposed and, if feasible, which are rapid-measuring or expendable and which involve simple deployment in the appropriate configuration.

Proposals may involve the improvement of existing techniques as well as component improvement. Utility to the basic research community to be given high priority.

7. TITLE: Quality Control for Automated Manufacture of Energetic Materials

CATEGORY: Research

DESCRIPTION: Energetic nitramine (RDX/HMX) particle filled elastomers are increasingly being used in tactical missile propellants, gun propellants and explosive warheads produced using batch manufacturing techniques. Chemically crosslinked rubbers (urethane) and physically cross linkable thermo-plastic elastomers filled for example, with particles of RDX, HMX, aluminum, or ammonium perchlorate are in various stages of development for these applications. Automated manufacture of these materials is limited by the processing science

base which is necessary to predictably minimize hazards. Control of the quality of energetic materials manufactured using high throughput, continuous processing techniques is also necessary to assure reproducibility and performance reliability. Knowledge of the physics that will permit on-line nonintrusive techniques to be devised that will sense variations in ingredient particle number density and size is needed. Knowledge of the effects of quality variations on propellant and explosive performance is also essential.

8. TITLE: Interactive Voice Work-Station for Problem Analysis

CATEGORY: Advance Development

DESCRIPTION: In a task environment where an operator's visual and psychomotor efforts must be directed elsewhere, additional communication links can be sustained through a voice-inquiry system. That system will require at least a capacity of 100 words, with a capability of expansion to a larger vocabulary, and a speech-recognition training period of no more than 3 trials per word. The system will allow for connected-word recognition of at least 5 words in the implementation of the operator's queries. The success rate of the recognition system shall be no less than 96% in a quiet task environment. Interaction with a data base and a rule-based algorithm is required so that there is a synthesized voice output to a given task solution in near real-time. The system will store the intermediate products of the problem solution so that the user may inquire about their values and states.

An interdisciplinary approach that utilizes concepts from engineering psychology, computer science, and signal processing should define an interactive system for solution of problems in near real-time.

9. TITLE: Molecular Biology and Bioelectronics

CATEGORY: Research

DESCRIPTION: Recent advances in immunological, protein and lipid technology permit the preparation of highly specific reagents that can recognize particular cell populations, infectious particles and surface molecules. The development of microgranule and microsphere techniques permit the packaging of toxic and other biological reagents in forms that are not toxic to cells until ingestion by the cells. The attachment of highly specific antibodies or lectins to the microsphere surfaces can allow the delivery of toxic or other chemicals, contained within the sphere, to selected cells. Immunoglobulins (antibodies), enzymes and lectins can be coupled to microcarriers, to plastics and to surfaces of semiconductors. The protein activity is usually stabilized as a result of such attachment and therefore this technology has industrial applications. The successful attachment of antibodies, prepared against nerve cells, to semiconductive surfaces may be important in the development of novel molecular electronic devices and of sensors, both having primary interest to the Navy. Research on the attachment of antibodies, enzymes and lectins to the external surfaces of microcarriers and semiconductors with regard to retention of biological activity is appropriate. Studies on the efficacy of coupling the microsphere to the protein reagents, before or after loading with the encapsulated ligand, is appropriate in this category. An example of the

semiconductor studies would be the demonstration that antibodies that were coupled covalently to semiconductor surfaces, such as silicon or gallium arsenide, retained their ability to bind cells with appropriate surface antigens. The demonstration that electrical discharge of the semiconductor stimulated the electrical depolarization of the attached cells would be of interest.

10. TITLE: Preparation of USP-grade, Pyrogen-free Water

CATEGORY: Advanced Development

DESCRIPTION: A system of dual reverse osmosis, ion exchange, carbon and ultrafiltration treatment is being developed for water purification aboard ships. This system will produce USP-grade pyrogen-free, sterile, injectable water for use in preparation of blood wash solutions and resuscitation fluids. The following are required prior to system procurement: Technical and operational evaluation; modifications to accommodate to sources and grade of water; a docking device for sterile filling of fluid bags.

11. TITLE: Visual Screening for Naval Aviation Candidates

CATEGORY: Advanced Development

DESCRIPTION: The visual exams, tests, and procedures used to screen naval aviator candidates at military enlistment processing stations need to be improved. The visual testing system must be accurate, reliable and easy to operate (automation is highly desirable). Tests used must be relevant to naval aviation operational requirements and designed to make cheating difficult. The system must be portable, inexpensive, and easy to maintain.

12. TITLE: Organization-wide, Integrated, Electronic Communication Network

CATEGORY: Management and Support

DESCRIPTION: The Navy medical research and development organization is composed of eleven activities in the United States and overseas. Communication could be greatly enhanced by a fully integrated network of word processors and automatic data processing (ADP) equipment. Even though each activity has ADP capability there is currently no electronic communication (i.e., electronic mail or data transfer). Concepts and ideas are solicited for an ADP system that would allow such interaction. The research should include a determination of requirements and provide discussion on feasibility and cost effectiveness.

13. TITLE: Evaluation of the Navy Occupational Health Information Monitoring System

CATEGORY: Exploratory Development

DESCRIPTION: A Navy Occupational Health Information Monitoring System (NOHIMS) is being developed for collecting, processing and displaying medical and environmental data for use in occupational illness and accident prevention programs. The NOHIMS effort requires the preparation of an evaluation plan to assess efficiency and savings in cost, time, and manpower, resulting from the use of this automated information system in a Navy regional medical command and the Navy Environmental Health Center, Norfolk, Virginia.

14. TITLE: Organization of Research and Administrative Historical Files

CATEGORY: Management and Support

DESCRIPTION: Historical files of the Naval Medical Research and Development Command are stored in file cabinets. Organization of these files could be enhanced to provide more efficient access and occupy less space. Concepts and ideas are solicited for a system of organizing the data for quick and easy reference. Cost effectiveness of the proposed system must be addressed.

15. TITLE: Basic Research in Electronics

CATEGORY: Research

DESCRIPTION: Focused basic research studies in electronics are of interest to NAVELEX in the areas of electronic materials development and fundamental device studies with emphasis on novel approaches to achieve goals of Navy interest e.g., improved radiation hardness.

16. TITLE: Low Power HF Surface Wave Communications

CATEGORY: Exploratory Development

DESCRIPTION: Low power (less than 1W) HF communications is required with a minimum data rate of 1,000 bits per second over ranges of 300 to 500 nautical miles. The transmitting antenna must be suitable for relatively small oceanographic buoys not exceeding 6' in height and 18" in diameter. The receiving antenna and radio must be portable and suitable for operation on a ship or vehicle hoisted on the beach. The data rate and ranges indicated must be achievable year round over open ocean conditions through a diurnal cycle. Hardware demonstration is desired to show performance at some site to be selected along the east coast. Support studies will project performance for different reasons and locations.

17. TITLE: Satellite Fleet Broadcast Reception

CATEGORY: Engineering Development

DESCRIPTION: Develop a simple, inexpensive means of expanding the capability of the existing satellite fleet broadcast receiver (AN/SSR-1) to permit the reception of the fleet broadcast channel from more than one satellite simultaneously and replacing the existing crystal controlled frequency selection method with a synthesized technique.

18. TITLE: Small System Applications for SSN Communications

CATEGORY: Advanced Development

DESCRIPTION: A technology assessment is required to investigate state-of-the-art data bus architectures for small systems applications and determine applicability of different architectures to submarine exterior communications.

The investigation of submarine communications system display requirements will assess applicability of video displays to the submarine exterior communications system for system status, system configuration, operator aids etc.

19. TITLE: Data Bus Technology/Application Study

CATEGORY: Advanced Development

DESCRIPTION: Data busses are a military necessity in many diverse, and expanding applications. The technology has wide interest at the federal, national (civil) and international levels (both civil and NATO). A survey is required to: (1) identify those organizations involved in developing and/or applying this technology; (2) determine the extent of data bus standardization for various applications; (3) determine trends in technology; (4) identify advantages (including estimated cost savings) and disadvantages experienced with different media, media access techniques, topologies, signal techniques or other technical characteristics identified as peculiar to data bus technology; and (5) summarize for reference the results of the survey.

20. TITLE: Frequency Agile Multicoupler

CATEGORY: Advanced Development

DESCRIPTION: Since the introduction of the HAVE QUICK anti-jamming WSC-3 radios in the fleet, frequency management and antenna proliferation problems have created radio jamming. The development of a frequency hopping multicoupler in the UHF band for shipboard use will minimize these radio jamming problems.

21. TITLE: VLF Transmit Antenna Design

CATEGORY: Exploratory Development

DESCRIPTION: A transport VLF (25-30 KHz) transmit system is being defined. The radiating element would be either the 3,000 foot tether of a tethered aerostat or a top loaded (12 radial top hat) 1,000 foot tower. The design may be applicable to either radiating element, but application to both is preferred. Design work is required to achieve an antenna efficiency of twenty percent or better, assuming a 0.0001 mho/meter ground conductivity. The hardware, including any necessary support equipment, must be reasonably transportable. The desirable features of the design are related to restrictions on site selection, installation in five days by a crew of ten people can be used as nominal upper limits for acceptability.

22. TITLE: Applications for "Personal Computers" Within NAVELEX

CATEGORY: Advanced Development

DESCRIPTION: Characterization of engineering, clerical and recordkeeping functions within NAVELEX. Estimation of efficiency increases in "throughput", decreases in cost or time and space savings, if any, resulting from the introduction of "Personal Computers" to the Command. Document thresholds and assumptions which if changed would influence the conclusion (i.e., cost of individual terminals, cost of memory, etc.).

23. TITLE: Automated Air Traffic Control

CATEGORY: Exploratory Development

DESCRIPTION: Study the many facets of automated aircraft control in the air traffic control application with particular emphasis on the utilization of JCS PUB-10 (TADIL-C), and compatibility and interoperability with JTIDS and GPS. Develop algorithms, control equations and computer software modules to demonstrate implementation of these concepts.

24. TITLE: High Resolution Beamforming for Acoustic and HF Signals

CATEGORY: Research

DESCRIPTION: The use of arrays of HF or acoustic sensors to provide information about the location and progress of ships at sea which emit radio and acoustic spectra can be greatly enhanced via the use of new signal processing techniques which take advantage of the wealth of improvements available to perform sophisticated digital processing tasks. Among these is a family of software algorithms described as eigenvector/eigenvalue solution techniques. These can be used to perform a type of optimized adaptive solution to the azimuth/elevation beamforming problem which simultaneously requires minimum aperture of the array and a minimum number of array elements compared to conventional techniques. Furthermore, clean copies of signals(s) can be derived in the presence of multipath, allowing both improved multi-array coherent processing and improved message analysis. What is needed immediately for a thorough evaluation of these techniques using real array data with the real noise characteristics, the latter being difficult to model.

25. TITLE: Low Cost Packaging of Electronic Equipment which Meets Navy Specifications

CATEGORY: Engineering Development

DESCRIPTION: The hostile environments in which Navy and Marine Corps electronic equipment must operate increases the cost of such equipment by as much as two to five times the cost of equivalent commercial systems. The purpose of this task is to: (a) Analyze the relevant military specifications which control the packaging of Navy Electronic equipment, (b) Analyze the current materials and packaging technology, (c) Determine if there are materials, techniques, methods, standards, etc., which show promise of reducing the cost of military packaging to (say) no more than 150% of commercial packaging costs. The effort shall produce a report which describes the possibilities and opportunities for reducing costs. The report shall also propose a one-to-two year program during which the possibilities and opportunities can be evaluated by building and testing prototype packaging of selected electronic equipment.

26. TITLE: EMI Prediction

CATEGORY: Research

DESCRIPTION: Develop analytical techniques to predict task force Electromagnetic Interference (EMI) levels resulting from natural and man-made electromagnetic emissions. Techniques to predict EMI levels at specific shipboard emitter locations is required.

27. TITLE: Multi-Color IR Sensor Technology

CATEGORY: Exploratory Development

DESCRIPTION: A new, affordable multi-color infrared sensor technology has been developed using multiple layers of epitaxial semiconductor alloy films. Spectral sensitivity, which ranges from 2 to 15 microns, is controlled by the alloy composition of the layers. Such integrated layers sensors could impact heavily on infrared guidance, fuzing and surveillance systems. The sensor's ability to generate signals in different electrical channels corresponding to the different IR colors in the scene, enables the system to distinguish between real and false targets. The technology, however, must be industrialized before it can be used in military systems.

28. TITLE: Digital Dosimeter Prototype Development

CATEGORY: Exploratory Development

DESCRIPTION: NSWC/WO has demonstrated a novel concept for a personnel radiation dosimeter which is inherently digital and quite sensitive. The device is made from standard semiconductor chips. The concept is to count the errors produced by ionizing radiation in computer memory circuits. The count of errors is a direct measure of the radiation dose to which the device has been exposed. The prototype device should incorporate various converters to control the response. It will probably make use of hybrid circuit technology. In addition to Navy applications the device should have wide use in the civilian radiation protection area.

A small business responding to this solicitation should have the capability of designing and building small lots of digital circuits using purchased chips. A capability of fabricating hybrid circuits would be a definite asset. Knowledge of radiation dosimetry would be a plus but is not essential.

29. TITLE: Imaging Infrared Scene Projection

CATEGORY: Exploratory Development

DESCRIPTION: A device is required for projecting realistic dynamic infrared scenes to imaging sensors in the laboratory. The primary requirement is in the 3 to 5 um spectral band. At least 500 lines of information are required over a 6 degree field-of-view, updated at a 60 hz field rate. The device must be capable of producing at least 100 shades of grey and the frame-to-frame flicker must be no more than 5 percent. The apparent source temperature range is from zero to 600 degrees centigrade.

30. TITLE: Broadband (Multioctave) Components and Monopulse Networks

CATEGORY: Advanced Development

DISCRIPTION: The increasing use of J-band (10 to 20 GHz) and K-band (20 to 40 GHz) for radar directed gun systems, missile homing systems, data links, battlefield portable radars, and surveillance systems has outpaced the

capabilities of counter antiradiation and ESM equipments. New theory and techniques for increased bandwidth and upper frequency extension are needed for stripline components and networks. New TEM stripline geometries that reduce the critical tolerance requirements but allow mass production with low cost manufacturing techniques are urgently required.

31. TITLE: Photodeposition of Metal for Multilayer Printed Circuit Boards

CATEGORY: Exploratory Development

DESCRIPTION: Devise a method of photodeposition of metals useful in printed circuits and hybrid circuits to meet the following requirements. (1) Metal runs no wider than 0.002 inch; (2) Spaces between metal runs no wider than 0.002 inch; (3) Demonstrate ability to fabricate multiple layers of metal runs in dielectric materials suitable for electronics applications.

32. TITLE: Tactical Weapons Effectiveness Study of a Land Attack Missile Using an Autonomous Forward Looking Sensor to Improve Terminal Accuracy

CATEGORY: Exploratory Development

DESCRIPTION: The cruise missile type weapons can provide long range attack against land based targets using conventional warheads. The desire is to provide a non-nuclear option for certain critical high value targets. Some of the target types will require precision terminal homing to achieve a kill using conventional warheads.

The purpose of this study will be to evaluate the effectiveness of various forward looking sensors (IIR, LASER, MMW, RAC etc.) and algorithms to achieve the precise terminal homing required. Because of the long range it is desired that this be autonomous. The targeting aspects to do mission planning for a tactical weapon shall be addressed in terms of requirements, assets required and quick response time.

33. TITLE: Compile and Investigate Advance DSMAC Algorithms to Improve Operational Performance

CATEGORY: Exploratory Development

DESCRIPTION: The cruise missile uses a Digital Scene Matching Area Correlation (DSMAC) system for precision update of its inertial system. This task is to compile and investigate advance correlation algorithms, feature recognition or other updating schemes.

Part one will evaluate algorithms and techniques that are compatible with its existing DSMAC hardware, mission planning hardware, software and operational limitations.

Part two will evaluate new and optimum techniques within the practical limits of hardware, software and operational use.

34. TITLE: Evaluate the Technical Feasibility of a Flush Mounted Radar Altimeter Antenna with a Controllable Radiation Pattern (Beam Steering)

CATEGORY: Advanced Development

DESCRIPTION: This task is to evaluate the technical feasibility of a flush mounted antenna system that has a radiation pattern controllable in two axis by the missile inertial platform to compensate for missile air vehicle attitudes. The antenna system must be compatible with the present missile radar altimeter system that requires separate transmit and receive antennas with isolation greater than 85dB. The purpose is to provide a beam steerable antenna that always points at the ground with low sidelobes and medium to high gain inbeam for good tracking and high ECM resistance in a dynamic environment. The antenna system must be nuclear hardenable in production.

35. TITLE: Effectiveness Study of Cooperative Target Recognition and Homing

CATEGORY: Exploratory Development

DESCRIPTION: The cruise missile systems may be enhanced by exploiting threat radiations for target classification, recognition and guidances aiding (homing). This study would compile and evaluate the effectiveness of the various Electronic Support Measures (ESM) concepts for use in a missile platform. The missions will include cueing for both ships and land type targets (Defense Suppression, C³, Radar etc.). The study should include various receiver techniques and algorithms including classical ESM, FMOP, FFTs, and unintentional radiated emissions and provide an analysis of the mission planning aspects of obtaining and using the required signatures.

36. TITLE: Encoding of Color Graphics Image

CATEGORY: Advanced Development

DESCRIPTION: Microcomputer based systems which can be used to produce specific types of color graphics presentation materials are now available. A scheme for the digital encoding of these images is required in order to permit the archival of these images and their transmission to aid replication on a variety of output devices.

37. TITLE: Effect of Print on Demand Capabilities on Documentation Management

CATEGORY: Advanced Development

DESCRIPTION: The availability of electronic page printers has made it possible to store and print copies of forms and documents such as specifications, standards, instructions, etc. as needed. An assessment of the economic impact of this capability is required as well as an estimate of its effect on traditional documentation management practices.

38. TITLE: The Use of "Expert Systems" Theory in Inventory Control Applications

CATEGORY: Advanced Development

DESCRIPTION: The objective of this effort is to develop and test the procedures required to utilize "Expert Systems" Theory in inventory control and maintenance repair decision making. At inventory control points, recommendations on procurement quantities are generated by programmed decision rules (reorder level, reorder point). Review of these recommendations are made by commodity managers utilizing their experience and expertise. This expertise needs to be incorporated into "Expert Systems" procedures.

39. TITLE: Availability Centered Inventory Model (ACIM) Utilization Requirements

CATEGORY: Management and Support

DESCRIPTION: Determine the specifications needed to utilize the ACIM (Availability Centered Inventory Model) in an inventory control point data processing environment. The ACIM will be used for determining levels of supply support. Specifications are to include hardware configuration and software requirements needed to exercise the model.

40. TITLE: Determination of Spares and Repair Part Prices

CATEGORY: Advanced Development

DESCRIPTION: Develop techniques for verifying the reasonableness of spares and repair part prices prior to contract award including the possibility of utilizing online visual display of the item to be procured.

41. TITLE: Model for Assessment of Contractor Performance

CATEGORY: Advanced Development

DESCRIPTION: Develop a model (techniques) for assessing contractor performance. Effort is to include the identification and measurement of relevant parameters indicating the success of the contractor in meeting performance objectives.

42. TITLE: Minefield Location and Identification System

CATEGORY: Exploratory Development

DESCRIPTION: Design and construct an instrument or system that can locate and identify minefields up to 20 miles from the operator; conversely, a "negative" indicator from the item must occur only when no minefields are present.

Item must be transportable on a tactical wheeled vehicle and maintainable and operable in a combat environment.

43. TITLE: Development Plan for Modernization of MTACCS*

CATEGORY: Exploratory Development

DESCRIPTION: The modernization of the components of tactical ground command and control systems due to advancing technology and changing functional needs, requires a 5 to 10 year development cycle. Since modernization is outside the

scope of normal maintenance and modification, research and development is required to accomplish product improvements. The systems of MTACCS are developing, however planning must be undertaken now to incorporate product improvement in functionality, survivability, endurance and capability. A plan is needed to identify appropriate areas for product improvement and to acquire the necessary products. Specific projects being considered currently are fiber optics for MIFASS/TCO** & PLRS,*** increase memory density for MIFASS**** mass memory units, incorporation of NBC protection, use of kelvar armor plating, software improvements/upgrades/interface for MIFASS/TCO and PLRS, upgrade of PLRS computer, large screen display for MIFASS/TCO & interfaces to TWSEAS***** from PLRS and MIFASS/TCO.

- * Marine Tactical Command and Control Systems
- ** Tactical Combat Operation System
- *** Position Location Reporting System
- **** Marine Integrated Fire and Air Support System
- ***** Tactical Warfare Simulation Evaluation Analysis System

44. TITLE: Optimum Payload Sizes for Tactical Vehical Fleet of Future

CATEGORY: Management and Support

DESCRIPTION: Tactical Vehicle Fleet (TVF) currently has three (3) elements: the light fleet having a payload capacity of two (2) tons; the medium fleet having a payload capacity of four (4) to six (6) tons; and a heavy fleet having a payload capacity of ten (10) to twenty-five (25) tons with the capacity to tow trailers with up to seventy (70) tons. Considering current and future roles of the Marine Corps, it is necessary to determine the optimum payload for each element of tactical vehicle fleet to meet future Marine Corps needs.

45. TITLE: Tactical Nuclear Effects Automated Processing System

CATEGORY: Advanced Development

DESCRIPTION: The Defense Nuclear Agency (DNA) has sponsored the development of CROM* nuclear effects modules to be used in the TI-59 handheld calculator; this system is employed for predicting weapons effects. Initial evaluations indicate the CROM modules potentially enhance weapon employment capabilities and defensive predictions. Effort will include a review of the DNA program status, collection of updated CROM modules and supporting software methodology, and an evaluation of each module/user's guide to determine their suitability for Marine Corps use. This evaluation will include examination of integration aspects associated with the CROM modules and similar TI-59 solid-state software modules used in conjunction with mortar and artillery conventional weapons employment. A detailed summary report is required at the completion of the project.

* Continuous Read Only Memory

46. TITLE: Tactical Air Operations Central (TAOC) - 1985 System Reconfiguration

CATEGORY: Engineering Development

DESCRIPTION: Current system design utilizes four 8' x 8' x 20' ANSI/ISO shelters to house all system communication, processing, display and cooling equipment. Although four Tactical Air Operations Modules (TAOMs) will comprise one TAOC, the current EDM* TAOM weight is near 15,000 pounds. Both current and projected shelter handling equipment in Marine Corps inventory precludes ease of shelter movement.

A study is required to identify TAOM reconfigurations designed to decrease shelter weight and decrease shelter size without significant increase in system lift requirements and to ensure that no system capability degradation resulted from any reconfiguration.

*Engineering Development Model

47. TITLE: Mechanical Sandbag Filler

CATEGORY: Advanced Development

DESCRIPTION: Design and construct a mechanical item to fill and close securely at least 600 sandbags per hour. Item should be motor operated, operable by one person in a combat environment, and transportable by tactical vehicles.

48. TITLE: IV&V* of the Software Development of the TCO** SYSTEM

CATEGORY: Engineering Development Support

DESCRIPTION: Software for the Tactical Combat Operations System in accordance with the redefined functional requirements for the system is being developed. This software will be integrated with the MIFASS software to produce a joint MIFASS***/TCO system. The process is expected to begin with data and control flows, proceed through PPS,**** PDS,***** PDD,***** and code and end with unit and system integration. Marine Corps Development personnel require assistance in independent varification and validation of the software effort. MIL-STD-1679A will be the appropriate software development standard. Required is a plan for verification and validation.

- * Independent Validation and Verification
- ** Tactical Combat Operation System
- *** Marine Integrated Fire and Support System
- **** Program Performance Specification
- ***** Program Design Specification
- ***** Program Design Document

49. TITLE: Advanced Automated Wargame Study

CATEGORY: Exploratory Development

DESCRIPTION: Prepare a study for the direction and scope of a follow on automated wargame system to replace the current Tactical Warfare Simulation

Evaluation Analysis System (TWSEAS). The current system is used to control tactical exercises which afford tactical decision training to Marine commanders and their staffs. The study should look at future concept of employment of such a Tactical Simulation system as well as in the aviation and combat service support areas. The study should identify proposed hardware configurations, software capabilities, life cycle costs, system growth and interfaces to current Marine Corps tactical systems (MIFASS,* TCO,** PLRS,*** TAOC-85,**** etc.)

- * Marine Integrated Fire and Air Support System
- ** Tactical Combat Operation System
- *** Position Location Reporting System
- **** Tactical Air Operations Central - 85

50. TITLE: Atmospheric Modeling of Chemical, Biological and Obscurant Clouds over Amphibious Operations

CATEGORY: Exploratory Development

DESCRIPTION: In order to operate effectively during amphibious operations, the Marine Corps must be able to predict the behavior of chemical, biological, and/or obscurant clouds which may be present on the battlefield. These clouds may represent a threat or they may be retaliatory, but their behavior must be predictable in order for ground/air forces to maneuver around or through them. Considerable efforts have previously been expended for atmospheric modeling but little has been done to model amphibious operation conditions such as salt fog, salt water, beachhead atmospheric turbulence, etc.

This study is to develop an integrated predictive capability for use by U.S. Marine Corps forces to realistically describe atmospheric behavior of chemical, biological, and/or obscurant clouds on an amphibious battlefield. The developed model must consider realistic topography, atmospheric conditions, urban/country structural characteristics, threats, and munition inventory. Marine Corps scenarios are recommended for study. The resultant model must be capable of use for development of doctrine and tactics, for training, and for real-time battlefield operations. A detailed summary report shall be provided at the completion of the task together with a reproducible copy of the model software and a users manual.

51. TITLE: Preplanned Product Improvement Program (P3I) Plan for MIFASS*/TCO**

CATEGORY: Management & Support

DESCRIPTION: The MIFASS System is currently in full scale engineering development. The TCO system is currently being reduced in scope and redefined. The current plan calls for the integration of these two systems into a single system, MIFASS/TCO, during production. Numerous software capabilities were deferred in MIFASS, new system interfaces are developing and additional requirements are emerging. TCO expects to incrementally develop capabilities and implement them in MIFASS/TCO in an evolutionary manner. A plan is needed to determine the product improvement to MIFASS/TCO and establish a chronological implementation plan for developing and integrating these product improvements. Close liaison

with Marine Corps Development personnel will be required to establish the appropriate priorities of product improvements. While the product improvements will mostly be software capabilities, the P3I plan will also consider hardware improvements and upgrades where appropriate.

- * Marine Integrated Fire and Air Support System
- ** Tactical Combat Operation System

52. TITLE: Ground Approach and Obstacle Avoidance Indicator for Parachutists

CATEGORY: Exploratory Development

DESCRIPTION: Design and construct a Ground Approach and Obstacle Avoidance Indicator for Parachutists. This is envisioned as a small (150 cm³ or less) sonar/acoustic device to be worn by parachutists participating in night/reduced visibility parachute jumps. The device must provide the descending parachutist with a continuous indication of his distance above the ground once he has descended to within 250 feet (500 feet desired) above ground level (AGL). The device must also provide similar range indication of distance to obstacles in the approach path of a parachutist flying a high glide ratio, ram-air parachute. The device must be covert in the electromagnetic spectrum.

53. TITLE: Fast Curing, High Build Epoxy Coating Systems

CATEGORY: Engineering Development

DESCRIPTION: Develop a coating system--including application equipment and procedures--capable of applying a 0.012-0.016 inch (dry film thickness) epoxy coating which is fully cured and ready for use within eight hours after application. The system developed must be compatible with normal shipyard production procedures (e.g., application by brush, roller or spray at ambient temperatures of 5 to 30 degrees C.). The coating must be resistant to oils and fuels, and protect steel and aluminum from corrosion by seawater. Systems based on fast curing epoxy resins, applied using heated proportional mixing equipment is one approach to developing such a system. The systems developed must meet OSHA regulations.

54. TITLE: Analytical Model for X-D Braided FRP Composites

CATEGORY: Research

DESCRIPTION: Analytical predictive methodologies based on classical lamination theory with extensive supporting computer capabilities have been developed for conventional Laminated Fiber Reinforced Plastic (FRP) composites. However, a new class of FRP composite materials has been developed with improved toughness properties based on a skeletal, multidirectional braided fiber reinforcement through the thickness as opposed to conventional laminar construction. This new class of materials in addition to its inherent resistance to delamination and ability to localize damage, can be braided to complex net shapes and be rigidized with resin to meet structural needs. Numerous, Naval applications are possible such as masts, structural panels, sonar domes, propeller shafts, propellers, rudders, diving planes, sonar windows etc. One of the present limitations that

hinders a greater interest in this X-D braided composite material is a fundamental understanding of its mechanical behavior. Thus it is proposed to develop an analytical capability to define performance of this X-D composite as a function of constructional variables including directionality of reinforcement, reinforcement fraction, and resin fraction. These analytical results would then be experimentally verified under a separate effort.

55. TITLE: Pollution Abatement from Navy-Ships

CATEGORY: Exploratory Development

DESCRIPTION: New pollution compliance requirements, as well as applicable laws and treaties, require the Navy to develop the appropriate technology and hardware to abate pollution arising from the operation of Navy ships. New or advanced pollution abatement concepts or systems are sought in air, sewerage and wastewater, oils and oily wastes, hazardous materials and solid waste.

56. TITLE: Fuel Contamination Quality Assurance Test

CATEGORY: Exploratory Development

DESCRIPTION: The presence of solid particulates, free water, undesirable petroleum-products, and contaminants in diesel marine fuel adversely affects the performance and durability of shipboard engine components. A continuous in-line monitor is needed to measure the concentration of contaminants present in Navy fuels at any point along the fuel distribution system. A fuel contamination quality control system is needed to determine the performance of fuel purification systems, the cleanliness of fuel storage and distribution systems, and also be capable of identifying the nature of fuel contaminants. Proposals are requested identifying unique approaches to investigate the feasibility of developing reliable, fuel contaminant quality assurance tests.

57. TITLE: Approaches to Processing Subsurface Data

CATEGORY: Exploratory Development

DESCRIPTION: For many problems involving subsurface vehicles, large amounts of data must be processed to find ocean bottom objects or features. Tethered vehicles are limited in data transmission rates and are subject to noise problems. Efficient pre-processing algorithms utilized with hardware on-board the vehicles would reduce the data rate to the surface, but allow higher rates of speed for ocean surveys.

58. TITLE: Submarine Depth Excursion Recording System

CATEGORY: Engineering Development

DESCRIPTION: Develop a self-contained and automated depth excursion recording system for use on submarines. A realistic cyclic load spectrum and lifetime definition is needed to project the fatigue life of submarine hull structures and make rational surveillance decisions. The depth excursion information is used to establish cyclic load spectrum.

The installation and operation of the system will be on least interference basis. Phase II could include developing a specification and a monitoring plan.

59. TITLE: Electronic Radar Beam Scanning

CATEGORY: Research

DESCRIPTION: Develop innovative approaches and new techniques, software and hardware in the area of agile beam, electronically scanned antennas. The objectives are to: provide future electronic scanning technology for application in equipments having improved characteristics in areas of cost and weight; provide wideband electronic scanning technology suitable for widespread use in Navy systems, so that the functional promise of electronic scanning principles becomes in fact universally available in Navy electromagnetic systems, and not just in high cost applications.

60. TITLE: Doppler Sonar

CATEGORY: Exploratory Development

DESCRIPTION: Some high definition sonar systems require sonar platform motion estimation accuracies that cannot be achieved using state-of-the-art Doppler sonar navigators. Presently, the best Doppler sonar systems have error levels of approximately 0.1 kt rms, while an error level of 0.01 kt rms is required to meet desired sonar performance goals. A precision Doppler sonar is to be designed and constructed which will meet the desired error level, 0.01 kt rms, and provide this accuracy with 1 to 2 sec averaging times. The sonar platform normally operates at 3 to 10 knots speed within 10 meters of the bottom; therefore, the sonar operating frequency and other critical parameters must be selected accordingly.

61. TITLE: Adhesive Systems

CATEGORY: Engineering Development

DESCRIPTION: High failure rates of underwater equipment have occurred because of poor durability and corrosion resistance of rubber to metal bonds which are exposed to seawater. Commercial adhesive systems are presently used to produce the rubber to metal bonds, and some are better than others.

The objective of this work is to develop an adhesive system(s) to bond neoprene rubber to carbon steel, aluminum, bronze, monel, and stainless steel for an expected lifetime of 15 years in a seawater environment. The one or more adhesive systems must be specified as to composition, preparation procedures, quality control and analysis procedures, and application procedures including surface preparation. Laboratory testing, including accelerated life testing, shall be performed to prove the durability and corrosion resistance of the bond.

62. TITLE: Accelerated Life Testing (ALT)

CATEGORY: Engineering Development

DESCRIPTION: Reductions in sonar transducer life cycle costs can be achieved by extending the operational lifetime of the units. This can be accomplished by optimum use of materials and proven design practices to improve the unit durability and tolerance to the seawater environment. However, methods are needed that will determine in the laboratory in a relatively short time what the expected real lifetime expectancy will be.

The objective is to develop an improved understanding of and predictive methods for determining the reliability and life expectancy of sonar transducers by accelerated life testing (ALT).

The approach should be to study the basis for ALT, especially in the situation where multiple aging mechanisms are operating simultaneously. Known aging modes such as rubber-to-rubber bonding, rubber-to-metal bonding, electrochemical reactions of the rubber and metal, changes in the rubber properties with time, permeation, and others will be modeled to relate the results of ALT to expectancies in real time. The appropriateness of ALT will be determined. The ALT procedure will be modified to reflect improvements in the understanding of the methodology and generalized to a composite unit ALT procedure for the complete transducer.

63. TITLE: Reproducibility of Piezoelectric Ceramics

CATEGORY: Exploratory Development

DESCRIPTION: The variability of piezoceramic properties - physical, electrical and mechanical - are well known in the industry by manufacturers and users alike. The variability relates directly, but not in a simple way, to composition and processing variables and emerges from lot to lot from a single supplier and from supplier to supplier. This creates problems for both the manufacturer and user alike. The manufacturer lives with lower than desired yields while the user must deal with delivery problems and often marginal performance and quality, which in turn affects transducer manufacturing yield, performance, and reliability.

The objective is to improve the reproducibility of lead zirconatelead titanate ceramics for sonar transducers.

One approach to the objective would be to develop an improved compositional control. The first step would be to develop analytic procedures for determining the chemical and structural composition of the material. Correlations could be established between impurity levels and microstructure and the electroelastic properties of production lead zirconate titanate.

Another approach would be to investigate improved process controls for the production of the ceramic. The process steps in question are raw material selection and qualification, mixing and granulation, calcination, grinding, power conditioning, forming, firing, machining, electroding, poling, property measurements, and quality control.

Firms responding should have experience in all aspects of piezoelectric ceramic manufacturing.

64. TITLE: Submarine Piping

CATEGORY: Engineering Development

DESCRIPTION: Develop and qualify for use in nuclear submarine non-metallic, light weight, high strength piping. Includes the development of adequate fabrication procedures for attaching pipe sections to each other and piping fittings, such as elbows, tees, and valves.

65. TITLE: Mine-Detection and Computer-Aided Classification

CATEGORY: Exploratory Development

DESCRIPTION: Develop innovative techniques for sonar signal processing and approximation of the target size for synthetic target imaging and classification of mine size targets.

66. TITLE: Proton Radiation

CATEGORY: Research

DESCRIPTION: Proton radiation effects on frequency controlled crystals.

67. TITLE: CTI-1561 Chip Set

CATEGORY: Engineering Development

DESCRIPTION: Develop complex testability models for the CTI-1561 chip set used for MIL-STD-1552B bus communication.

68. TITLE: Polymide Quartz Multilayer Board

CATEGORY: Advanced Development

DESCRIPTION: Ceramic integrated circuit packages have thermal mismatch when mounted on the standard epoxy fiberglass multilayer board. If a polymide quartz multilayer board could be developed, it would provide a much closer thermal expansion match with the ceramic package.

69. TITLE: The Physics of Metal Matrix Composites

CATEGORY: Advanced Development

DESCRIPTION: The use of metal matrix composites in advanced missiles and guidance systems in particular is at the introductory level at this point in time. A concentrated development program is required to improve our understanding of the physical properties of these materials, its application in areas where stability, strength, and low weight are of critical importance could be of significant benefit.

70. TITLE: Use of Robotics in Automatic Factory Assembly

CATEGORY: Advanced Development

DESCRIPTION: The application of robotics in other industries has already shown improvements in quality control, time and cost savings, and reliability. Future applications of robotics to specialized very low volume manufacturing processes should be developed. The above factors are of principal interest. Low volume is in the range of 10 to 100 per month.

71. TITLE: Improved Inspection Techniques

CATEGORY: Exploratory Development

DESCRIPTION: High Z metallic material is spray deposited on metal surface packages for some design applications. It is important for these applications that the coating be continuous and without holes.

Current inspection of this process is slow by conventional techniques. An improved, non-destructive technique is required.

72. TITLE: Evaluation of Functions Represented by Grid points

CATEGORY: Advanced Development

DESCRIPTION: A future guidance system might have to derive gravity from a set of values stored on a three dimensional grid of points around a trajectory. The optimum approach requires a tradeoff between the interpolation function, the number and regularity of the grid points, the computer filing system, speed and memory. Another guidance application would be the derivation of a map in map matching guidance. What is desired is a generalized algorithm and associated techniques which would allow specialization of the algorithm for a particular application to yield an efficient computer program.

73. TITLE: PROM Programming Methodolgy

CATEGORY: Engineering Development

DESCRIPTION: The method of programming a PROM* (i.e. the characteristics of the programming pulse (amplitude, ramp, how many, etc.)) affects the reliability of the blown fused-link. New technology PROMs (such as Titanium - Tungsten) have not been studied from the viewpoint of military programmability. This should determine what factors affect the reliability of the blown link and what their values should be in order to guarantee a reliable "blow".

* Programable read only memory.

74. TITLE: Urethane Materials

CATEGORY: Advanced Development

DESCRIPTION: Non-MBOCA urethane compounds having similar physical and casting properties to current MBOCA urethane compounds need to be developed.

75. TITLE: Toxic Gas Detection Equipment

CATEGORY: Advanced Development

DESCRIPTION: The suitability of current portable instrumentation for detecting toxic gases from burnt propellant needs to be assessed. Development requirements of new state-of-the-art portable equipment to detect lead oxides, hydrogen sulfide, hydrogen cyanide and nitrous oxides should be determined.

76. TITLE: Rotation Measurement Techniques

CATEGORY: Advanced Development

DESCRIPTION: A means of measuring relative rotation between components with an accuracy of several arc-seconds needs to be developed. Measurement range is less than a degree and the components are permitted to translate one inch with respect to each other. Measurement and recording device must be self contained and compact.

77. TITLE: Aging of Non-Metallic Materials

CATEGORY: Advanced Development

DESCRIPTION: The change in material properties; elongation, static and dynamic stiffness, hardness etc., for non-metallic materials used in systems as a function of time and temperature need to be investigated along with the physical mechanisms by which these changes occur. Methods for predicting long term aging characteristics or preferably minimizing these changes needs to be identified.

78. TITLE: Corrosion Resistance Evaluation Techniques

CATEGORY: Advanced Development

DESCRIPTION: Develop advanced techniques to evaluate the corrosion resistance of prototype hardware, such as by using potentiometric surveys. Evaluation techniques should employ accelerated testing and a means for predicting real time behavior.

79. TITLE: Improved Remote Distance Measurement Techniques

CATEGORY: Advanced Development

DESCRIPTION: Compact and reliable means of measuring distances of up to 500 inches with an accuracy of $\pm .005$ inches are needed during launch tube and mount tube manufacture, final machining and installation/assembly.

80. TITLE: Improved Shipboard (Submarine) Velocity and Sea Environment Sensors

CATEGORY: Advanced Development

DESCRIPTION: During underwater missile launches, accurate data on sea environment and relative underwater speed will help increase the probability of successful launch. Shipboard sensors that are accurate and practical (reliable, compact, maintenance free, etc.) to measure the sea environment (i.e. waveheight, sea state) and relative speed across the deck (low speed flowmeters concepts to measure crossflow) are required.

81. TITLE: Underwater Launch Hydrodynamic Modeling

CATEGORY: Advanced Development

DESCRIPTION: Improved analytical modeling of hydrodynamic phenomena in such areas as cavity flows, separation and wakes, boundary layer separation, etc. is needed to support predictive models of underwater launch/flight trajectories of missiles up to missile surface broach. Theoretical/experimental efforts leading to efficient and practical analytical computer models are sought.

82. TITLE: Mathematical Techniques/Modeling/Simulation - Automatic Translation Techniques

CATEGORY: Research

DESCRIPTION: Develop an automated procedure, process or algorithm to translate optical imagery (photographs) into radar reflective maps useful in terminal guidance while correcting and retaining the precision of the optical reference.

83. TITLE: Modeling SLBM Underwater Launch Trajectories

CATEGORY: Research

DESCRIPTION: Develop an algorithm or model to the underwater trajectory (including Broach) of an SLBM* missile taking into account ship position and attitude, submarine induced turbulence, current, current slew, varying water properties surface effects (wind, wave, and current) and the hydrodynamic shape of the missile.

* Submarine Launched Ballistic Missile.

84. TITLE: Global Positioning Satellite

CATEGORY: Advanced Development

DESCRIPTION: Study to determine feasibility of using Global Positioning Satellite to obtain vehicle heading and attitude to within $\pm 1^\circ$.

85. TITLE: Fracture Toughness of Bonded Composite Components Category

CATEGORY: Exploratory Development

DESCRIPTION: Determine material and strength characteristics of various materials that have been bonded by epoxy type bonds. Develop testing methods similar to Charpy V Notch testing techniques determining fracture toughness or bonded elements.

86. TITLE: Improved Non-Destructive Test Methods for Detecting Unbonds in Large Bonded Components

CATEGORY: Exploratory Development

DESCRIPTION: Explore new improved non-destructive test methods to detect cracks, voids, unbonds between materials that have been bonded with epoxy type bonds. Determine analysis methods to determine effects of unbonding in such structures.

87. TITLE: Fiber to Resin Ratio Measurement

CATEGORY: Advanced Development

DESCRIPTION: Rocket motor cases are made from high strength fibers (Kevlar or graphite) which form a composite with resins - usually epoxy types. In conducting failure assessment of chambers, it is difficult to ascertain the resin content of the composite at the failure origin. A method to ascertain fiber to resin ratio by weight for finite sections of chamber in the cured composite would aid in understanding composite failure mechanisms.

88. TITLE: Binder-Filler Interaction in Hi-Energy Propellants Category

CATEGORY: Research

DESCRIPTION: Strategic Missiles require rocket motors with high solids loading and energetic binders and plasticizers. The interactions of the binder and filler materials are critical in determining the physical properties and thus the useability of propellant formulations. Basic studies would include interaction of binders and fillers as they relate to physical properties including the effects of moisture and other environmental factors. Particular emphasis should be in the area of PEG (Poly Ethylene Glycol) binders highly loaded with HMX and Aluminum.

89. TITLE: Very High Level Simulation

CATEGORY: Exploratory Development

DESCRIPTION: Modern day electronic systems are of a level of complexity which currently prohibits adequate design verification prior to hardware implementation. Computer simulation tools at the transistor and gate level are extremely powerful when used at the lower levels of design. However, there is a need to model to various subsystems at a sufficiently high level of abstraction such that the entire system may be simulated.

The system is to be viewed as a finite number of partical physical subsystems with real world inputs and outputs, digital and analog. The simulation should also be capable of "standing-in" for any single subsystem or all of the subsystems in verifying the composite system. This, of course, represents both a software or hardware/software simulation.

Invited are proposals which conceive of such a system consisting of a two phase effort: establishing the definition followed by actual implementation leading to feasibility demonstration. Proposals for "tangible" improvements in logic simulators will not be considered.

90. TITLE: Replacement of Isocon Tubes to Real Time X-Ray Imaging Systems

CATEGORY: Advanced Development

DESCRIPTION: High Energy Real Time Radiographic (HERTR) systems are used to inspect large solid rocket motors. One component of such system is isocon tubes. These isocon tubes have a high useage rate and limited life in the field.

Also, a low yield of acceptable isocon tubes from the producer creates a serious maintenance/logistic problem. A more reliable isocon tube for HERTR systems or a substitute device with better reliability would result in a significant savings of time and resources.

91. TITLE: Composite Pressure Vessel Damage Assessment

CATEGORY: Advanced Development

DESCRIPTION: Strategic missile rocket motors utilize high strength to weight fiber composites for the motor pressure vessels. The missiles are subject to various movements and handling which can inflict damage which is not always visually detectable. Efforts to investigate the effects of damage to the pressure vessel and to develop useable and cost effective non-destructive testing to assess the extent of damage would allow more effective use of missile assets; of particular interest are Kevlar-epoxy and Graphite-epoxy chambers.

92. TITLE: Mobile Robot for Hazardous Duty

CATEGORY: Exploratory Development

DESCRIPTION: Design a mobile robot system for application in Navy hazardous duty operations such as fire-fighting and ordnance loading. Investigate requirements, feasibility, and alternative approaches.

93. TITLE: Chemical Synthesis of Energetic Materials and Intermediates

CATEGORY: Exploratory Development

DESCRIPTION: Perform chemical synthesis of energetic intermediates needed for the synthesis of new explosive and propellant ingredients. Perform scaled-up synthesis (1 to 50 pounds) of explosive and propellant ingredients. The explosive/propellant ingredients and intermediates include aliphatic nitro and nitramine compounds as well as nitrate esters.

94. TITLE: Deposition of Low Defect Density Optical Coatings

CATEGORY: Exploratory Development

DESCRIPTION: Develop a suitable coating technique for the fabrication of low defect concentration coatings (defect size 1-10 microns, defect density less than 100 per cm² per micron of coating).

1. Evaluate alternate approaches such as ion beam deposition and vacuum evaporation.
2. Deposit coatings using standard process and an appropriate modification designed to reduce particle counts.
3. Evaluate the results using scanning electron microscopy.
4. Submit samples for final evaluation.

95. TITLE: Low Cost Simple Thrust Vector Control

CATEGORY: Exploratory Development

DESCRIPTION: Thrust Vector Control (TVC) has been under study by the Navy, Air Force, Army and NASA for numerous years. Various concepts have been investigated including movable nozzle, jet vanes and jet tabs; each concept having its own merits.

A new, simple low cost TVC system is needed for application to Navy tactical missiles. A system is needed which can function for about 3-4 sec, but which will not degrade the missile's propulsion system performance significantly. The system should occupy minimum volume (or missile length) and is envisioned as a variation of the movable nozzle concept, but significantly more cost effective.

96. TITLE: Impact of Short Term Memory on Combat Control

CATEGORY: Research

DESCRIPTION: The rates of information transfer/exchange involved in modern combat control environments requires significant amounts of information to be stored in short term memory. Current research indicates that an individual's short term memory capacity is not only finite but directly influenced both by the type/format of the information being remembered and the input of additional similar information. Without rehearsal information in short term memory is rapidly lost and the input of additional similar information leads to a more rapid degradation of the previously stored information (interference).

The proposed research will investigate short term memory functioning in a combat control environment with the specific focus of information formats and interference caused by new information inputs. The anticipated outcome is a greater understanding of short term memory functioning given the unique types of information associated with a combat control environment. This insight should provide the potential for modification of information formats to reduce/eliminate interference and may also provide insight into training techniques to facilitate short term memory functioning in the combat control environment.

97. TITLE: Improved Tonpilz Transducer Head Masses

CATEGORY: Exploratory Development

DESCRIPTION: Modern use of sonars with new and more complex signal waveforms, will require high power active bandwidths of 30% and bandwidths of 60% for passive operation. Two options are seen for modifying the currently used Tonpilz transducers to this end; (1) increasing the radiating area and (2) decreasing the head mass.

The use of standard materials in routine designs to achieve these goals results in a flexing piston face with an unacceptable bimodal response.

If a head mass is designed with a low density but with high flexural stiffness, it is believed that the flexural resonance will be moved well out of the operating band. It is further believed that a material such as beryllium has the necessary characteristics to allow such a design.

It is proposed here to design such a head mass. Beryllium will be used as the most likely material of choice, and will be compared to metal matrix and plastic composite materials. A "test bed" transducer element will be constructed to evaluate the results. Transmitting and receiving responses will be measured, as well as other pertinent electroacoustic characteristics. Holographic analysis will be performed, supplemented with finite element techniques.

98. TITLE: Current Induced Instability in a Conducting Fluid

CATEGORY: Exploratory Development

DESCRIPTION: The primary asset of a liquid metal current collector is the ability to carry very high current density with low electrical losses. Current densities up to 30,000 amps/sq. in. have been observed experimentally. Recent experimental results at high current densities suggest that instabilities may occur at very high current densities which can interrupt the current flow through the collector. It is reasonable to expect an upper limit to exist for current density through a liquid metal based on considerations of pinch effect and other instabilities which occur in plasmas. It is also reasonable to assume that the presence of a properly oriented magnetic field could, to some extent, alleviate such instabilities.

Conduct a theoretical analysis of current transport in a liquid metal (NaK) under the conditions characteristic of both a free surface and positive containment current collector. Determine the current density limitations as a function of current collector type, characteristic dimensions, and fluid properties. Consider the effect of magnetic fields on the occurrence of instabilities.

99. TITLE: Conditions Necessary for Hydrodynamics Stability in Liquid Metal Sliprings

CATEGORY: Exploratory Development

DESCRIPTION: Satisfactory operation of a liquid metal current collector depends on the ability to maintain a stable flow of the liquid in the slipring annulus. At very high tip speeds, instabilities have been observed in test devices wherein the liquid metal ceases to remain in the collector gap. These instabilities may be caused by a combination of hydrodynamic effects and interactions at the gas liquid interface.

Some types of current collectors overcome these effects by positive containment of the liquid with a controlled leak rate. In these cases the liquid metal is collected and returned to the active region through an external pumping system. The above instabilities in this case may affect the collection of the liquid in the slipring annulus. The presence of transport current and/or

magnetic fields may alleviate or aggravate the situation depending on the collector design and operating conditions. An understanding of the conditions which give rise to these instabilities and, conversely, conditions necessary to prevent their occurrence would be of great benefit in the design of current collector systems for long term generation at high tip speeds.

Analyze theoretically the hydrodynamic interactions present in a current collector slipping annulus at high (turbulent) tip velocities. Analyze the interactions occurring at the gas-liquid interface. Determine the combination of conditions necessary to maintain a stable flow condition. Determine the effects of currents and magnetic fields on the flow stability and characteristics. Extend this analysis to the case of discrete collector sites located around the slipping periphery.

100. TITLE: Improved Potable Water Disinfection System for Ships

CATEGORY: Advanced Development

DESCRIPTION: Navy ships generate their own potable water by evaporation of seawater. This water is stored in large tanks and distributed throughout the ship by piping systems. In order to safeguard the health of shipboard personnel, this water must be disinfected and a rapid means of confirming this must be available. Past and present shipboard disinfection systems employ sodium hypochlorite solutions, powdered calcium hypochlorite and, most recently, bromine impregnated on a resinous material. Disinfection employing hypochlorite is inexpensive, but requires the storage of hazardous materials. Bromine impregnated resins are expensive and are restricted in the levels of disinfection achievable. The objective of this task is to define a disinfection technology innovation, suitable for development for a large (20,000 - 400,000 GPD) shipboard system. Emphasis should be placed on safety, maintainability/reliability, cost and manning requirements. Comparisons with existing shipboard systems should be made. The subjects of corrosion, disinfection level achievable, and method to confirm disinfection and state of development of this technology should be addressed. Information should be presented to document feasibility for a shipboard system.

101. TITLE: Acoustic Sea Bottom Classifier

CATEGORY: Exploratory Development

DESCRIPTION: Mines buried in the sea bottom are difficult to detect and pose a significant threat to our ships. Current and projected buried-mine mine countermeasures systems have low area clearance rates. Therefore, it is desirable to deploy these systems only in areas where it has been established that mines will bury. To avoid inefficient use of resources, it is desirable to perform a rapid acoustic survey of the suspected minefield before minehunting operations begin to establish specific regions of the suspected minefield where mines are likely to bury. Develop a rapid survey sonar having parameters selected to permit acoustic wave penetration of the bottom and signal processing algorithms devised to permit characterization of those engineering properties of the bottom from mine burial probability may be derived.

102. TITLE: Advanced ASW Weapons Technology Evaluation Strategy

CATEGORY: Exploratory Development

DESCRIPTION: With the demonstrated improvements in the Soviet submarine force over the past decade, the effectiveness of current and planned inventories of U.S. undersea weapons is being challenged. Shortfalls are becoming apparent in air and surface deployed ASW weapons and very little technology development is being done beyond the advanced Lightweight Torpedo (ALWT). The Naval Ocean Systems Center recognizes this need and is currently planning a Tech Base program in support of high potential advanced concepts.

In the process of identifying the most appropriate concepts and technologies to pursue, a scientific or quantitative decision making process which considers risk (loss) versus worth (gain) will be required. Proposals are requested for development of an evaluation strategy for selecting the most promising concepts/technologies packages for future ASW weapons. The evaluation strategy should contain technologies and criteria for assessing relative risks, costs and performance.

103. TITLE: Passive Variable Resistance Techniques

CATEGORY: Advanced Development

DESCRIPTION: Thermal stability and the absence of large thermal gradients are key design elements in maintaining accuracy through improved stability of critical alignments and also aids in improved performance of the inertial components for guidance systems in missiles.

A technique whereby the thermal resistance across a heat flow path can vary as a function of the heat flux present would result in improved thermal stability in critical areas. In particular, the development of a compact passive variable thermal resistance device should represent a unique advance in thermal design.

104. TITLE: Anti-Reflective Window Coatings

CATEGORY: Advanced Development

DESCRIPTION: Light detectors are used for star sensing which in turn provides information for position fixing in space. In order to gather as much star light as possible, it is important to transmit the light to the detector and reduce reflections to an absolute minimum. Anti-reflective coatings applied directly to all windows in the light path would be of assistance in maximizing the star energy reading of the detector and would lead to improved design capabilities. This effort then is directed at seeking highly efficient anti-reflective coatings and also having long term stability in varying environments.

105. TITLE: Evaluation of Undershoot Effects on NMOS Microcircuits

CATEGORY: Advanced Development

DESCRIPTION: The effects of negative boltage pulses (resulting from signal reflections) on the input signal pins of NMOS technology microcircuits are

largely unknown. A test and evaluation program which identifies and quantifies immediate and long term performance and reliability degradation as a function of NMOS device type and/or input structure, negative voltage pulse amplitude and duration, and other electrical and environmental parameters is required in order to properly specify and apply NMOS devices in military electronic systems.

106. TITLE: EPROM Evaluation

CATEGORY: Advanced Development

DESCRIPTION: There is a need for an evaluation of the applicability of UV EPROMs and EEPROMs for military use. Past work has shown that exposure to sunlight may be deleterious to UV EPROMs. Program retention is of prime importance to military applications. Effort should be undertaken that will define the effects of environment on data retention (i.e. what conditions will affect data retention and how much).

107. TITLE: Development of Metallic Surfaces with Very High Light Absorption Capability

CATEGORY: Advanced Development

DESCRIPTION: Stellar inertial guidance requires star images to be detected with a high probability of acquisition. Stray light reflected from the sunshield or other surfaces in the light path to the detector creates background noise which reduces the signal to noise ratio and hence the probability of acquisition.

There is a future need for the development of a new, very non-reflective and very durable surface which will not allow stray light from the sun, moon, earth or plume to scatter off its surface into the stellar detector.

108. TITLE: Non-Flooding Portable Pressure Calibrator

CATEGORY: Engineering Development

DESCRIPTION: The Portable Pressure Calibrator presently used is a self-contained portable system designed for the calibration of pressure gauges, transducers, and other pressure measuring devices. The system is designed to route and control gases to a master indicator and test circuit.

Develop a non-flooding Portable Pressure Calibrator (PPC). The current models of the PPCs are frequently flooded when operated. These flooded units must be returned to the vendor for repair at significant expense.

109. TITLE: Pre-Faulted Modules for Training Systems

CATEGORY: Advanced Development

DESCRIPTION: Pre-Faulted Modules are inserted in tactical hardware in training systems to enhance training on maintenance and casualty procedures. Advanced tactical system diagnostics have rendered many Pre-Faulted Modules useless. If

a Pre-Faulted Module is inserted prior to system startup, the automated diagnostic will terminate the startup process and automatically locate the fault. A technique must be developed whereby faults can be activated during operational sequence, thus requiring the student to recognize system degradation, respond with appropriate casualty procedures and ultimately locate and replace the faulted component. A remote triggering method, timer or other technique must be developed for application primarily on standard electronic modules. Modification of the tactical hardware, except for the Pre-Faulted Module, should be avoided. The module should not be recognized by the student as a Pre-Faulted Module until it is removed.

110. TITLE: Computer Image Generation for Area of Interest and Target Projection

CATEGORY: Exploratory Development

DESCRIPTION: Simulators for training weapons operators who view and track moving targets often use area of interest or target tracking projection displays. This method is attractive in that it keeps system costs down. The Area of Interest (AOI) display would be of even greater effectiveness if costs could be reduced permitting larger quantities to be available for training. Emerging hardware and software advances in computer graphics can significantly reduce the cost and increase performance of Computer Image Generation (CIG) for AOI and target projection in weapons training simulators.

The work would involve the development of a low cost CIG for a single channel AOI and target channel application. The unit as a minimum should perform the same function as the TV camera and aircraft target model which is part of the Navy Air Combat Maneuvering Simulator, Device 2E6. The CIG output would drive a 525 TV line monochrome projector. The CIG target model's position would be computed 60 times per second and be a high quality three-dimensional object in true perspective. The work would further define the design approach for a high performance version of the above minimum development. This version would be capable of producing a color 1024 line display of greater scene complexity with special effects but with low cost techniques as a primary factor.

111. TITLE: Feasibility of Embedded Training in Operational Aircraft

CATEGORY: Exploratory Development

DESCRIPTION: Limited simulator/trainer availability reduces training opportunity and proficiency maintenance. It would appear that software training packages could be developed to interface, or embed, with operational aircraft computer systems. These training "packages" would effectively turn an aircraft into a simulator by enabling the aircraft's avionics and weapon systems to be exercised while still on the flight line (with only electrical power required). At sea, each aircraft would represent a potential simulator which would not otherwise be available. A feasibility analysis and cost benefit analysis of embedded training in operational aircraft is required.

112. TITLE: 3-D Simulation Visual Display for Pilot Close Approach Cues

CATEGORY: Exploratory Development

DESCRIPTION: In close approach to terrain a helicopter pilot uses various visual cues including binocular cues, but binocular cues are not normally provided in flight simulation. This project will require some familiarity with close approach tasks, an evaluation of the relevant literature on the use of visual cues and a behavioral study with pilots in a simulator to measure performance with and without binocular cues.

113. TITLE: High Gain/Directive Screens for Vehicle Simulation

CATEGORY: Exploratory Development

DESCRIPTION: Many flight simulators for Navy training require a large field of view of the simulated scene for the pilot and this scene is often projected on to a dome screen surrounding him, using color television projectors. The arrangement gives somewhat limited brightness and contrast in the image and requires expensive projectors. Increased brightness and contrast, together with reduced cost by using smaller projectors, could be obtained if a satisfactory directional screen could be developed. The work under this project will include a literature search on previous work in this area, evaluation of various approaches including the use of diffraction patterns (holograms) and various forms of fine structure applied to the screen surface, and a bench demonstration of the chosen approach. A well defined exit pupil of chosen size and shape is required.

114. TITLE: Measurement of Brain Activity for Enhanced Training

CATEGORY: Research

DESCRIPTION: A gross indication of certain electrical aspects of brain function has been available for many years using the electroencephalograph and recent developments, particularly of techniques of magnetic brain field measurement, offer increasingly localized measurement capabilities. A system capable of displaying the pattern of brain activity in real time with fair resolution offers the potential for enhancing training. Certain patterns of activity may be found to be preferable to others in absorbing and retaining information and it may become possible to diagnose a trainee's learning problems and improve his capabilities.

The work will include a literature search and visits to laboratories leading to the setting up of a program of experimental work with subjects.

115. TITLE: ISAR Part Task Trainer Using Voice Transaction

CATEGORY: Exploratory Development

DESCRIPTION: Synthetic Aperture Radar (SAR) has been in use for many years, but Inverse Synthetic Aperture Radar (ISAR) is only now coming into use and a requirement exists to simulate it. ISAR is particularly useful for recognizing ships at extreme range at sea. The image is noisy and distorted in many characteristic ways, which give cues to the vessel's attitude and direction. Recognition of the type of ship and its attitude and motion is a skill that needs practice to acquire.

The work will include visits to Navy activities, evaluation of ISAR imagery and a bench demonstration of a system suitable for ISAR training. It is envisaged that ISAR images will eventually be carried on videodisc and that interaction between the trainee and the trainer will include voice recognition by the trainer of a limited vocabulary.

116. TITLE: Computer-based Development of Steam Propulsion Plant Operator Training (SPPOT) Materials

CATEGORY: Exploratory Development

DESCRIPTION: The existing SPPOT training and development materials are based on laborious paper and pencil analytic tools. The present effort proposes to automate these development tools to make this generation far more efficient while also allowing for easier update capabilities. These activities if successful will lead to prototype development of support tools for a wide range of shipboard training programs.

117. TITLE: Management System Interface and Demonstration for TRIADS CBI Hardware

CATEGORY: Engineering Development

DESCRIPTION: This product development will provide management access to TRIADS* hardware system capabilities by providing appropriate data base development, networking of communication facilities, and integration of both graphics and videodisk development (of visual materials). This work will provide a prototype of a larger scale joint services use of hardware and software development tools.

*TRIADS is an effort to develop a family of software and hardware to support computer-based instruction in a wide variety of military training and education applications. TRIADS consists of a library of computer-based instructional programs, sufficiently flexible to support development, delivery, and management to meet most military instructional requirements.

118. TITLE: Naval Aircraft Refueling Alternatives

CATEGORY: Advanced Development

DESCRIPTION: At present the Navy refuels its aircraft on the carrier, shore airbase or from an aerial tanker. Alternative in-flight refueling concepts are desired. The contractor is asked to submit proposals that study various new ways that aircraft can be refueled in-flight. These concepts will be fully developed and analyzed by the contractor. The study will include a section that outlines cost-effective concept demonstration test protocol. Once these concepts are identified and the analysis is complete, the Navy will determine which approaches appear to have the most potential for further investigation.

119. TITLE: Innovative Coatings Research

CATEGORY: Exploratory Development

DESCRIPTION: New methods to incorporate novel coating to investigate:

- (1) corrosion inhibitors to enable enhances corrosion resistance including arrestment of stress and fatigue corrosion.
- (2) the chemical composition, microstructure and electrochemical properties to determine the important characteristics of a coating such as adhesion and corrosion protection.
- (3) coating systems to reduce radar cross section and/or reflectance in the infrared and laser spectrum.

120. TITLE: Polymers for Aviation Materials

CATEGORY: Exploratory Development

DESCRIPTION: Novel studies of polymers to investigate their use:

- (1) in advanced composites for dual role of both structural elements and radar handling materials.
- (2) as sealants, adhesives, vibration isolation dampers, foams and fuel tank protection.
- (3) in cockpit canopies with EMI,* laser, EMP** protection and nonreflecting infrared insulation.

* Electromagnetic Interference

** Electromagnetic Pulse

121. TITLE: Non-Destructive Testing and Inspection Techniques

CATEGORY: Advanced Development

DESCRIPTION: Recent scientific development in the area of ultrasonics internal friction damping, eddy current changes, X-ray line broadening are very useful. It is desired to develop innovative non-destructive testing to determine fatigue damage prior to cracking and/or residual stresses in critical aircraft parts. Another area of interest is the application of innovative ultrasonic measuring techniques to determine the location and size of defects in advanced composites.

122. TITLE: Robotic Deck Scrubber

CATEGORY: Engineering Development

DESCRIPTION: Design and construct a robotic deck scrubber to be used in the hanger deck of a carrier to clean up oil spills. Device would be programmable with obstacle avoidance sensors. Device would dispense detergents and contain built in brushes and vacuum system.

123. TITLE: CV Supplemental Wind Sensor Investigation

CATEGORY: Exploratory Development

DESCRIPTION: Effort involves an aerodynamic analysis of existing CV 63 and CVN-68 class wind tunnel three dimensional flow data to provide additional wind sensor locations to supplement free stream measurements. These sensors will provide realistic wind data in the carrier launch and recovery areas. Payoffs include increased safety for aircraft operations and reductions in vessel steaming requirements, estimated at 60,000 barrels of oil (or the equivalent for ships with nuclear power plant) per vessel per year for a 3 knot reduction in ship's speed.

124. TITLE: Multi-AC Electric Motor/Wheel Navy Aircraft Handling Vehicle

CATEGORY: Engineering Development

DESCRIPTION: Develop and construct a feasibility demonstrator. Many of the problems with handling aircraft aboard ships are closely aligned with vehicle configuration. Users complaints of instability, poor braking, tire wear, insufficient drawbar pull, large turning radius, large size, difficult to use, etc. can all be improved by the proposed concept. This vehicle would utilize the ability to synchronize the speed of several independent AC motors over a wide speed range by adjustable input power frequency. This control can be achieved at the required power levels, by solid state switching circuitry. The multi-wheeled vehicle will approach the benefits of a tracked vehicle without its mechanical limitations. Some of these limitations are synchronizing tracks or belts, skid steering, and suspension difficulties.

125. TITLE: Pneumatic Lifting Mechanisms for Support Equipment

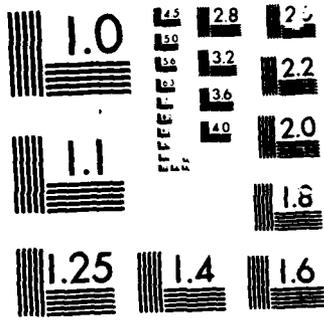
CATEGORY: Engineering Development

DESCRIPTION: To investigate the relative characteristics and advantages of pneumatic vs. hydraulic lifting/hoisting mechanisms for Support Equipment. Once the advantages are defined a breadboard system such as a potential new spotting dolly lifting mechanism will be designed, built, tested and documented for Engineering Development & evaluation.

126. TITLE: Gas Penetrant Inspection Method Using Krypton Gases

CATEGORY: Exploratory Development

DESCRIPTION: There is a need to quantitatively measure turbine blade coating quality and to locate and size LCF cracks in titanium and nickel base alloy disks with a full field inspection method. Liquid penetrants and eddy current prove unsatisfactory. The greater penetrating power of gases makes this possible through a technique called the Krypton Exposure Technique. This audioradiographic process has been used successfully to locate casting flaws in turbine blades. Further exploration requires R&D to understand the physical chemical barriers of this new breakthrough in NDI.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

127. TITLE: Turbine Instrumentation

CATEGORY: Advanced Development

DESCRIPTION: Developments of small, durable instrumentation which will measure temperatures and pressures at actual operating conditions without disturbing the flowstream to a significant extent.

128. TITLE: Ceramic Development

CATEGORY: Advanced Development

DESCRIPTION: Development of a durable ceramic that can be applied to turbine hardware which will reduce cooling flow requirements and remain intact over the entire life of the turbine.

129. TITLE: Development of a Test Device and Method to Assess Lubricant Load Carrying Capability Requirements for Modern Aviation Power Drive Systems

CATEGORY: Advanced Development

DESCRIPTION: The Ryder Gear Machine has been the major device used to assess the load carrying capability of lubricants in gas turbine engines and associated drive systems. This method has become costly, at times unreliable and frequently mistrusted as a device for predicting lubricant performance in modern aviation power drive systems. There is a need to thoroughly evaluate the entire range of conditions which exist in the lubricated contacts of current and advanced power drive systems. This assessment should then be used to define the criteria for lubricant evaluation, followed by the development of rational approach to measure lubricant load carrying capacity.

130. TITLE: Radome Design Technology

CATEGORY: Exploratory Development

DESCRIPTION: Perform a survey to determine the radome design and analysis techniques presently in use by industry, academia and government facilities. Identify and explain the theoretical electromagnetic basis of the various methods of approach and delineate the critical features of each technique. Determine the availability of the computer codes for use by the government. Survey results will be used in establishing parametric limits of the various design techniques.

131. TITLE: High Temperature Pneumatic Actuator

CATEGORY: Exploratory Development

DESCRIPTION: Design and fabricate a pneumatic actuator for missile applications having a torque output of 1000 inch-pounds, a no-lead slew rate of 400 degrees/second operating from cold gas (helium, nitrogen). This actuator must be capable of operating for at least one minute in 700° F environment. Internal gas cooling may be considered.

132. TITLE: Safe Separation Sensor Accelerometer

CATEGORY: Exploratory Development

DESCRIPTION: This program is needed to obtain a concept for an accelerometer to be used in a safe separation sensor for guided missiles.

The desired accelerometer is a micro miniature device that is not more than one half inch long by one quarter inch wide by one quarter inch thick.

The accelerometer should be able to operate in the range from 0.5 gravity units (G's) to 35 (G's) and should be able to withstand random vibrations, handling shocks, ambient temperatures, aircraft vibrations and shipboard vibrations associated with guided missiles.

133. TITLE: Ultra Linear Microwave Voltage Controlled Oscillator

CATEGORY: Advanced Development

DESCRIPTION: Design an ultra linear microwave voltage controlled oscillator (VCO). Output frequency slope with respect to control voltage must be linear and constant to within 1% over tuning range of $\pm 2\%$ of nominal frequency. Center operating frequency of design can be any where from 3 GHz to 10 GHz, but techniques employed to achieve linearity must be adaptable to any frequency within that range. Circuit must be sized to missile applications.

134. TITLE: Low Cost General Purpose Shop Computers

CATEGORY: Engineering Development

DESCRIPTION: Develop a low cost general purpose microcomputer system for use in I-level and O-Level maintenance shops. These systems would be used for inventory, workload monitoring and control, personnel work schedules, and general statistics and calculations. The effort would use the popular CPM 2.2, Z80B based microcomputer technology, available from many sources and encompass a packaging development to meet the new FCC radio frequency interference regulations. The system specification would require a more durable case, better power supply protection, and choice of energy sources, with interfaces for common existing military peripherals. This would not be a "militarized" computer in the MIL-STD sense, but a less costly and demanding development task.

135. TITLE: Automated Fiber Optics Measurements

CATEGORY: Advanced Development.

DESCRIPTION: The goal of this project is to develop fiber optic (FO) test methods and automated measurement systems to perform FO characterization and life-test measurements. Life-test measurement systems must be self-calibrating for the duration of the test. Exploratory development is required to develop test methods and test instrumentation for certain fiber optic components since many such tests currently do not exist either in the military or commercial realm. In conjunction with test methods development, advanced development is required to develop instrumentation that can rapidly and accurately characterize

FO components at the receiving and inspection level. Many current FO tests require highly trained individuals. Through the incorporation of automation, FO testing can be performed by semi-skilled personnel. This is particularly important as the volume of inspection chores increases as fiber optic systems transition to production.

136. TITLE: Fiber Optic Avionics Retrofit Cable Assembly

CATEGORY: Advanced Development

DESCRIPTION: The goal of this project is to provide retrofit activities a fiber optic cable assembly that is an exact replacement for a metallic wire cable assembly. The electrical connector on either end of the cable would be the same as the former electrical cable assembly. The electrical/optical and optical/electrical conversion would be done within the backshell of the electrical connector. Miniaturization of the transduction circuitry will be required. As a first step, the basic problem should be analyzed to identify all the steps needed to accomplish the desired hardware.

137. TITLE: Low Thermal Resistance Interface

CATEGORY: Exploratory Development

DESCRIPTION: Many electronic modules dissipate their heat by conduction to a cold wall. The conductive path from the device to the heat sink contains many resistances. One of the largest of these is at the interface between the module guide rib and the cold wall. A means of reducing this thermal resistance by a method other than through a material state change would allow higher power dissipation. The following parameters apply:

1. A marine environment requires that corrodible materials and galvanic cells be avoided.
2. Cold wall material is anodized on electroless nickel plated aluminum.
3. Module material is electroless nickel plated copper or aluminum.
4. Guide rib dimensions are .20 X 3.5 inches.
5. The installed contact pressure must be 25 psi.
6. Any interfact must be abrasion resistant since the rib is used as a sliding guide for module insertion and extraction.

138. TITLE: Cloud/Sea Clutter Background Modeling and Clutter-Suppression Signal Processing

CATEGORY: Exploratory Development

DESCRIPTION: This effort is for the development of engineering working models of IR cloud and sea clutter in an IRST* environment. The models will support the Navy BMAP** program and will be developed and be refined interacting with

BMAP measurements until substantial agreement with data is achieved. Clutter suppression techniques will then be added for generic IRST systems yielding a simulation code which will exercise various candidate IRST systems.

* Infrared Search and Track

** Background Measurements and Analysis Program

139. TITLE: Real-Time 3-D Computer Vision

CATEGORY: Exploratory Development

DESCRIPTION: Develop passive vision system for robotic and other applications that will provide range and classification of objects in three dimension space in real time (video frame rates).

140. TITLE: Research & Development Assessment & Planning Methodology

CATEGORY: Advanced Development

DESCRIPTION: The utilization of the most appropriate technology is the best means of keeping Naval Aviation ahead of all potential adversaries. The desired methodology would provide a means of assessing and planning those technologies which best meet Naval Air System Command needs. The methodology should allow identification of the best methods of categorizing, prioritizing and allocating of resources to the most promising R&D. Also included should be: the development of means of recognizing viable research and development and ways to recognize the technologies which need resource allocations to develop into mature and useful technologies.

141. TITLE: Tunable VHF/UHF Airborne Cosite Filter

CATEGORY: Exploratory Development

DESCRIPTION: To perform research and development of advanced RF component concepts for use in minimizing interference between colocated VHF and/or UHF radios operating on adjacent frequencies. The advanced concepts shall consider the feasibility of emerging technologies such as hybrid components, microprocessor control, and improved fabrication methodologies. These concepts shall provide the capability of maximum Q, minimum insertion loss, full band operation and minimum size, weight, power and cost.

142. TITLE: High-temperature Resins

CATEGORY: Research

DESCRIPTION: Generally, the organic resins used as binders in sprayable coatings will begin to decompose at temperatures over 400°F. New resins are needed to produce hard, durable coatings capable of withstanding up to 700°F. (Most silicone resins lack sufficient hardness and adhesion.)

143. TITLE: Optimum Electromechanical Marine Kevlar Cable Design

CATEGORY: Advanced Development

DESCRIPTION: Single and Multiple-conductor underwater cables using Kevlar as the strength member will be designed, fabricated, and tested to determine optimum designs for sonobuoy applications. The compatibility between the stress-strain characteristics of the component members of the electromechanical cable (choice of type of conductor and variation of Kevlar), the type of construction (parallel lay, contrahelically wound, or braided), and the need for jacketing will be addressed.

The problems of conductor z-kinking and column buckling when stressed beyond yield point by the dynamic tension variations of sea conditions and of Kevlar constructions maintaining high strength when subjected to dynamic working over sheaves or capstands or at terminations will be investigated.

144. TITLE: Slack Line Automatic Mooring System

CATEGORY: Exploratory Development

DESCRIPTION: Long term missions at sea require moored platforms which can survive in the ocean environment.

The Slack Line Automatic Mooring System (SLAMS) concept has the potential to provide the technology to make aircraft deployed moored systems practical.

There are two unique features inherent to this concept. The first is a segmented cable pack with buoyancy modules located at specific stations along its length. These modules support the weight of the cable and prevent it from abrading on the ocean's bottom, a severe life limiting problem with slack moorings. A primary objective of this effort is to demonstrate the feasibility of automatically deploying this unique cable pack.

The second feature of the SLAMS concept is a split outer housing which is used as a "hydroflap" to sense the cessation of flow on impact with the ocean bottom and initiate deployment of a sensor. Demonstration of the feasibility of this design is the other primary objective of this effort. This effort will address the unique features of the SLAMS concept, i.e. the segmented cable pack and the split skin housing. A preliminary design will be developed with sufficient flexibility to accommodate modifications. Models will be fabricated. Laboratory tests will be conducted to demonstrate the function of hardware. Deployment tests will be conducted to demonstrate the function of the hardware. Deployment tests will be conducted in the NSWC 100 foot mine tank. Based on these tests some redesign and hardware modifications will be incorporated and the tests will be repeated. As a follow-on effort, models will be fabricated for deep deployment demonstration. A demonstration test will be conducted in 2000 feet at Jervis Inlet.

145. TITLE: Water Pulse Jet to Deploy and Orient a Horizontal Array

CATEGORY: Advanced Development

DESCRIPTION: The problem of deploying and orienting a long horizontal line array can be solved by a small propulsion vehicle to pull the array into alignment. One such vehicle is a water pulse jet which may be powered by a gas such as hydrogen. Lithium hydride, when mixed with water, produces hydrogen gas, causing a piston to expel water from a tube, causing the vehicle to move forward. Other gas sources are possible and a unit packageable in an A-size sonobuoy needs to be developed.

146. TITLE: Remote Optical Crack Sensor

CATEGORY: Engineering Development

DESCRIPTION: There is a need for research and development of a remotely monitored fiber optic crack sensor that is sensitive to strain field changes induced by the initiation of a crack. An installed system will incorporate a cluster of sensors bonded in stress critical locations and joined by a common optical fiber. The sensor will include a strain multiplier that would be able to break the fiber and cutoff light continuity at a stage when a small crack first emerges and at a position some distance away from the crack tip. The sensor should be inexpensive and lightweight, and need no additional monitoring equipment. Ultimately, once the optical fiber is broken, the signal indicating a crack has started will be observed by the extinction of a small light display on a panel at a convenient location, thus protecting the entire structure from crack induced structural failures.

147. TITLE: Micro-Miniature Emergency Frequency (121.5 and 243 MHz) Distress Alert Receiver

CATEGORY: Advanced Development

DESCRIPTION: Aircraft carrier deck personnel require a means to rapidly detect and locate inadvertently activated aircraft crash beacons. What is envisioned is an extremely low powered, very small battery-operated device easily carried in a pocket, having an audible alarm augmented by an LCD display showing the relative magnitude of the RF signal. The intent would be to guide the user to the aircraft via visual signal strength indications.

AIR FORCE SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM

The purpose of the Air Force's portion of the Small Business Innovative Research Program is to stimulate technological innovation. The following pages list 279 specific research topics submitted by Air Force laboratories and product divisions. Small businesses should submit proposals directly to the address shown or referenced for a particular topic.

For FY84 and beyond, emphasis will be on technically acceptable proposals that meet the funding guidelines outlined in paragraph 1.2 of this solicitation.

1. TITLE: Cold Weather Flight Gloves

DESCRIPTION: The current flight glove HAU-11/P is designed for normal flying in a cockpit properly controlled by the environmental control system (ECS) on the aircraft. It is designed primarily to provide protection for the hands in the event of a flash fire and provides very little protection from cold during parachuting or in the event of loss of ECS at altitude.

There is a need for a glove design to provide a minimum of 15 minutes protection at -50°F . This protection should prevent frostbite and allow the crew member to retain sufficient dexterity to open parachute canopy release and survival kits/equipment. The bulk of the glove must be such that it can be used during flight and must not interfere with switches, knobs and other type of aircraft installed equipment. The glove must be fire resistant and have an acceptable service life (not one time use). It should also be laundrable for hygiene consideration and must be comfortable when worn for several hours during normal flight at $55-70^{\circ}\text{F}$.

Currently there is no known glove to fulfill these requirements. Fabrics/insulations must be developed and gloves designed to meet this need.

Address to which proposals will be mailed/hand delivered:

Special Assistant for Program Coordination
ASD/AE
Bldg 57/Bay 1
Wright-Patterson AFB OH 45433



2. TITLE: Angle of Attack Transmitter with Digital Output

DESCRIPTION: The objective is to develop an angle of attack sensor with a digital output for use on future weapon systems with a digital data bus. The primary problems with the sensors developed for most current aircraft is in the type of outputs available. The outputs typically have either been synchros or potentiometers. Only recently were RVDT's introduced on the USAF F-16 and Navy F-18 to improve reliability of the transmitter. The primary problem that must be considered on future aircraft is in the conditioning of the outputs and the number of outputs required to adapt the signal to the using subsystem. Studies have shown that with the standardization of air data system hardware and the interface with the MIL-STD-1553 multiplex data bus, there is a need for improvement of the existing AOA and AOS sensors interface. Currently, available output devices (i.e., synchros, potentiometers, RVDT's, etc) require extensive signal conditioning to interface with the digital air data computers and the multiplex bus. Also, there is the growing need for redundancy and failure monitoring for future weapon systems, particularly as an input to the multi-redundant digital flight control system. The need for multi-redundant systems of this type has been demonstrated on aircraft such as the USAF F-16 and Navy F-18 aircraft. An angle-of-attack sensor with redundant digital outputs to interface with the Digital Air Data Computer and flight control system would benefit the overall system design in terms of size, weight, cost, power consumption and reliability. The approach should be to conduct a program to modify existing Angle of Attack (AOA) transmitter designs to interface directly with a 1553 multiplex data bus.

Address to which proposals will be mailed/hand delivered: Refer to 1

3. TITLE: Simplified Procurement Procedure for Small Business Contracts

DESCRIPTION: The procurement cycle in the Government is considered lengthy and expensive by many small businesses. Though many procurement actions are necessary because of higher level regulations (DOD instructions, Congressional instructions, or laws), it is believed that some of them could be streamlined or even eliminated in the interest of making it easier and less expensive for a Small Business firm to do business with the Air Force.

This study would:

- identify all documents impacting on Small Business contracting with the Air Force;
- review all these documents to identify those documents, or sections thereof, which are conflicting, duplicative, of questionable value to the procurement action, or simply unnecessary;
- discuss suggested changes or eliminations with the organizations or persons who control those documents; and
- report results, conclusions, and recommendations of the study to include estimated savings in time and money to the firm and to the Air Force from each of the suggested changes, with supporting rationale for the changes.

Address to which proposals will be mailed/hand delivered: Refer to 1

4. TITLE: Pyrolytic Graphite Replacement for Copper

DESCRIPTION: This research would look at the potential application of pyrolytic graphite to replace copper as a conductor. Pyrolytic graphite has been treated with various doping materials to increase its connectivity. Pyrolytic graphite offers certain advantages over copper, i.e.,

1. it has a zero temperature coefficient;
2. it has twice the current carrying capacity of copper in the same diameter;
3. it is anisotropic (conducts in one place);
4. it is lighter and stronger than copper.

However, research is needed in order to develop applications and a connector for the material.

Address to which proposals will be mailed/hand delivered: Refer to 1.

5. TITLE: Self-Cleaning Filter

DESCRIPTION: Self-cleaning filters work in chicken fryers by removing the contaminants from the cooking oil. They also remove ice from the filter media. If this type of filter would work in the sub-freezing airflow from the outlet of an air cycle refrigerating turbine as used in aircraft air conditioning, it could significantly improve cooling performance and use less fuel. The present water separators used on aircraft environmental control systems (ECS) cannot operate below 35°F due to icing and blocking of the filter screen. A self-cleaning filter which would remove the ice as quickly as it forms would allow ECS operation down to 10°F, hence greatly improving the performance of the air cycle refrigerant system. A filter similar to that used in chicken fryers which removes contaminants from the cooling oil may be applicable to the ECS filter problem.

Address to which proposals will be mailed/hand delivered: Refer to 1

6. TITLE: Improved Aircraft Wiring and Connector Performance

DESCRIPTION: Estimates from experienced maintenance people and design engineers indicate that a significant portion of maintenance resources are expended because of problems associated with aircraft wiring and connectors for equipment black boxes. The objective of this research is to develop inexpensive materials, tools, processes, procedures, design criteria, and isolation methods that would have high pay-off in decreasing the amount of resources necessary for aircraft wiring and connectors.

The maintenance effort that is done is largely hidden in secondary efforts such as "cannot duplicate failure" depot, intermediate shop "retest o.k." (unable to find problem), and intermittent conditions that cannot be found. One aspect of this research is to get credible data on the extent and nature of the problem and conduct a cost analysis of current and proposed solutions for these failures. Two general areas are apparent in creating solutions to the problems. The first of these is design criteria for new systems. This involves creative investigation of the "interconnecting function" on a broad system basis. Getting a suitable approach would include the assessment of design, manufacturing, quality assurance, and field maintenance with a capability for field modification. The proposed solution must cover the system activities from establishing the architecture to detail design, through production quality assurance with emphasis on modification and maintenance of the interconnecting devices for application in air frames expected to be used from 10 to 20 years. Existing, proven approaches are preferred with plans for a comprehensive validation program for evolving approaches to remedy the interconnection problems. A medium for the transmission of data such as the use of fiber optics or signal multiplexing could be considered as potential candidates for a cost reduction effort.

A second general area of concern relates to the aircraft systems currently in the Air Force inventory. The creation of "quick fixes" or simple aids to be used in the isolation and repair of problem areas or protection of existing cables and connectors could produce a large cost savings in maintenance dollars as a result of prudent investigations. Some known problems that should be assessed in this area include connector pin corrosion, abuse in handling wire and cables, intermittent signal conditions, and wire harness chaffing. An investigation could also be made to better define and quantify the sources of problems associated with cables and connectors to assist in making a more judicious decision in appropriating funds for procurement and support.

Address to which proposals will be mailed/hand delivered:

ASD/AFEA
Avionics Division
Bldg 17, 2nd Floor
Wright-Patterson AFB OH 45433

7. TITLE: Improved Anthropometric Dummies for Ejection Systems Testing

DESCRIPTION: Current anthropometric dummies do not adequately represent dynamic human responses. As ejection systems become increasingly sophisticated, simulation of actual human response in the testing of these systems becomes increasingly important. With the current emphasis on injury-free ejections, the dummies must simulate limb-flail reactions as closely as possible. Center of gravity, moment of inertia, and correct anatomical proportions also must be realistically simulated. The latter is especially needed in view of the added female members of the flying population. All these parameters and more must be quantified and integrated into low cost dummies. An appropriate initial effort would be design of the major joints (shoulder, elbow, hip and knee) and spinal column so that they effectively emulate the movement of their human equivalent and can be instrumented to measure forces.

Address to which proposals will be mailed/hand delivered:

ASD/ENO
Engineering Operations Office
Building 14, Room 208
Wright-Patterson AFB OH 45433

8. TITLE: Development of Visual Displays Mil-Prime Specification

DESCRIPTION: The USAF is beginning to move from hard specification to tailored specifications that are based on mission, system, and operator performance. This new performance-based document is termed the Mil-Prime Specification. This document will have requirements containing blanks (e.g., "... the luminance of the numbers shall be _____ foot-lamberts") that will be filled in

(tailored) for the system under development. The values to be filled in are derived after careful consideration of all relevant factors. The basic format for a Mil-Prime is a requirements section containing requirements with blanks (where appropriate), and a handbook section containing rationale for each requirement, guidance for each requirement (when to invoke, how to fill in blank, suggested values or range of values, background information, references, considerations, interactions), lessons learned, verification (by inspection, demonstration, analysis, measurement, or test), verification rationale, verification guidance, and verification lessons learned. The requirements section is separate from the handbook section but are formatted in parallel.

A Mil-Prime that needs to be developed is one for Visual Displays as it relates to the operator. Visual display design data are currently contained in MIL-STD-1472C, section 5.2. Phase I in the development of this document would be the reformulation of the requirements of section 5.2 into the new format, the updating of the requirements to reflect new display technology (e.g., color cathode-ray tubes, contrast enhancement filters, glare reduction, night vision goggle compatibility), and the extraction of data from the literature that can be used to form the handbook section. Finding the scientific basis for current hard specifications is very difficult because they have often been derived empirically from the field and current specifications do not cite their references. The new Mil-Prime should be firmly based in human visual/cognitive performance scientific data.

Address to which proposals will be mailed/hand delivered: Refer to 7

9. TITLE: Phase I Topic Solicitation for Project Oxygen Sensor Development

DESCRIPTION: There is a need for a sensor to monitor the oxygen in the respirable gases made available to an aircrewman when on high altitude missions in order to ascertain the proper operation of the oxygen regulator. At present, the oxygen regulator (by design) provides an oxygen mass flow limited by an aneroid flow control valve and orifice. No assumed O_2 concentration is verified.

The oxygen sensor must be responsive to concentrations up to 100% oxygen and yet be capable of long term use. Current sensors of the electrolytic silver-gold-potassium chloride concepts become chemically depleted upon exposure to high oxygen content. Hydroxide sensors do not have sufficient life effectiveness for satisfactory operations. Likewise, acid battery type sensors are not long-life devices.

Research into newer concepts for possible application to oxygen monitors is needed. Laser concepts for giga frequency O_2 absorption bands can be evaluated for a signal proportional to the oxygen present. Ceramic sensors based on electrolytic conductance proportional to the oxygen exposure need to be evaluated. Gallium arsenide transistors respond to oxygen concentration by

a change in current flow. These suggested concepts in conjunction with a gas flow proportionating system can provide a candidate system for O₂ sensing.

A battery charge-discharge system using microchip control for sensor regeneration after an oxygen sensor discharge can be a potential sensor system. Miniaturization, gas flow proportionating, microchip charge-discharge control for sensor regeneration and microchip readout and control can provide an oxygen monitor and control system.

An oxygen partial pressure sensor could provide microchip inputs to a life support on-board monitor giving a warning to the pilot(s) of a hypoxic situation for flight safety considerations, and also could be another control component of the flight recorder to be recorded for later review. Accurate oxygen partial pressure monitoring could also provide detection of delivery of excess oxygen concentrations and allow on-board oxygen stores conservation. The need is clear for an accurate, small, lightweight and reliable oxygen partial-pressure monitor.

Address to which proposals will be mailed/hand delivered: Refer to 7

10. TITLE: Implementation of ADA on Aircrew Training Devices

DESCRIPTION: The aircrew training device (ATD) relies heavily upon the digital computer for its operation. During the acquisition phase of a typical ATD, software development and the associated documentation account for thirty to sixty percent of the total development costs. Over the last ten years many software techniques and tools have been developed in FORTRAN to address the real-time ATD unique problems. This development process represents a substantial investment by the Air Force.

As the result of a DOD directive mandating the implementation of the ADA environment on all major weapon systems development, the ATD engineering community is faced with hosting ADA on future ATD software development systems while any questions dealing with the real-time ATD unique requirements under ADA remain unanswered. Considering the current multi-million dollar development costs of an ATD, a full scale development effort using ADA would contain a high element of risk at this time.

The research should first study and analyze the feasibility of implementing ADA on an ATD, and its impact on those hardware and software requirements that are real-time ATD unique. An analysis of the ADA environment tools is required to determine their applicability to ATD software development and provide recommendations on what tools must be developed. The research would also require that real-time ATD modules be written, tested and demonstrated under the ADA environment to determine how the current ATD specification should be modified to accommodate the implementation of ADA on a full scale ATD development.

Address to which proposals will be mailed/hand delivered: Refer to 7

11. TITLE: Flight Simulator Image Metrics

DESCRIPTION: Computer generated image systems are being used extensively in visual systems for flight simulators. They are used to generate out-the-window displays in either raster scan or calligraphic formats. Computer generated imagery is also being used to create radar imagery.

Innovative research is needed to determine a way to measure the quality of the computer generated image that the pilot sees. Visual displays are currently specified in terms of quantity of edges, vertices, light points, mini-rasters or combinations of all. No standard test procedures exist for their evaluation.

The objective of the proposed image metric project is to develop a quantitative test method capable of the evaluation of quality and realism of a CIG image.

The method should:

- a. be capable of evaluating a simulator's visual system from the pilot's eyepoint;
- b. use hardware which is easily transportable;
- c. use hardware which is sensitive enough to measure low light level displays typically encountered on flight simulators;
- d. result in quantitative numbers representing display parameters and comparisons of the displayed image with real world imagery;
- e. be easily duplicated by simulator manufacturers or government agencies with good correlation of results; and
- f. be capable of being specified as a standard test procedure for flight simulator visual system acceptance testing.

The program should include provisions for:

- a. development of the test methodology;
- b. demonstration of a breadboard measurement system;
- c. specification of the method and a standard test procedure; and
- d. the development of a portable test set-up.

Address to which proposals will be mailed/hand delivered: Refer to 7

12. TITLE: Long Life Icephobic Coating

DESCRIPTION: Current methods for protecting aircraft flight surfaces, radomes, and inlets from icing are expensive in terms of aircraft maintenance costs and performance penalties. Pneumatic boot de-icing utilizes a small amount of aircraft resources but has a limited life and requires maintenance. Heating surfaces with engine bleed air or with electrical heating elements imposes a substantial performance penalty on the aircraft.

One method of aircraft ice protection that would have a negligible penalty and little maintenance is the application of a coating that would greatly reduce the shear force required to break ice from the surface--ice-phobics. A viable icephobic coating must be capable of withstanding the erosion effects of dust, sand, rain, hail, etc. encountered for a substantial length of time.

Research is needed in the icephobic coating area with emphasis on longevity of the coating. Results of any investigations should include the maximum expected useful life of the coating, any trades between coating life and required shear force, and the effect of ambient temperature on shear force.

Address to which proposals will be mailed/hand delivered: Refer to 7

13. TITLE: Evaporative Heat Sink

DESCRIPTION: Increased aircraft performance coupled with increased avionics heat loads and the emphasis on reducing aircraft infra-red (IR) signatures requires the utilization of aircraft heat sinks other than ambient ram air or fuel for aircraft thermal control. Current versions of the F-111 utilize water as an expendable heat sink. Problems associated with using water as a heat sink are the corrosive effects on the water boiler tank, its relatively high boiling temperature, and the requirement to use distilled water to reduce boiler residue.

Investigation of alternative, high performance, evaporative heat sinks is required. Candidate heat sinks should be non-corrosive, possess a low boiling temperature, have a high latent heat (low boiling rate), and should be non-toxic. Trades between these qualities and the specific weight of the candidate heat sinks should also be investigated. The expected result is a documented complete study/survey of possible candidate heat sink compositives with recommendations and rationale as to their application in new weapon systems.

Address to which proposals will be mailed/hand delivered: Refer to 7

14. TITLE: Man-Ladder Interaction Model

DESCRIPTION: The task consists of researching the available literature sources, operational units, etc. to scope and define the situation and problems of personnel climbing into and out of airplanes using aircraft-mounted ladders. Ultimately, the program is to result in computer software to predict loads and motions during use of any single or dual shaft ladder and define the "operational needs" criteria/requirements to be used in the Aircraft Structures Mil-Prime Specification.

The computer program is to represent a person approaching, ascending, and descending the ladder in three dimensions. Therefore, large motions of the person and ladder are to be considered when predicting ladder deflections and loads (both external and internal). Different means of supporting the ladder need to be considered and included as a parameter of choice in the modeling. The program is to be written in two high level languages for which compilers are readily available, e.g., PASCAL, FORTRAN, S-BASIC, etc.

Address to which proposals will be mailed/hand delivered: Refer to 7

15. TITLE: Adverse Weather Turbulence Structural Criteria

DESCRIPTION: A study is needed to assess the need for refinements/improvements in aircraft structural criteria for turbulence, considering advances in airborne avionics which allow or will allow an increase in flying during and into adverse weather conditions. An evaluation of the applicability of current parameters is needed, and the recommendation of new or augmented parameters is desired.

A computer program which allows for the comparison, evaluation, and demonstration of the refined criteria versus current criteria is to be written in two high level languages that are compilable, e.g., PASCAL, FORTRAN, S-BASIC, etc. The program is to be used to assess the impact of the new criteria versus the current criteria for different categories of aircraft, including fighters, bombers, cargo and trainer airplanes.

Any changes to the "operational need" type of requirements in the Aircraft Structures Mil-Prime Specification and supporting handbook information of guidance, rationale, and lessons learned are to be parts of the final report.

Address to which proposals will be mailed/hand delivered: Refer to 7

16. TITLE: Aircraft Accident Data Analysis

DESCRIPTION: A computer program is needed that will organize and store available "sanitized" accident data in such a way that the information can easily be retrieved in a format that will readily support the Aircraft Structures Mil-Prime Specification "lessons learned" effort. A repetitious structural problem may go undetected if much time elapses between occurrences, or if they occur on different airplanes.

A computer program is to be created that will provide the number of occurrences of a problem and related information for any selected structural discipline of loads, dynamics, flutter, stress, materials, corrosion, durability, damage tolerance, and criteria. The software is to be written in a high level compilable language, e.g., PASCAL, FORTRAN, S-BASIC, etc. and used to organize and store available accident data.

Use of the computer program will be demonstrated and documented. A highly desirable output would result in support of requirements in the Aircraft Structures Mil-Prime Specification.

Address to which proposals will be mailed/hand delivered: Refer to 7

17. TITLE: Crack Growth Rate Data Processing

DESCRIPTION: This effort would include producing (a) computer program(s) to process raw material crack growth rate data and to provide a large selection of output formats. The purpose of the program is to provide equation coefficients that best fit the input data and to graphically display the input data and the mathematical equation. The user should have the option of selecting the form of the equation to be used from a library of the most commonly used equation forms. The program must possess ease of use (extremely user friendly), be flexible in input requirements, and provide any of the specified output equations or tables, in terminal graphics and hardcopy display.

The programs are to be written in high level languages, preferably FORTRAN or BASIC, and be modular and compatible with ASD computer facility equipment. Complete documentation is to be provided—program tapes, programming manuals, data flow diagrams, and comprehensive test cases.

Address to which proposals will be mailed/hand delivered: Refer to 7

18. TITLE: Conversion of FASTGEN Models to NASTRAN Models

DESCRIPTION: This work would provide a computer program to translate FASTGEN II input data decks to equivalent NASTRAN bulk data decks. This effort shall include the development of a complete static B-52 NASTRAN Model and a complete static F-16 NASTRAN Model. The FASTGEN II Computer models will be supplied. FASTGEN II air vehicle models provide a complete target description by developing detailed item by item geometric representation. Numerous FASTGEN II models are available.

NASTRAN models provide a complete structural description. NASTRAN models can be used for laser vulnerability structural analysis, nuclear overpressure vulnerability analysis, and stress structural analysis. These detail NASTRAN models can easily be converted to dynamic models for flutter and gust analysis.

Developed computer programs must be compatible with CDC 6600 and/or VAX 11780 computers at WPAFB.

Address to which proposals will be mailed/hand delivered: Refer to 7

19. TITLE: Migration of Personal Micro Computers into Professional Workstations

DESCRIPTION: The Deputy for Engineering Aeronautical Systems Division (ASD/EN) is currently in the process of procuring micro-computers through the Air Force Requirements Contract (to be signed no later than 15 September 1983). These systems are to be placed throughout the organization and are to be used by approximately 1600 engineers assigned to the organization. The micro-computers will be used to increase the current capabilities of our engineers thus helping them to work more efficiently.

The task at hand is to integrate the micro-computer into the professional environment. Research should be done to find the best concept to utilize the micro-computers. The concept used to implement the installation of the micros should maximize their utility by using them as workstations. Workstations must have the capability for lateral and vertical communication. This includes developing software and procedures to allow the micros to transfer files from micro to micro, micro to host computer (i.e., VAX, CDC, IBM, etc.) and to networks currently envisioned within Area B of Wright-Patterson AFB. The implementation concept needs to include the results of research done to answer the questions of compatible operating systems and hardware interfacing. Also required is the development of a concept of what additional hardware and software is required to perform the tasks that our professionals need.

The concept developed should span the planning and implementing stages concerning the total system. Established checkpoints should also be included in the plan to ensure the correct installation.

Address to which proposals will be mailed/hand delivered: Refer to 7

20. TITLE: Investigation of Concepts for Internally-Mounting Electronic Combat (EC) Equipment in Aircraft Pylons

DESCRIPTION: Historically, electronic combat (EC) equipment was not originally installed within fighter aircraft. In many of the existing fighter aircraft EC equipment was later installed "piecemeal" throughout the aircraft with existing design constraints governing its location. In other instances, space was not available and the design of EC equipment took the form of a pod. There are advantages to pod EC (e.g., it is a relatively inexpensive approach and pods can be serviced and changed rapidly). There are also significant disadvantages and sacrifices to EC pods (e.g., they occupy critical store stations, degrade aircraft performance and must be carried to and from the target). When EC pods are attached to the tertiary ejection rack (TER) or the multiple ejection rack (MER), the racks also stay with the aircraft since most EC capabilities represent the advanced state-of-the-art in electronics and cannot be jettisoned.

An initial assessment is that the supporting pylon itself is designed to provide an aerodynamic strong hard point for stores carriage and possesses numerous bays or areas that equipment could be located. It also appears worthwhile to investigate the feasibility of integrating EC equipment within or "blister" mounted to the pylon, and returning the store station to ordinance use.

The physical constraints of size, weight, and volume of pylons need investigating to assess whether potential packaging of current EC components shows initial promise. Detailed investigations of surviving concepts will then be carried out. Functional and actual physical interfaces such as electrical, hydraulic and cooling requirements will be examined in detail relative to the available resources of host aircraft candidates.

Address to which proposals will be mailed/hand delivered:

Directorate of Concepts and Innovation
ASD/XRZ
Room 249, Building 11A
Wright-Patterson AFB OH 45433

21. TITLE: Research and Development Funding Strategy Model for Research and Development Decisions

DESCRIPTION: A fundamental need exists to develop a model that recognizes the weapon system life cycle stage, vis a vis the projected threat, to determine if significant patterns emerge of changes in research and development funding intensity. For example, the Air Force's weapon systems can be typified as being in emerging, growth and mature categories. Each of these types of systems need different kinds of research and development programs ranging from near-term to far-term in order to meet their respective threat, and thus are competitive with each other. Mature systems seem to focus on specific near-term replacement technologies while growth systems focus on planned improvement gain from near to mid-term technology. The growth systems are competitive with emerging systems in the near-term but not in the far term. At present, the decision that is used to allocate research and development funds between these categories is haphazard.

The initial portion of this project would be to lay out as many factors as possible that contribute to the development of the decision process and, most importantly, to the collection of consistent valid data.

The final product of this basic research and development effort would be to define a research and development funding strategy that is focussed and timely and will tend to influence research and development budget changes that are more consistent with both the Air Force's near and far-term objectives.

Address to which proposals will be mailed/hand delivered: Refer to 20

22. TITLE: Artificial Intelligence for Aircrew Assistance

DESCRIPTION: Aircrews are presently heavily burdened with information and this situation will get worse in the future. Aircrews also now serve as a source of information which must be processed/transmitted to achieve mission objectives.

Considering the year 2000 and beyond, models for planning the extensive use of artificial intelligence to assist aircrew functions are required. Models can be developed from library research or from other sources but should be limited to that minimum necessary for their projected use in planning and development of artificial intelligence assistance to aircrews. Separate models (for the year 2000 and beyond) to be synthesized are:

- a. generic penetrating offensive manned aircraft (POMA);
- b. C³I system;
- c. the environment which the POMA and C³I system will encounter; and
- d. missions to be accomplished by the POMA.

In addition to the models a brief narrative report shall be prepared and should include descriptions of each model; descriptions of the present state-of-the-art for artificial intelligence to assist aircrews; description of major activities necessary to advance the use of artificial intelligence to assist aircrews.

Address to which proposals will be mailed/hand delivered: Refer to 20

23. TITLE: High Energy Fuels For Use In Turbine Engines

DESCRIPTION: High energy fuels applied to turbine engines offer significant potential benefits in range and/or vehicle weight over current high-density liquid fuels and carbon-slurry fuels for many applications. Whereas some fuels have increased heating value per gallon and a decreased heating value per pound, as compared to liquid fuels, other fuels offer the combined benefits of greater heating value per gallon and pound. The use of high energy fuels present challenging problem areas for turbine engines. Atomization and ignition of the fuel are difficult and require advances in fuel chemistry, atomization, and combustion technologies. The fuel rheology must be developed so that acceptable viscosity is obtained while maintaining desirable stability, storage, fuel manageability, and durability characteristics. The objective of this program is to develop fuel formulations that exhibit vastly superior heat contents, rheology, stability, and combustion properties over previous fuels.

Address to which proposals will be mailed/hand delivered: Refer to 20

24. TITLE: Oxidation Resistant Coatings/Inhibitors for Carbon/Carbon (C/C) Materials at 3500 °F

DESCRIPTION: Turbine engine efficiency increases dramatically with increases in turbine inlet temperature. Carbon/Carbon is of great interest because it is relatively light weight, it can be configured to meet a wide variety of component geometries and it retains its high strength and modulus throughout the temperature operating regime of interest. A major technology hurdle, however, is the susceptibility of C-C to rapid oxidative degradation at elevated temperatures, and the need to provide a protective mechanism to prevent such oxidation.

The objective is to develop oxidation resistant coatings and/or inhibitors with emphasis on understanding chemistry, mechanics and thermophysical interplay of coatings and substrates. Typical areas of concern are the conversion reaction, kinetics and influence of additional elements such as B on the Si and C-C reaction; the conversion of SiC or Si to SiO₂, the influence of B on viscosity and the possible use of hot hardness tests for identifying flow threshold; the effects of stoichiometry on the structure of SiC surface coats; and the use of physical vapor deposition of ZrO₂ in columnar configurations. The coating/inhibitor must withstand temperature variations from 1000°F to 3500°F for the life time of the engine which could be from 10 hours to 5000 hours. Unique coatings/inhibitors and processes for their integration into C/C materials are desired.

Address to which proposals will be mailed/hand delivered: Refer to 20

25. TITLE: Zero Knot Thrust Reverser

DESCRIPTION: A zero knot thrust offers the potential of providing superior short landing (SL) capability for fighter aircraft regardless of runway surface condition (dry, wet, icy). However, two problems arise as the aircraft slows from about 40 knots to zero knots: a. hot gas reingestion, and b. foreign object damage.

Proposals should address "simple" low cost ways to eliminate these problems while minimizing any detrimental impact to aircraft inflight performance.

Address to which proposals will be mailed/hand delivered: Refer to 20

26. TITLE: Math Model for Weapon Trajectory Simulation

DESCRIPTION: To achieve the required level of training effectiveness in future flight simulators, the weapon trajectory must be more faithfully simulated. Current simulation for "smart bombs", guided missiles and other weapons are inadequate in terms of a descriptive data base and modeling. In addition, new weapons are being introduced into the inventory which will require simulation on current and future trainers.

The objective is to develop:

- a. a generic weapons system trajectory simulation math model for incorporation into current and future flight simulators;
- b. a descriptive data base which will be the source of data for the generic model; and
- c. documentation of the model interface with the simulator.

Address to which proposals will be mailed/hand delivered:

ASD/YWE
Directorate of Engineering
Building 11, Room 001
Wright-Patterson AFB OH 45433

27. TITLE: All Mobile Tactical Air Force

DESCRIPTION: Tactical force flexibility and mobility is highly desirable. The need or capability to operate from damaged runways, concealed locations and other sites is a requisite for mobility. The fixed-site air base and industrialized support structure is currently inflexible, immobile and vulnerable. Dependence on this structure limits mobility and consequently effectiveness. Developing and improving an ability to operate from large numbers of dispersed operating locations is fundamental to future objectives. Proposals for developing improved mobility concepts should accomplish or enable one or more of the following.

- Define aircraft characteristics and requirements for mobile squadrons.
- Define requirements for upgrading paved roads, etc., to accommodate current TAC aircraft.
- Define modifications to current aircraft to operate from various sites.
- Develop overall operational concept emphasizing battle damage repair, maintenance and logistics concepts for mobile squadrons.
- Identify technological advancements required to insure feasibility of mobile squadrons concept.
- Compare effectiveness of mobile operational concepts with current concepts (such as fixed base concepts).
- Estimate impact on enemy resources of a tactical Air Force consisting entirely of mobile squadrons.
- Establish plan for making mobility possible for current aircraft and future aircraft.

Address to which proposals will be mailed/hand delivered: Refer to 20

28. TITLE: Artificial Intelligence (AI) Software Program Development Aids

DESCRIPTION: The technology of artificial intelligence (AI) has evolved to the point that consideration of its use as an electronic combat aid to pilots in the tactical aircraft environment is warranted. Towards that end the Avionics Laboratory has developed a comprehensive plan in the area. The plan contains a structured mix of contractual efforts and in-house activities. The in-house portion is in the formative stages and support in this area could significantly enhance the expertise in artificial intelligence within the DOD and ultimately result in improved management of contracted efforts.

Desired efforts involve initial survey analysis and specification on non-real time AI support software development tools to assist, eventually, in the efficient design of selected military AI decision aiding packages. Such tools exist in the world of conventional programming; for example, the Partitioning Analyzing and Linkage Editing Facility (PALEFAC), developed under the DAIS program, is a software program to aid in the design and development of executive software. Similar tools exist in AI; for example, ROSIE developed by the RAND Corporation. However, these AI software tools have

been structured around the needs of the academic community and will likely have to be tailored or redesigned to accommodate the requirement of the tactical aircraft environment.

A logical follow-on to the subject effort would result in development of the AI design tool, hosting the system on resident computing resource facilities, and demonstration involving the design of a limited decision aiding application as proof-of-concept of the utility of the AI software design aid tool.

Address to which proposals will be mailed/hand delivered;

Avionics Program Office
Building 22, Room S110
Wright-Patterson AFB OH 45433

29. TITLE: Design Automation Tools

DESCRIPTION: Design automation tools for very large scale integrated circuits are rapidly becoming unable to effectively handle the complexity of the design process. There is a need to study and compare the various technical approaches that are emerging to improve design automation systems such as knowledge based systems, dedicated hardware, synthesis tools, new programming/design languages, and new analytical design methodologies. Studies should investigate the advantages and disadvantages of the approaches listed above, and comment on their current and future markets. The studies should in part be directed towards the specific needs and requirements of the military in order to establish a quick turnaround design capability targeted primarily at the system and subsystem levels.

Address to which proposals will be mailed/hand delivered: Refer to 28

30. TITLE: Gallium Arsenide Memory Application Study

DESCRIPTION: Gallium Arsenide (GaAs) memories can have access time of less than one nanosecond. Studies are required to determine full significance of this speed capability and how to most effectively use GaAs memories. Questions to be answered by such a study are as follows:

-What effect does this short access time have on the throughput of signal processors?

-How is memory architecture affected?

-What are the advantages of having both logic and memory on the same integrated circuit? Is an integrated logic-memory approach required to fully utilize the speed capability of GaAs memories?

An analytical study with verification by simulation is desired.

Address to which proposals will be mailed/hand delivered: Refer to 28

31. TITLE: High Speed Testing of Integrated Circuits

DESCRIPTION: As the complexity of digital GaAs integrated circuits increases to LSI and greater, it is going to become increasingly more difficult to completely characterize GaAs ICs at full operating speed. Presently, functional testing of LSI circuits with commercial test equipment is done at speeds of under 100 MHz. It is desirable that future LSI test systems perform functional testing in the 500 MHz to 4 GHz region. This presents a very complex microwave systems problem. With many pins running at GHz clock rates, there will be difficulties with cross-coupling between pins. Extremely accurate control of phase relationships between digital inputs will be necessary. Large capacity, small access time memories will need to be developed and small delays and discontinuities in transmission lines will drastically affect signal timing and circuit operation. There is a need for new data analysis techniques to sift through voluminous amounts of high speed data. Innovative approaches to solve these and myriad other problems associated with high speed LSI testing are needed.

Address to which proposals will be mailed/hand delivered: Refer to 28

32. TITLE: High Speed Device and Circuit Modeling

DESCRIPTION: The operating frequency of integrated circuits using GaAs MESFETs has reached low GHz range. The emerging modulation doped FET ICs has the potential of providing even higher operating speed. In high frequency operation, circuit parasitics become the dominating factor in determining the ultimate speed of the ICs. A precise knowledge of these parasitics is of paramount importance for device/IC design and simulation. An effort to calculate and minimize parasitics (self and mutual capacitances of electrodes, etc.) as a function of actual device configurations, dimensions and circuit lay-out is essential for operation of integrated circuits in high GHz range.

Address to which proposals will be mailed/hand delivered: Refer to 28

33. TITLE: GaAs Device Research

DESCRIPTION: Research is needed to better understand the physics of GaAs device and circuit operation. These devices and circuits are needed for avionics, missile and space applications. Such devices provide ultra high speed digital data rates and recently clock rates of 8.9 gigahertz were observed. Higher speed circuits allow fabrication of radar systems with improved performance characteristics. Consequently, DOD and especially the Air Force have programs to develop GaAs technology. The purpose of this research is to supplement and enhance the development of GaAs technology. Of prime interest is work on Modulation Doped FET, since this represents a new and extremely promising technology. Other areas of interest are insulated-gate GaAs field effect transistor technology, bipolar heterojunction transistor technology and MESFET technology. Theoretical, analytical or device and circuit fabrication efforts are of interest to further develop the above indicated technologies. Theoretical studies may include two dimensional device modeling, evaluation of ballistic effects, velocity overshoot effects, Gunn domain formation, and circuit simulation.

Analytical work may include materials evaluation by Auger spectroscopy, Rutherford backscattering, etc. Finally, transistors and circuits could be designed, fabricated and tested. The above description maps out a wide area of interest and the anticipated program would attack a small segment of this above described area. Proposals addressing individual areas will be considered.

Address to which proposals will be mailed/hand delivered: Refer to 28

34. TITLE: Advanced Integrated Circuit Processing Technology

DESCRIPTION: Advanced processing technology is required for the fabrication of ultra high performance gallium arsenide integrated circuits. Key areas to be addressed are numerous and include electron beam/ion beam/x-ray and deep UV lithography techniques, new implantation studies, plasma dielectric deposition, plasma etching, refractory metal deposition, and low temperature contact techniques. High resolution pattern transfer techniques to replicate submicrometer patterns are needed. Studies/techniques to increase scaled device dimensional accuracy and to improve packing density are required. The goals of these exploratory development activities are to meet the gigabit per second processing rate needs for future military electronic systems.

Address to which proposals will be mailed/hand delivered: Refer to 28

35. TITLE: Vacuum Plasma Sprayed Boron Nitride on OFHC Copper

DESCRIPTION: The objective of this effort is to fabricate and evaluate several (minimum of 3) samples of metal ceramic interfaces. Specifically, this effort is to explore the feasibility and subsequent demonstration of a vacuum plasma spray for forming a boron nitride ceramic layer on an oxygen-free-high-conductivity (OFHC) copper substrate. The samples shall consist of a flat OFHC substrate of about 200 micrometers thick and a boron nitride thickness of at least 1000 micrometers. No halogens, such as chlorides, may be used as these may be released at the final applicational operating temperature which can be as high as 600°C in a 100 nanopascal (10^{-9} torr) vacuum and would cause poisoning of other tuber parts. Sample testing should evaluate boron nitride layer thickness and composition uniformity, electrical and dimensional stability, and discuss any outgassing observed for substrate temperatures of 600°C. Based on these findings, a discussion of the feasibility for the vacuum plasma sprayed boron nitride technique, when applied to a helically wound metal ribbon, should be presented. The final applications will require depositions about 1000 micrometers thick on either a large cylinder about 400 millimeters long, 3 millimeters in diameter, and about 250 micrometer thick copper, or a medium cylinder about 250 millimeters long, 1.6 millimeters in diameter, and about 150 to 200 micrometer thick copper.

Address to which proposals will be mailed/hand delivered: Refer to 28

36. TITLE: Ceramic Packages for Microwave GaAs Power FETs

DESCRIPTION: The objectives of this program are to develop the tooling and to fabricate sample quantities (10) of ceramic packages for microwave gallium arsenide (GaAs) power field effect transistors (FETs). Packages are desired for devices operating from 2-20 GHz with a nominal package size being .4 x .4 x .2 in³. The packages shall have two beamleads, a mounting flange and be hermetically sealed to house the FET chip and associated impedance matching microstrip substrates. There are no requirements to make or mount the GaAs FETs and impedance matching substrates; only the ceramic packages shall be developed. Detailed drawings of a 7.5 GHz package to be developed will be provided. The long term objective of this work is to establish a domestic commercial source of microwave FET packages.

Address to which proposals will be mailed/hand delivered: Refer to 28

37. TITLE: Controlled Nucleation Thermochemical Deposition of Thermally Conductive Dielectric Materials

DESCRIPTION: This effort addresses controlled nucleation thermochemical deposition (CNTD) of anisotropic pyrolytic boron nitride. This investigation is to address the CNTD technique in terms of deposition rates, texture, achieved thickness, and uniformity. The dielectric material must have a minimum thickness of 1 millimeter, be electrically and dimensionally stable, and show negligible outgassing at temperatures up to 600°C in a 10⁻⁹ torr vacuum. The objective of this work is to provide for the deposition of anisotropic pyrolytic boron nitride via a controlled nucleation thermochemical deposition of the dielectric material on 0.25 millimeter thick, flat copper substrates. A minimum of 3 samples shall be delivered to demonstrate this technology. The findings of this investigation shall be discussed in terms of the above enumerated requirements. Also, the applicability of this technology for helix structures should be discussed.

Address to which proposals will be mailed/hand delivered: Refer to 28

38. TITLE: Suppression of Sidelobes for Beams from Diode Lasers

DESCRIPTION: In order to meet stringent systems requirements relating to crosstalk suppression, optical signal processors must use optical beams that are diffraction limited, and have very low scattering and sidelobe levels. The first two objectives can be met by the use of high quality optics in a well designed architecture. In principle, the objective of sidelobe suppression can be managed by properly weighting and truncating the optical beam. For gas lasers, which have a nearly ideal Gaussian intensity profile, this is not a difficult problem. However, for diode lasers, which emit broad, asymmetric, somewhat stigmatic, and only quasi-Gaussian beams, the problem is more difficult to solve. What is needed is the development of techniques for characterizing the output beams of diode lasers, determining the proper complementary weighting function that produces low sidelobes, and methods for physically implementing this weighting function. The primary goal of this effort would be to suppress all sidelobes of a focussed beam from a diode laser by at least 40 db.

Address to which proposals will be mailed/hand delivered: Refer to 28

39. TITLE: Laser Pump Fluorescence Converter Bulk Material Improvement

DESCRIPTION: In the interest of improving overall solid state laser efficiency, suggested methods have included spectral improvements to pump sources, especially fluorescent converters. Fluorescent spectral enhancement has two dominant critical aspects: down-conversion of undesirable spectral portions, and transport of desirable spectral portions into the laser medium. This research will deal primarily with the down-conversion itself. To date, experiments involving fluorescent converters have used materials which were not well suited to that task. Used as converters, these materials have had weak conversion or caused strong de-optimization of cavity performance. For application, flexibility, and optimal function, an expanded materials parameter space is needed. This will require an investigation of a growth method to produce solid fluorescence converter materials (cf. titanium 3-plus in alumina) for neodymium:YAG absorption enhancement from flashlamp sources. Issues will be high doping into proper ionization state, with the related issue of achieving high absorption coefficients approaching 10 per centimeter for short wavelengths while efficiently fluorescing proper wavelengths. Beneficial wavelengths should have low attenuation; however, very low scattering may not be necessary, or even desirable. Fluorescence characteristic decay times of less than a microsecond are desired.

Address to which proposals will be mailed/hand delivered: Refer to 28

40. TITLE: Crystal Growth Development of Cadmium Telluride Modular Material

DESCRIPTION: Present crystal growth of cadmium telluride produces very low yields of single crystal bars suitable as modulators of 10.6 micrometer CO₂ laser radiation, especially as used in laser radar. The object of the research is to develop the crystal growth technology of cadmium telluride to improve the material characteristics and increase the yields. The technology goals of the research will be to develop the crystal growth process to produce a yield of 20% of single crystal cadmium telluride bars with dimensions 5mm x 5mm x 50mm. The difficult 50mm dimension is to be along a 110 crystallographic direction. Orientation of side faces depends upon intended application. The cadmium telluride bars should exhibit very little CO₂ laser line absorption, in-grown stress and axial orientation, but rather they should be isotropic and homogeneous. The research is organized into two phases. The first phase research has two tasks. In task one, the research would examine existing thermodynamic theory of the crystal growth process of cadmium telluride to determine the conditions necessary to achieve practical crystallization of cadmium telluride samples suitable for CO₂ laser modulators. Task two will assess the approaches to growing large single crystal cadmium telluride samples. Each approach will be examined to determine if all the thermodynamic conditions obtained in task one are achieved in the crystal growth approach under consideration. Estimates of the material properties and yields will be made. A phase one report will be written detailing the analyses and recommended approach. Phase two research would determine optimum experimental crystal growth conditions, actual material characteristics, and yields.

Address to which proposals will be mailed/hand delivered: Refer to 28

41. TITLE: Increased Optical Energy Transport Efficiency through Surface Preparation Techniques

DESCRIPTION: Current Air Force flashlamp pumped laser systems require increased optical energy transfer efficiency to increase the overall efficiency of the laser. Typical systems utilize flashlamps encased in tubes which transfer energy to laser material formatted as plates, cylinders or rods. In order to increase the amount of energy delivered to the pump bands of the laser rod, down conversion techniques are being studied. After this spectral enhancement is accomplished however, one must address the problem of transporting desirable spectral portions into the laser medium. This is especially difficult for light originating within a fluorescent converter because so much of the total solid angle emission occurs in directions which become trapped due to total internal reflection (TIR). In order to reduce TIR and thereby increase fluorescent output, it is desirable to study surface preparation techniques that would expose facets and increase the amount of transferred energy. For each technique examined it would be necessary to obtain quantitative spatial (scanning in two directions) radiometric spectrophotometry measurements and compare them to those obtained for an untreated surface. Preliminary examination suggests that narrow distributions about the radial direction in the case of cylinders and normal direction in the case of slabs are to be desired; however, modeling, an important part of this program, may conclude otherwise. Results from the study would conclusively show whether development in this area is worthwhile.

Address to which proposals will be mailed/hand delivered: Refer to 28

42. TITLE: Compound Semiconductor Research

DESCRIPTION: Thin layers of semiconducting material with very sharp interfaces have been shown to have a number of properties that are very interesting to the Air Force. Specific device concepts employing these structures are under development and basic research to support those developments is underway. Primary interest at this time is in the GaAs/AlGaAs system, but other materials will become of interest as they show significant advantages. At the present time, molecular beam epitaxy (MBE) and metal organic chemical vapor deposition (MPCVD) are the primary methods used to grow the thin structures, and there is interest in programs to improve these two techniques or in other techniques that might be better. New physical principles govern the performance of the new class of devices that is evolving and new measurement techniques or variations of established techniques are needed to understand the materials properties that control that performance. Research to show the connection between the material characteristics and device performance is also of interest. Examples of topics that would be of interest are: 1) development of experimental techniques to measure interface sharpness between layers of GaAs and AlGaAs to within a half of a lattice constant; 2) development of ways of determining carrier concentration profiles within 100 Å of an interface; 3) development of measurement techniques that would give impurity and defect profiles close to interfaces for both residual and doping concentrations; and 4) studies of unique characteristics that would have a significant impact on present or new device concepts. This list is by no means exhaustive but should give the flavor of the type of programs of interest.

Address to which proposals will be mailed/hand delivered: Refer to 28

43. TITLE: Two-Phase Fluid Flow Heat Transfer

DESCRIPTION: A fundamental method for improving the efficiency of heat transfer loops is to use a two-phase (liquid-vapor) fluid rather than a single-phase liquid or gas. Boiling and condensing of the fluid provides high heat transfer coefficients and greatly reduces the quantity of fluid that must be pumped around the loop. However, use of two-phase fluids on spacecraft will require a better understanding of the flow regimes and heat transfer characteristics to be expected in a weightless environment.

Two-phase fluid work provides the foundation for other elements of thermal management for high energy spacecraft applications (e.g., space-based surveillance systems and space-based lasers). It allows the design of compact, highly efficient thermal control subsystems and will be directly applicable to a complete satellite thermal analysis computer program. Data are needed for the later "very large heat load" systems which may employ vapor cycle heat pumps.

Methods for optimizing flow networks based on better understanding of flow regimes will have a high payoff for weight and volume savings on future spacecraft. The uniqueness of heat transfer in zero gravity necessitates analytical and experimental research.

Address to which proposals will be mailed/hand delivered:

AFWAL/XRPF
Area "B", Building 45, Room 105
Wright-Patterson AFB OH 45433

44. TITLE: Chemical Warfare Agent Simulation for ECS Application

DESCRIPTION: Current aircraft employ open-loop environmental control systems (ECS) which are incapable of providing or maintaining contaminant-free air to crew compartments in a chemical warfare (CW) attack scenario. This is due to the fact that open-loop ECSs exhaust cabin air to the ambient and replace it with conditioned engine bleed air drawn from the contaminated environment.

Closed ECSs (CECS) can alleviate this problem by recirculating a high percentage of cabin air. Bleed air requirements are thereby reduced to those of system leakage, which is sufficient to sustain cabin oxygen at an acceptable level. CECS configurations, which incorporate CW filtration/decontamination/sensing systems, need to be evaluated in this regard.

To perform accurate analytical studies of ECS and cabin CW agent penetration and accumulation, physical data on non-toxic, laboratory testable simulants, which closely represent the important physical properties CW agents, are required. These data, in functional or tabular form will be required to be incorporated into ECS simulation software. A full range of simulations must then be made and correlated with laboratory data to be obtained from testing in an aircraft cockpit configuration. The test system will subsequently be used to determine a more efficient scheme for thermal redistribution of cockpit air while maintaining an effective level of CW protection.

Address to which proposals will be mailed/hand delivered: Refer to 43

45. TITLE: Structural Evaluation of High Elongation Carbon Fiber Composites

DESCRIPTION: A new family of carbon fiber reinforced composite materials is being developed in response to new aerospace structural requirements. These materials have relatively high elongation to failure as a result of improvements in carbon fiber manufacturing. A need exists for specific research in the durability of composites containing the improved fibers and new resins developed for use with them. Emphasis needs to be placed on determining possible failure mechanism changes and their effect on structural applications of these new materials.

Address to which proposals will be mailed/hand delivered: Refer to 43

46. TITLE: Digital Fringe Data Processing

DESCRIPTION: Techniques such as holographic interferometry, photoelasticity, moire', and speckle photography are being used to measure the response of various aerospace structures to static and dynamic loads. All of these approaches result in fringe patterns which must be converted to useful engineering information. Video-computer systems are now being used to convert these fringe patterns to digitally stored information. What is now required is computer software to process these data.

Address to which proposals will be mailed/hand delivered: Refer to 43

47. TITLE: Innovative Methods to Reduce Hole Wear in Composite Structures

DESCRIPTION: Modern structures are often being designed with the use of composite materials in highly loaded applications. One problem that has the potential of limiting the application of composites is that of hole wear at the fastener due to repeated reversed loading.

A need exists to hypothesize and review innovative methods of reducing or eliminating the process of hole wear at fasteners in composite structure. This effort should also include an experimental verification of the improvement to the structural integrity.

Address to which proposals will be mailed/hand delivered: Refer to 43

48. TITLE: Evaluation of Spectrum Marking Approaches to Enhance Fractographic Tracking

DESCRIPTION: The accurate measurement of flaw growth is significant to the understanding of the fatigue and fracture behavior of structures. At critical details in many structures, flaw growth cannot be normally measured during service on test, because the detail is often hidden from view by other components such as plates, covers, or fastener heads. Because of these problems, fractography has become a powerful tool in making after-the-test

measurements of the structural fatigue behavior.

Past investigations have found that some loading spectra produced no discernible fracture surface marking, while others created easily seen markings. The purpose of this effort is to evaluate and define loading spectrum requirements to enhance microscopic analyses of fracture surface topology.

Address to which proposals will be mailed/hand delivered: Refer to 43

49. TITLE: Development of Durability Design Criteria for Advanced Powder Metallurgy Alloy Structures

DESCRIPTION: Advanced aluminum powder based alloys indicate great promise for improving structural performance due to increased mechanical properties. The properties of these materials are sufficiently different from conventional materials that it may be necessary to evaluate their capabilities for use in critical applications.

Design criteria are needed to justify the use of advanced powder alloys in damage tolerant structural components. Research efforts should focus on establishing the initial quality of complex structures made from advanced metallic structures.

Address to which proposals will be mailed/hand delivered: Refer to 43

50. TITLE: Forward Speed Effects on Acoustic Propagation

DESCRIPTION: It has been theoretically shown that subsonic motion of a noise source changes its static directionality as heard both by a stationary observer and by an observer moving with the noise source. The change in acoustic intensity is proportional to the source convection velocity as measured from the direction of motion. Some research indicates dependency upon the type of noise source. Other research indicates independency of noise source.

The acoustic pressure field carried along with the noise source has a preferential radiation forward and a reduced radiation aft. This phenomena is often referred to as convective amplification, or the convective effect. This effect is in addition to any change in observed frequency - known as the Doppler effect.

The convective effect has been identified experimentally, for low forward speeds. An analysis of the effect of forward motion on various engine noise components for large airplanes has been reported. In correlating static and flyover noise, on a source separated basis, the convective effect, including the strong forward arc lift, was shown to hold for fan, core, and turbine noise. Test work has verified the convective effect for angles from 30° to 150° at Mach numbers up to 0.25. In view of the large impact at the higher Mach numbers, validation at these speeds is urgently required.

There do not appear to be any reports or data where this effect has been identified at high speed. Effort is required to understand and confirm

the validity of this factor throughout the speed range. Application to high aircraft Mach numbers where the effect is far more significant, is therefore, questionable. Whether the effect is equally applicable to point sources as well as distributed sources also requires clarification. The effort to better define the applicability of this effect to observer locations - either stationary or moving with the source - needs further study, both theoretically and experimentally.

Since the noise radiated from military flight vehicles is one of the observables that can be utilized for detection, tracking, and identification purposes, a requirement exists to determine accurately the effects of flight vehicle forward speed on the source strength and radiation characteristics.

Address to which proposals will be mailed/hand delivered: Refer to 43

51. TITLE: Directed Energy Thermal Shields

DESCRIPTION: As the development of directed energy weapons proceeds, there is strong incentive to consider protective countermeasures to alleviate or negate their damaging effects on structures. Aside from anti-ballistic missile applications, space-based directed energy weapons also have the potential for attacking satellite communication and information gathering systems.

One suggested countermeasure approach is the use of a protective shield with sufficient thermal capacity to safely absorb the thermal energy generated by directed energy beams. Such an approach requires that the entire surface of the structure in question be protected against the effects of direct beam impingement, even though the beam may encompass only a small fraction of the surface. A shield designed on this premise will be inherently heavy and inefficient.

A much more efficient approach is to utilize a thermal mechanism for dissipating the heat generated in the area covered by the beam over the entire surface of the structure being protected. The principles of heat transport can be used to distribute thermal energy deposited by the incident beam throughout the shield structure. The energy is dissipated by a combination of heating the surrounding shield structure and radiating heat from its surface to the environment.

The goal of the proposed effort is to determine if structures in space can be protected from damage by high intensity directed energy beams. Thermal shields are applicable to commercial as well as military space structures, and may also be used for protection against inadvertent damage from laser beams employed in industrial and medical applications.

Address to which proposals will be mailed/hand delivered: Refer to 43

52. TITLE: High Temperature Metal Matrix Structure

DESCRIPTION: Advanced spacecraft reentry vehicles require airframe structure operating in the 2000°F range. Few materials possess the necessary high temperature stability, toughness and fatigue resistance. Super-alloy and refractory metals do the job, but at high weight and require protective coatings. The use of discontinuous reinforcements in superalloy matrices offer the potential for high temperature and high strength/stiffness material systems. In particular particulate oxides, carbides or nitrides in Inconel 718 or Rene 41 alloys offer attractive properties. Before they can be utilized however, basic design data must be developed.

These new metal matrix composites (ceramic particulate reinforcement of super-alloys) require development of consolidation processes, microstructure characterization, and mechanical property characterization. Design allowables for fracture toughness, fatigue and basic yield, elongation, and ultimate strength need to be established.

Address to which proposals will be mailed/hand delivered: Refer to 43

53. TITLE: Digital Control Algorithms for a Terrain Model Board Probe Protect System

DESCRIPTION: Terrain model boards have been employed for many years in engineering flight simulation for generation of the out-the-window visual scene. Regardless of the specific board design, care must always be exercised during operation to assure safe clearance between the system's optical pickup (probe) and the board surface to avoid surface, and more importantly, probe damage. Terrain avoidance scenarios, which by design require continued close proximity to and high speed tracking of the board topography, only serve to reinforce the need for development of a dynamic probe protect capability. The capability should ideally operate autonomously from the main simulation computer network, thus providing protection even in the event of computer system failures and during stand-alone operation such as maintenance. Research is required into hardware and digital technology which can provide this fail-safe probe protection while at the same time providing maximum dynamic tracking of aircraft flight path.

The specific area to be addressed by this effort is research into the microprocessor based digital controller, and control algorithms used to implement the probe protect process. The controller would receive instantaneous height-above-the-ground data from sensors and would intervene when necessary in driving the vertical axis to avoid collision. The controlling algorithms must allow maximum dynamic tracking of flight path. Should intervention become necessary, the procedure would be to follow the aircraft ground position, tracking terrain vertical boundaries, until such time as the flight path can be reacquired with smooth transitions when both entering and leaving the protection profile.

Address to which proposals will be mailed/hand delivered: Refer to 43

54. TITLE: Probe Protect Capability for Terrain Model Board Visual System

DESCRIPTION: With the same background as topic 53 above, the specific area to be addressed by this effort is research into the proximity sensing hardware which would provide the raw height-above-the-board information for the protection system. The sensor must work over a continuous range to permit feedback control techniques, the range being roughly six inches with an accuracy of $\pm 1/16$ of an inch. It must be able to supply repeatable data with no discernable lags despite variation in terrain slope, reflectivity and texture. Various technologies being developed for proximity sensing in the robotic field offer promise in application to this problem.

Address to which proposals will be mailed/hand delivered: Refer to 43

55. TITLE: Output Predictive Algorithmic Control for Terrain Following/Terrain Avoidance

DESCRIPTION: Terrain Following/Terrain Avoidance (TF/TA) system concepts are being evolved to application oriented point designs and ground-based flight simulations as part of an accelerated technology transition effort by both government and industry. Several approaches have been taken for TF/TA trajectory generation including the Feasible Directions Algorithm (FDA), a gradient search technique; Dynamic Programming Algorithm (DPA); and decoupled TF and TA application of the Advanced Low Altitude Techniques (ADLAT) algorithm. Less effort has been devoted to control of the aircraft flight path compared to the computed trajectory. Virtually all development has been based on a high-gain, high-order inertial feedback approach incorporating an inertial-to-body-axis command decoupler. This approach requires the measurement of inertial positions, velocities, and acceleration and high feed-forward system gain to achieve good system performance.

Output Predictive Algorithmic Control (OPAC) is a new control design technique which appears well suited to the TF/TA flight path control task. All the trajectory generation techniques produce control information on the future flight path. OPAC may be applied to produce anticipatory control (as opposed to reactionary control which characterizes the conventional feedback approach), with reduced order inertial feedback. An investigation is required to verify the applicability of OPAC to TF/TA and to demonstrate any performance or design benefits.

Address to which proposals will be mailed/hand delivered: Refer to 43

56. TITLE: Robust Decentralized Control

DESCRIPTION: The uncertainties in system modelling arise from several sources: parameter errors, model truncation errors, actuator/sensor modeling errors, nonlinearities, noise, and disturbances. It is extremely important to consider these uncertainties in the control system design process. This is particularly important for systems such as large flexible space structures whose missions demand precise performance while they are in orbit for several years. Current research concentrates on robustness theory only for analysis of control systems, and not for design purposes. To minimize the computational burden of on-line calculations, it is very important (especially for large space structures) to design decentralized control systems where instead of designing a single controller, several controllers are designed to operate in a performance-defined hierarchy. Specific research should be done to develop the theory required for designing robust decentralized control systems for application to large flexible space structures.

Address to which proposals will be mailed/hand delivered: Refer to 43.

57. TITLE: Front/Rear Projection Screens for Tactical Air Visual Simulators

DESCRIPTION: Tactical air-to-air and air-to-surface combat engineering flight simulators require wide field-of-view simulation systems with the capability of depicting a variety of air and surface targets and other imagery in high resolution. Real-image dome type visual display approaches are desirable because of the ability of this type of display to accommodate a variety of cockpit seating arrangements essential for supporting R&D engineering simulation. Because of space limitations and interference problems inside the dome, it is desirable to project wide field-of-view background information from outside the dome and high resolution, narrow field-of-view imagery from inside the dome. A flat screen faceted dome is attractive in that expensive distortion correction inside the image generator is unnecessary.

Successful implementation of such a dome visual display system requires a screen material with good combined front and rear projection capability. Some sample screens with fair performance have been demonstrated. Also, various improved screen configurations using Fresnel and other specialized elements have been theorized.

In order to realize a satisfactory screen material, elements of the theorized screen material need to be fabricated, tested, and refined. In addition, techniques need to be developed for manufacturing large panels as well as for handling and mounting in a faceted dome configuration. Desirable performance figures are screen gains greater than 10 at half angles of 10° for both front and rear surfaces. Screen sizes required are approximately 6 meters on a side.

Address to which proposals will be mailed/hand delivered: Refer to 43

58. TITLE: Application of an Expert System to the Single-Seat Cockpit

DESCRIPTION: As the mission of the single seat pilot becomes more demanding, he must continuously rely upon the avionics system to aid him in decision making. The expert system is a software technique which promises to be of great value to the pilot. Of how much value, however, is presently unknown. It is necessary to apply an expert system to a series of test cases - specifically electrical, hydraulics, and fuel problems - to determine the difficulty in building the knowledge base in each of these areas, and to demonstrate the level of problem solving complexity the expert system can achieve.

Address to which proposals will be mailed/hand delivered: Refer to 43

59. TITLE: Real Time Optimal Feedback Control for Integrated Aircraft/ Missile Systems

DESCRIPTION: Optimal control and differential game theory can be used to develop optimal combat maneuvers for aircraft and optimal guidance laws for air-to-air missiles. Up to date, these mathematical tools were applied separately to the aircraft and the missile guidance problems. However, since these two problems are highly coupled, a more promising approach would be to address the integrated aircraft/missile problem. This integrated approach is the objective of this research. An additional objective is to use this approach in building the base for developing the optimal control laws for multiple target kill by a single aircraft.

Address to which proposals will be mailed/hand delivered: Refer to 43

60. TITLE: Demonstration of Adaptive Learning Networks (ALN) for Flight Control (FC) Reconfiguration

DESCRIPTION: Reconfiguration shows great promise of being able to significantly increase the damage/fault tolerance of FC systems. This is done by utilizing other FC surfaces to reconstruct the forces and moments after a surface failure. There are a number of techniques or strategies for doing this. The purpose of this project is a proof of concept of ALN as a re-configuration strategy. To weed out alternative techniques as expeditiously as possible, a flight demonstration is needed. The most economical test bed is a fully instrumented light aircraft of which there are many existing at universities and research institutes. The ALN technique could be programmed on a signal processing type of computer and interfaced to the instrumentation. Various surfaces could be failed in flight (surface locked to center). The ability of the ALN to accurately model the new aircraft characteristics in the presence of real world noise, disturbances, initial conditions, and other inputs would be evaluated. The role of ALN in reconstructing lost forces and moments would be investigated. The primary purpose of this project is demonstrate as quickly as possible the ability/shortcomings/limitations of ALN in reconfiguration.

Address to which proposals will be mailed/hand delivered: Refer to 43.

61. TITLE: Demonstration of Self-Organizing Systems (SOS) for Flight Control (FC) Reconfiguration

DESCRIPTION: Reconfiguration shows great promise of being able to significantly increase the damage/fault tolerance of FC systems. This is done by utilizing other FC surfaces to reconstruct the forces and moments after a surface failure. There are a number of techniques or strategies for doing this. The purpose of this project is a proof of concept of SOS as a reconfiguration strategy. To weed out alternative techniques as expeditiously as possible, a flight demonstration is needed. The most economical test bed is a fully instrumented light aircraft of which there are many existing at universities and research institutes. The SOS technique could be programmed on a signal processing type of computer and interfaced to the instrumentation. Various surfaces could be failed in flight (surface locked to center). The ability of the SOS to accurately model the new aircraft characteristics in the presence of real world noise, disturbances, initial conditions, and other inputs would be evaluated. The role of SOS in reconstructing lost forces and moments would be investigated. The primary purpose of this project is to demonstrate as quickly as possible the ability/shortcomings/limitations of SOS in reconfiguration.

Address to which proposals will be mailed/hand delivered: Refer to 43

62. TITLE: Trans-Atmospheric Launch of Boost Glide Vehicles

DESCRIPTION: Boost Glide Vehicles (BGV) possessing high hypersonic L/D (>3.5) offer several potential strategic, long range operational capabilities useful in future systems. Current efforts are underway to evaluate the utility of BGVs in the ground and air-launch modes not only for application in future systems but also as a research vehicle to explore lifting reentry technologies. This approach would couple with that effort.

What is needed is the conceptual analysis of applying boost glide vehicles to launch from a vehicle in orbital and suborbital flight. The aeromechanics and dynamics problems associated with launch and atmospheric flight of the BGV need to be understood. The advantages of conducting high-speed research technology development and demonstration for this class of vehicles should be examined. Initial velocities of the BGV will range from M 15 to orbital speeds. Its high energy will provide it with a ground impact footprint over a significant area of the earth's surface. This suggests unique approaches to test range requirements for a research vehicle and highly flexible strategic operational capability. The exploitation of these unique flight characteristics must be understood and taken advantage of in any conceptual investigation.

Address to which proposals will be mailed/hand delivered: Refer to 43

63. TITLE: Take-off Augmentation Devices for SSTO Reusable On-Demand Launch Sortie Vehicles

DESCRIPTION: Operational requirements for on-demand single stage-to-orbit (SSTO) vehicles strongly suggest a horizontal take-off, horizontal landing vehicle. Rapid turn around and improved logistics are two of the benefits of this concept approach. However, the technology demands of a SSTO concept places it in a high development risk category with a relatively far term development time. To lower risk and development time and minimize gross-lift-off-weight (GLOW), the use of a sled like device on take-off has been suggested. Some limited evaluation of this concept has taken place.

These earlier investigations indicate that SSTO vehicle feasibility exists through elimination of on-board take-off gear, and impacting high SSTO lift off velocities. Several devices that have been suggested include a rail-launcher, a multi-wheeled towable and steerable launcher, and an air-cushioned launcher. Survivability demands strongly suggest the launch concept include the capability to flush the empty SSTP vehicle to another base on warning and provide launch capability after flushing. This suggests a flyable launch device.

Concepts for SSTO ground launch assist are needed for vehicles in one to one-and-a-half million pounds gross lift-off weight class with lift-off velocities of approximately 300 knots. Conceptual data required for such devices include propulsion system, aerodynamic performance capabilities, alternate base or ferry capability, runway and basing requirements, and rapid turn-around capability.

Address to which proposals will be mailed/hand delivered: Refer to 43

64. TITLE: Computational Navier-Stokes Research (6.1)

DESCRIPTION: Future military aircraft should be highly maneuverable, operate over an extended flight envelope, possess low IR and radar signatures, carry a variety of weapons, and have short take-off and landing capabilities. To accomplish these desired characteristics, innovative vehicle designs must be formulated through on data generated from experimental techniques and advanced numerical prediction methods. Specifically, research in the area of computational aerodynamics to develop methods to predict the aerodynamic characteristics of practical aircraft configurations is required. The application of the time-dependent, three-dimensional Navier-Stokes equations to numerical techniques is needed to accurately capture the flow phenomena which govern the performance of advanced aircraft designs. Areas of emphasis within current Navier-Stokes computational research include the development of three-dimensional grid generation techniques, improved turbulence modeling application for separated flow regions, and development of efficient numerical algorithms that will allow solutions of practical Air Force configurations.

Address to which proposals will be mailed/hand delivered: Refer to 43

65. TITLE: Powered Airfoil Design

DESCRIPTION: Exploratory studies have shown that the proper application of boundary layer control (BLC), by either suction or blowing, can significantly enhance the aerodynamic performance of airfoils used in various aircraft applications. One notable example of powered airfoil potential occurs when considering High Altitude Long Endurance (HALE) aircraft. In-house studies have indicated that properly designed blowing jets, applied at the beginning of the upper surface pressure recovery region, can improve HALE airfoil lift/drag ratios by twenty-five percent or more. This is just one example of an interesting application of powered airfoil technology. There are many others.

Research is solicited to explore the area of powered airfoil design, select an appropriate air vehicle application and design a BLC airfoil, using available methodology, and compare the predicted results with those achievable using unpowered designs. Very accurate accounting of BLC power requirements will be needed to obtain a meaningful performance comparison.

Selected high performance BLC airfoils may be wind tunnel tested to further verify computed performance projections.

Address to which proposals will be mailed/hand delivered: Refer to 43

66. TITLE: Vortex Control Devices

DESCRIPTION: Vortex control devices, such as leading edge strakes, extensions, and flaps have been utilized quite extensively on the current generation of fighter aircraft. Most of these devices have been developed empirically, from costly wind tunnel data. However, emerging vortex flow analytical procedures offer the potential for theoretically assessing the effectiveness of new and unique vortex generating concepts, prior to conducting controlled performance substantiating wind tunnel experiments.

Research should investigate unique vortex control devices using available empirical and rapidly developing theoretical methodology. Performance comparisons should be made between conceived geometries and existing vortex device architecture for selected air vehicle performance parameters.

Selected vortex devices which show exceptional promise for enhancing military aircraft lift/maneuver performance may be selected for wind tunnel testing.

Address to which proposals will be mailed/hand delivered: Refer to 43

67. TITLE: Euler Equations Algorithm Development

DESCRIPTION: The complexity involved in the analysis and design of future military weapons systems has increased considerably due to: flight envelopes expanded for high maneuverability at transonic speeds, short take-off and landing requirements, advanced weapons carriage concepts, and design implications of low observables technology. Advanced numerical aerodynamics prediction methods based on the Euler equations are needed to complement new ground

testing facilities. Current Euler equation methods are limited by available grid generation schemes and detailed knowledge of the proper boundary conditions, especially for boundary-layer matching in separate flow. Precise investigations of how the Kutta condition arises in the numerical solution of Euler equations for both sharp-edged and round three-dimensional bodies are needed to resolve current controversies. Additionally, the effects on the solution of the selection of variables transmitted between a boundary-layer or Navier-Stokes algorithm and the Euler code must be determined to increase user confidence and applicability. The impact of grid density and shape on these problems must also be investigated as well as generation of optimum grids for force and moment prediction using the Euler Equations.

Address to which proposals will be mailed/hand delivered: Refer to 43

68. TITLE: Performance Methods for Two-Body Separation

DESCRIPTION: A number of military systems development efforts are in progress which involve the separation of one vehicle from another in areas where aerodynamic forces may have important effects. These efforts include such work as the advanced military spacecraft capability and advanced aeroconfigured missiles. Although the safe separation of the vehicles in the first few seconds of flight is essential to the development of these concepts, the criteria which determine a safe separation is not well established. In addition, separation dynamics computer programs, when used at all on a particular concept, contain variations in the assumptions used. This effort is therefore to develop a generalized two body separation computer program that can be used to simulate the flight paths of various concepts on a common ground.

The initial need in this area is to determine what methods are available and the means of different approaches. Upon selection of a suitable approach the methods must be tested. Innovative ideas are encouraged to produce reasonable fidelity in the calculations while retaining ease of use. Desired aspects of the program resulting from this work would permit incorporation of thrust, control of both vehicles, interference aerodynamics, and allow calculations and display of the dynamic response of both vehicles.

Address to which proposals will be mailed/hand delivered: Refer to 43

69. TITLE: Manufacturing Scheduling Analysis/Risk Assessment Software

DESCRIPTION: Develop a computer program which enables program offices to perform schedule assessments. This program will involve review of the data and information generated in the Automated Management System (AMS) Software Development program, development of the system architecture, and development of user friendly software which meets the following requirements.

- Optimizes manufacturing schedules to minimize risk based upon both user selected and computer selected parameters while producing a complete risk assessment of the schedule.
- Derives engine schedules from airframe schedules.
- Provides "what if" simulation capability with interactive review of the results.

- Provides the analysis within one minute of the input completion.
- Integrates resource and cost factors into the model.
- Provides a detail analysis of the impact and estimated cost of schedule changes.
- Integrates "Line of Balance" technique into the model.
- Provides a "User Friendly, Interactive and Menu Driven" user environment utilizing artificial intelligence concepts.
- Provides a flexible input/output capability.
- Retains all schedule data until deleted by a delete command.
- Provides on-line terminal graphic display and plotting capability and off-line plotting and printing capability.
- Applies learning curve theory to the schedule development.
- Provides for schedule concurrency.
- Integrates Test Flight Time and Spares Requirements into the model.
- Provides for full system and data security.
- Retains the ability for expansion of the software into a complete manufacturing analysis schedule/risk assessment data base.
- Is compatible with the ASD AMS which utilizes a VAX/VMS 11/780 computer system.

The data generated in the AMS Study are available from ASD/YZ upon request. They provide a complete documentation of the system requirements and identifies that there is currently not any commercially available software which meets these requirements.

Address to which proposals will be mailed/hand delivered:

Deputy for Propulsion
 Manufacturing/Quality Assurance Directorate (ASD/YZD)
 Building 46, Column 1C5
 Wright-Patterson AFB OH 45433

70. TITLE: Nondestructive Evaluation

DESCRIPTION: Nondestructive evaluation plays a major role in the production, operational safety, and maintenance of Air Force systems. Current emphasis has largely been on the inspection of airframe of engine components, sub-assemblies, and entire systems during manufacture and throughout their service lives as a major element of maintenance and repair procedures. The tremendous variations encountered in the articles to be inspected, in matters such as geometry, material composition, service conditions, and defect detection requirements, has led to the study of many physical, chemical, and mechanical phenomena which can be used as inspection techniques. Research is needed to improve the theoretical and experimental understanding of existing and new nondestructive evaluation (NDE) techniques for the detection and characterization of flaws in air frame and engine materials including metals, composites, and ceramics, in electronic device materials and components, and also for the real-time monitoring and control of manufacturing processes. In particular, research is needed on electromagnetic, ultrasonic, radiographic, and new and improved methods for the detection of bulk and surface defects in metals and composites, imperfections in material coatings, and corrosion. Of particular interest are those research efforts which give an improvement in the reliability of the inspection process, and those efforts which allow the quantitative characterization of the flaws detected.

Address to which proposals will be mailed/hand delivered:

AFWAL/XRPM
Attn: Kay March
Area "B", Bldg 653, Room 406
Wright-Patterson AFB OH 45433

71. TITLE: Microwave Materials

DESCRIPTION: It is becoming clear that gallium arsenide based amplifiers and monolithic integrated circuits will find increased usage in military systems. The key for the fabrication of these microwave devices and circuits is the basic semi-insulating gallium arsenide material. Research objectives in these areas of material research are aimed at: advancing the technology of uniform crystal growth (which is concerned with a variety of problems concerning the ability to grow large boules); the necessity for maintaining the solid liquid interface in the furnace for improved crystalline properties; and the lapping and polishing procedures to produce required wafer quality and size.

Address to which proposals will be mailed/hand delivered: Refer to 70

72. TITLE: Electronic Packaging

DESCRIPTION: Research is needed to study microelectric problem areas and to develop electronic crystal materials, new packaging approaches, reliable solder materials, optimized printed wiring boards and materials with required properties, such as specified thermal expansion coefficient and low dielectric constant. This research is in support of the current very high speed integrated circuit program. This program is anticipated to advance microelectronic technology in areas such as device materials and processes, packaging, lithography, and material characterization. The ultimate research objective in these efforts is aimed at a reduction of electronic chip pattern geometries from approximately three microns to approximately one micron within the next three years.

Address to which proposals will be mailed/hand delivered: Refer to 70

73. TITLE: Broadband Radomes

DESCRIPTION: The objective of the present research and development program in this area of radomes is to develop and evaluate broadband radome materials that will operate at velocities up to Mach 5, have high transmission efficiencies at the frequencies of interest, and have high resistance to thermal shock and rain erosion. Both ceramic and reinforced plastic (e.g., quartz and polyimide) materials will be considered.

Address to which proposals will be mailed/hand delivered: Refer to 70

74. TITLE: Infrared Detectors

DESCRIPTION: The Air Force requirement for improved surveillance systems has created a need for an advancement in detector array technology. These arrays may be composed of a checker board pattern of several thousand very small detectors each measuring about two to three thousandths of an inch. Mercury cadmium telluride detectors have a high potential for meeting anticipated system performance requirements. One of their advantages is that they can operate at a higher temperature and thus require less cooling than other detectors. Research objectives include growing crystals of mercury cadmium telluride having the appropriate ratios of the three individual elements so that the material properties can be optimized. In addition to the development of a mercury cadmium telluride detector, there is a need for basic research and exploratory development of silicon materials for very high density detector arrays to meet Air Force detector requirements in target acquisition systems. The thrust of this research is to develop crystal growth techniques which optimize detector parameters such as detectivity and operating temperature.

Address to which proposals will be mailed/hand delivered: Refer to 70

75. TITLE: Synthesis of New Thermooxidatively Stable Polymer Systems

DESCRIPTION: Approaches are needed for the synthesis and characterization of thermooxidatively stable polymeric materials specifically tailored in molecular structure for new, improved matrix resins and adhesives. Approaches are needed for (a) high molecular weight processable polymers exhibiting high thermo-oxidative stability, which by virtue of chemical additions, cycloadditions or rearrangements can be cured to high strength materials; (b) polymers containing a high degree of chain rigidity which can be ordered (and/or oriented) and processed to high strength materials; (c) reactive oligomers capable of being converted to environmentally resistant, high molecular weight, high glass transition temperature materials by controlled chemical addition reactions and/or molecular rearrangements; and (d) low polymers or prepoly- mers which can, without the production of by-products, be cross-linked chemically and/or through low energy cures to high polymer networks with excellent resistance to thermochemical and mechanical environments and stresses. Approaches are also needed to provide improved new polymer forming reactions, multifunctional monomers and cross-linking agents required to produce the above polymeric materials.

Research will establish viable approach(es) to the preparation of the above types of polymers. Further research would plan for the implementation of these approach(es) to synthesize and characterize the desired polymers.

Address to which proposals will be mailed/hand delivered: Refer to 70

76. TITLE: Initial Impact Damage of Composites

DESCRIPTION: A composite structure can be damaged by a low velocity impact. Tests have shown that transverse impacts due to minor accidents during the assembly process can cause internal delaminations, and matrix cracking. The

delaminations reduce the maximum compressive load that can be designed. An approach to understanding the phenomenon is to divide the problem into two parts: an initial damage, and the growth of this damage under load. The goal of this project is to better understand the first of these. It may be possible to reduce the level of initial damage by substituting new matrix materials, but as yet, we do not know which material properties need to be changed. Hopefully, if the impact phenomenon can be properly modeled so that internal stresses of the non-homogenous materials can be predicted, the dominant material properties will become evident.

The impact problem has been recognized for many years, and therefore a body of literature already exists. One task required is to first survey the literature to find particularly relevant work. In this study, we would like to concentrate on low-velocity impact (energy levels of 10-50 ft-lbs, velocities up to 100 ft/sec). Once a survey is complete, a model of the phenomenon is needed which will yield numerical values for internal stress and strain. The model can be built up in steps, adding more detail with time. For example, an accurate model will have to include some way to handle progressive cracking and delamination. Because of the complexity of progressive failure models, however, this detail may have to wait until after accurate stresses in the unflawed composite can be made. The analysis should be able to take into account variations in plate geometry, boundary conditions, and impactor size and mass. The model should also be able to give insight into what is the dominant damage causing process, stress wave propagation, bearing load, plate bending or others.

Address to which proposals will be mailed/hand delivered: Refer to 70

77. TITLE: Oxidation Resistant Structural Carbon-Carbon Composites

DESCRIPTION: New, novel approaches are needed for the development of materials and processes for future Air Force systems requiring combined oxidation resistance and structural load carrying capabilities. Such approaches will involve the use of oxidation resistant fibers and matrices in surface-coated and/or indepth inhibited carbon-carbon composite constructions which retain structural integrity and minimize thermal expansion mismatch among constituents. Oxidation resistance will be provided over wide temperature range excursions with peak temperatures, in some cases over 2200°K. Applications for these materials include gas turbine engine components, heatshields, rocket nozzles, ramjet combustors and both primary structures and airframes for reuseable aerospace vehicles. Additional desired attributes of such material systems are low weight (lightweight construction), fast processing for high rate/high volume production of parts, and low cost.

Address for which proposals will be mailed/hand delivered: Refer to 70

78. TITLE: Advanced Simulation Language for Process Modeling and Design Optimization

DESCRIPTION: Simulation modeling based on the finite element method for mature CAD technologies provides a means for linking the user (designer) with manufacturing and vendor (parts supplier) industries. Computer-aided engineering

(CAE) systems with consistent user interfaces are needed. From the application-program viewpoint, the simulation environment should have a consistent means of sending and receiving information from the user, of storing and receiving information from a data repository; and of each application package being independent of the context in which the program is being used. The user should be capable of isolating the application packages and combining them again in a transparent way. A new simulation language is needed for improving the environment because performance (time) is of the utmost importance. The new language should be designed for parallel processing and it should be structured in such a way that it can be used on or provide the basis of designing advanced hardware for modeling based on VSLI and VHSIC technologies. The goal is to improve the simulation engineering and manufacturing environment. The hardware needed to support the engineering environment should be capable of turning the solution around in 60 - 120 sec CPU + Input/ Output time.

Address to which proposals will be mailed/hand delivered: Refer to 70

79. TITLE: Expert System for Design and Process Simulation

DESCRIPTION: In the CAD/CAM field a large number of application programs exist which assist design engineers in evaluating and defining design concepts and manufacturing processes; however, these programs do not represent a connected sequence which allows the design engineer access to an integrated manufacturing system spanning the steps from concept evaluation to manufacturing. The programs provide design aids but make no attempt to inject ideas to stimulate the designer in creating adequate or advanced concepts.

Expert systems offer a potential capability for prompting and aiding the design engineer in his task of finding effective solutions to complex problems. Because many simulation programs are capable of providing results which are equivalent in validity to experimental data, they could be used by expert systems to evaluate speculative designs in the same manner as that employed by engineers before giving results to the user. Modern CAD programs could be incorporated into an expert system to accelerate the design process without intermediate user intervention, and expert system intervention could take place at a variety of stages from concept evaluation to material selection and manufacturing. Each stage of intervention could make use of mature CAD technology.

Research is needed to combine Artificial Intelligence (AI) principles with mature CAD technologies to develop an expert system that would be capable of redefining the design problem such that it would automatically produce an adequate solution or an optimum design.

Address to which proposals will be mailed/hand delivered: Refer to 70

80. TITLE: Candidate Base Stocks for High Temperature Gas Turbine Engine Oils

DESCRIPTION: At present, advances in gas turbine engine propulsion systems are limited by the inability of currently used gas turbine engine oil to sustain bulk oil temperatures of 550-600°F or higher and, at the same time,

meet the -60°F pour point requirement. Some candidate fluid basestocks, for example, polyphenylethers, can meet the 550°F goal, but have a pour point of +40°F. Other candidate basestocks, such as perfluoroalkylethers, may be able to meet both the high and low temperature requirements but because of other considerations, would necessitate a complete redesign of the engine to be successfully employed. The feasibility of developing a hydrocarbon basestock capable of operating over the temperature range of -60°F to 550-600°F, and which is compatible with current engine designs and materials, needs to be researched.

Address to which proposals will be mailed/hand delivered: Refer to 70

81. TITLE: Improved Aluminum and Titanium Alloys

DESCRIPTION: New approaches leading to improved aluminum and titanium alloys are needed. Current Air Force interest in aluminum alloys centers around three families of alloys, namely high strength/corrosion resistant alloys, high modulus/low density alloys and elevated temperature aluminum alloys. Of particular interest is the response of these materials to various types of processing, e.g., consolidation, forging, extrusion, and rolling. A second area of interest encompasses development of innovative methods that lead to products with RST microstructures, but at a substantially reduced cost. Current programs in this area include development of canless billet making technology, examination of spray forming processes, and investigations of processes that are capable of producing RST sheet directly from powders of the melt.

Titanium alloy research in rapid solidification technology (RST) will lead to the development of titanium alloys with improvements in three areas: temperature capability, strength, and modulus/ density ratio for use in advanced engine and airframe applications. Studies should be conducted in the following disciplines: alloy development, powder compaction, and mechanical property evaluation with supportive fractographic analysis.

Address to which proposals will be mailed/hand delivered: Refer to 70

82. TITLE: Oxidation Inhibition of Synthetic Hydrocarbon Lubricant Candidates

DESCRIPTION: The Air Force has recently sponsored work to develop a dynamic oxygen absorption test apparatus for the evaluation of engine oils. This apparatus is microprocessor controlled and can be used with various fluid sample sizes, down to 20ml. The absorption apparatus, which can directly measure oxygen absorption in an oil, has been found useful in screening evaluations of various classes of synthetic basestocks and in evaluating the effect of oxidation inhibitors. A more extensive data matrix is desired for combinations of: (1) fluids such as hydrogenated polyalphaolefins, alkyl benzenes, esters, halogenated alkanes and ethers which are of interest to the Air Force as high performance fluids; (2) commercial and experimental oxidation inhibitors; (3) various metal catalysts typical of aircraft engines; and

(4) temperature.

The Air Force will provide the fluids and additives and will recommend metals for this effort. Test apparatus and some post-test fluid evaluation (acid number, infrared analysis, etc.) will be provided by the research.

The research should further refine this test as an aid in screening fluids and additives by establishing a standardized test procedure and by further refining the test equipment. The standardized test should be suitable as an ASTM procedure for qualification of an oil or evaluation of field engine samples. It should then be possible to correlate this test with a standard corrosion oxidation test, coking tests and ultimately engine tests.

Address to which proposals will be mailed/hand delivered: Refer to 70

83. TITLE: High Performance Elastomers

DESCRIPTION: High technology is needed for new elastomeric polymers and compositions that withstand chemical, thermal and fluid environments. The highly fluorinated polyalkylether structure is an example of a polymer type that is expected to be broad temperature range (-100° to +400°C), fluid resistant and oxidatively stable. Preparation of precursors, monomers, polymers, and crosslinking chemistry is involved. Novel elastomer reinforcement technology is also needed to develop practical elastomeric materials capable of dynamic performance above 300°C. For example, a highly fluorinated polyether elastomer has been disclosed in U.S. Patent 4,238,602 assigned to the Air Force and has potential—if the molecular weight can be increased to millable gum stage and a thermally stable crosslinking system could be developed. Other areas of interest include surface modified reinforcing agents, specialty fillers for elastomeric materials, conductive polymers or additives, liquid injection molding compositions, and thermal conductivity.

Address to which proposals will be mailed/hand delivered: Refer to 70

84. TITLE: Life Prediction for Engine Materials

DESCRIPTION: Cumulative damage models for metals and composites due to time loading and environments are required as a basic building block for life predictions. This model should be derived for laboratory-size specimens, with and without stress concentrations. Effects of mean stress, positive and negative stress ratios, combined stresses, overloads, rate and frequency of loading, hold time, load sequencing and damping need to be investigated. Materials can then be designed to a required reliability.

Address to which proposals will be mailed/hand delivered: Refer to 70

85. TITLE: Development of a Spacecraft Materials Data Base

DESCRIPTION: An effort is currently underway to develop an improved test method for the characterization of materials used in spacecraft applications. The result of this test method will be the generation of outgassing and con-

densation data. A computerized data base and retrieval system is needed to be developed and maintained that contains all pertinent information for spacecraft materials. Besides outgassing and condensation data, examples of other properties of interest would be conductivity of materials used in charge suppression, mechanical properties of potting compounds and adhesives, optical properties space stability of thermal control material, and mechanical, thermal and stability properties of spacecraft structural materials.

Research should determine the feasibility of such a data base, and establish the procedure for the data base network to be developed. The development of the data base, by establishing and maintaining input from the aerospace community, could also be studied. The program, once established, should become self sufficient with the operating company charging a fee for access to the system and providing a credit for data input.

Address to which proposals will be mailed/hand delivered: Refer to 70

86. TITLE: Thermally/Dimensionally Stable Reentry Vehicle Dielectric Materials

DESCRIPTION: High temperature dielectric materials are currently being used on hypersonic reentry to permit transmission of radar signals and to thermally protect the underlying transmitter/receivers. Fused silica and teflon have been commonly used for this purpose, but significant improvements in ablation resistance, strength, fabricability and fracture toughness are required. New and novel materials compositions, concepts and constructions are being sought which have the potential for significant performance gains at reduced cost. Studies and experiments leading to high payoff concepts are urgently needed. Follow-on efforts are also required to reduce the concepts to practice and to develop the predetermined composition and construction. Fabrication sizes range from small (inches) to large (several feet) in dimensions and up to an inch in thickness.

Address to which proposals will be mailed/hand delivered: Refer to 70

87. TITLE: Silahydrocarbon Research

DESCRIPTION: The Air Force is interested in research to develop thermally stable, wide-liquid range base fluids with chemical and physical properties equivalent or superior to the silahydrocarbons (tetraalkylsilanes), (Reference 1-3) but which are capable of being synthesized by chemical processes capable of producing these fluids in the 50,000 gallon or higher per year volume range for significantly less cost than the estimated \$80 per gallon cost of the silahydrocarbon. Alternative synthetic routes must be explained and justified. For any alternative classes of fluids proposed, data or rationale must explain or show why their properties would be equivalent to the silahydrocarbons. Samples of candidate fluids synthesized must be characterized for viscosity, temperature and thermal stability properties, and 250ml samples of up to six of the more promising candidate fluids shall be submitted to the Air Force for further characterization. Ref. 1 "Synthesis and Characterization of Silahydrocarbons - A Class of Thermally Stable Wide-Liquid Range Functional Fluids," Synder, Jr., C. E. et al., ASLE Transactions Vol.

25, 3, 299-308. Ref. 2 "Determination of Storage Stability of Hydraulic Fluids for Use in Missiles," Gschwender, L. et al., ASLE Preprint No. 83-AM-1A-1. Ref. 3 "Synthesis and Properties of Silahydrocarbon, A Class of Thermally Stable, Wide Liquid Range Fluids," Tamborski, C. et al., I&EC Product Research & Development 1983, 22 172.

Address to which proposals will be mailed/hand delivered: Refer to 70

88. TITLE: Characterization of High Temperature, High Performance Polymers

DESCRIPTION: Approaches and new techniques are needed for characterization of high temperature, high performance polymer. Confirmation of molecular structure and determination of physical and chemical property correlations and morphology are needed as guidance to the synthesis of monomers, oligomers, prepolymers, polymers, and resin systems. Fundamental structure-property correlations are needed to interrelate physical and mechanical properties with engineering properties. The elucidation and application of fundamental polymer structure-property correlations are essential for the development of synthesis and processing chemistry needed to generate new resin systems which offer desirable balances in properties, namely with respect to environmental stability, processability, mechanical behavior, and costs. Further, a technical basis must be provided for the reliable prediction of the use properties from the polymer structure of candidates for advanced structural materials, including matrix resins, adhesives and molecular composites.

Address to which proposals will be mailed/hand delivered: Refer to 70

89. TITLE: Reliable High Temperature Materials for Advanced Gas Turbines

DESCRIPTION: In Air Force turbine engines, materials are operating at or near their capacity with regard to stress, temperature and environment. Yet, it is necessary to extend the life of current systems, and new systems are envisioned which will demand lighter-weight structures of extreme reliability and resistance to environmental attack or catastrophic failures. A rational basis for developing improved material systems (alloys, ceramics, or composites) is required through understanding of the principles that govern properties and behavior as functions of microstructural features, composition, and processing. New approaches leading to higher temperature performance of nickel-base alloys, protective coatings for such alloys, and ceramics are required as follows.

Nickel Alloys. Research is required to identify thermodynamically stable oxidation-resistant turbine engine blade, vane, disk, and combustor materials which offer significantly improved creep, fatigue, and oxidation properties. Improved basic understanding of rapid solidification and single crystal metallurgy is especially important.

Ceramics. Research to identify new families of high performance ceramic materials capable of economical consolidation, and processing improved thermal stress and fracture reliability is needed to extend the limits of future generation high temperature turbine engine components. An improved

understanding of the design, fabrication, and properties of ceramic matrix composites is particularly important.

Coatings. Research is needed to identify improved coatings which offer both longer life and higher temperature protection to advanced directionally solidified and rapidly solidified powder nickel-base alloys. Of special concern is resistance of coatings to thermal-mechanical fatigue under rapid transients of turbine inlet conditions.

Address to which proposals will be mailed/hand delivered: Refer to 70

90. TITLE: Failure Analysis of Thermoplastic Composites

DESCRIPTION: The effects of impact damage on thermoplastic composites has not been well characterized. Structural analysis, impact phenomena modelling, and the effect of damage on laminate behavior shall be accomplished for PEEK matrix composites. This shall include fuel leakage effects as well as mechanical property assessment after damage. The analysis should include the ability to model materials exhibiting large amounts of plastic strain before failure.

Address to which proposals will be mailed/hand delivered: Refer to 70

91. TITLE: Thermoplastic Polymer Morphology and Characterization

DESCRIPTION: Thermoplastics such as PEEK have not been well characterized. The neat resin should be characterized from the unit cell level to the spherulite level. These morphological characteristics should be correlated with mechanical and physical properties. The effects of various fibers on the morphology of the resin matrix should be determined.

Address to which proposals will be mailed/hand delivered: Refer to 70

92. TITLE: Components and Test Methods for Electrochemical Thermal Batteries

DESCRIPTION: Development of one or more of the following technologies is needed in the thermal battery area.

Lithium aluminum and lithium silicon alloys rich in lithium (approximately 60 atomic percent lithium) in foil form (1 to 10 mils thick); and these alloy foils on iron foils to form bimetallic foils for thermal battery anodes.

Non-destructive test methods for thermal batteries that are cost effective and applicable to volume production of 100 batteries per hour.

Lightweight, high strength, low cost case materials suitable for use with high temperature thermal batteries.

Advanced, low cost, electrical and thermal insulation materials to replace mica, asbestos, and fiberfax insulators in thermal batteries.

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Wright-Patterson AFB OH 45433

93. TITLE: Primary (Non-rechargeable) Electrochemical Batteries

DESCRIPTION: Development of one or more of the following battery system technologies is needed.

A reserve battery capable of 10 years shelf life for ambient temperatures of 70+20°F that delivers at least 100 WH/# and 6 or more watt hours per cubic inch at the 15 minute discharge rate with a pulse capability of at least 1kW/#.

A reserve battery capable of at least 10 years shelf life that delivers at least 30 watt hours per pound and 3 watt hours per cubic inch at the 2 minute discharge rate over an ambient temperature range from -65 to +165°F without external heat. Pulse capability of at least 10kW per pound is desired.

Active primary batteries with at least 90 percent of fresh battery capacity retained after 5 years storage at 75+5°F. The battery should be safe for flight crew members to carry on their person and should deliver at least 150 watt hours per pound and 12 watt hours per cubic inch at 75+5°F, at the 1 hour discharge rate, in sizes from 0.25 to 5 ampere hours. The battery should retain at least 50 percent of room temperature capacity at -65°F. In all the above capacity measurements, battery voltage must remain within 80 percent of the open circuit values.

Address to which proposals will be mailed/hand delivered: Refer to 92

94. TITLE: Rechargeable Electrochemical Batteries

DESCRIPTION: Satellite Batteries: Rechargeable batteries are needed with the following characteristics:

Up to 15,000 charge-discharge cycles at 100 watt-hours per pound delivered for each discharge for a fully packaged battery. Discharges are for .75 to 1.2 hours maximum and charge periods are typically 4.8 to 22.8 hours. Calendar life of 10 or more years. Energy efficiency of at least 85 percent. Peak power capability of 1kW/# or more for a fully packaged battery.

30,000 charge-discharge cycles (30 minutes discharge, 1 hour charge) at 50 watt hours per pound for each discharge (specific energy based on a fully packaged battery). Calendar life of 5 years or more. Energy efficiency of 90% or greater. Peak power capability of 1kW per pound or more for a fully packaged battery.

State of Charge: An on-board state of charge indicator for aircraft capable of indicating nickel cadmium battery state-of-charge within 5 percent of the actual state-of-charge from 10 to 90 percent of full charge. The indicator should be compatible with vented nickel cadmium batteries of 5 through 50 ampere hours with 15 to 25 cells. The indicator should not require cali-

bration with battery changes and should not be affected by temperature changes or non-repetitive cycle routines as might be encountered aboard aircraft.

Research and development in either or both areas of rechargeable battery technology may be addressed.

Address to which proposals will be mailed/hand delivered: Refer to 92

95. TITLE: Calculation of Electron-Ion Recombination Rates Near Phase Changes

DESCRIPTION: Basic research is desired in the area of plasma properties in high pressure gases when the gas conditions are near the phase change conditions. Of particular interest is a theoretical calculation of electron-ion recombination rates in high pressure glow discharges under such conditions. Such a study should include a study of the mechanisms causing the phase change and how these mechanisms might be initiated externally. Initially, simple gases such as N₂, He, and Ar would be of interest. The formalism should be sufficiently general to handle gas mixtures.

Address to which proposals will be mailed/hand delivered: Refer to 92

96. TITLE: Development of Theory for Photoacoustic/Photothermal Effect

DESCRIPTION: Recent experimental work has shown the photoacoustic/photothermal deflection technique to be a feasible diagnostic technique for use in combustion research. However, a sound theoretical basis does not yet exist that explains the signal variations due to laser pulse length, relative spatial relationship of beams (parallel vs perpendicular), and beam shape. Such a model would require coupling the theories of lasers, gas dynamics, and thermodynamics together to provide an explanatory as well as predictive capability.

Address to which proposals will be mailed/hand delivered: Refer to 92

97. TITLE: Spacecraft Energy System Thermal Management

DESCRIPTION: Future military spacecraft will employ solar, chemical, and nuclear power systems for a variety of conventional and novel mission applications. These advanced missions give rise to an abundance of power system thermal control and waste heat transfer and rejection problems requiring novel engineering solutions. The problems of interest include techniques which allow scale up to 25-100kW heat transport and rejection regime, while improving thermal management system weight characteristics significantly, as well as their survivability to potential external threats. Pulsed power transient heat transfer techniques utilizing thermal energy storage and ultra lightweight radiators and/or collectible evaporant working fluids require investigation. Solutions to high heat flux cooling of payload and power electronics are required beyond present traveling wave tube amplifier and klystron baseplate capabilities. Long term space storage of cryoreactants (eg H₂, O₂) and high flow rate reactant conditioning from storage temperature to use temperature, with and without waste heat economizer methods, require development. Improved conventional and hybrid heat pipes and/or two phase transport devices

are required for high capacity, high power "thermal bus" and large radiator applications.

Address to which proposals will be mailed/hand delivered: Refer to 92

98. TITLE: Solar Cell Array Technology for Satellite Application

DESCRIPTION: Present solar cell arrays on satellite vehicles utilize solar cell covers attached with silicon adhesive, are interconnected in series and parallel with soldered interconnects, and are stowed and deployed by the space vehicle in orbit. These solar cell arrays degrade in orbit by adhesive darkening from ultraviolet radiation and by current and voltage degradation of the solar cells by particulate radiation such as trapped electrons and protons.

Research and development is needed to provide better methods for encapsulation and protection of the solar cells from both front and rear surface irradiation, preferably without adhesive. Also, improvement in solar cell technology is required to improve end of life performance. This can take the form of improving GaAs solar cell efficiency and radiation resistance as well as improve the high temperature capability through contact metallurgy, cover techniques, and interconnect techniques such as welding. Improved diagnostic techniques for assessing solid state interactions in solar cells are needed, especially with the newer AlGaAs cell and multijunction cell technology. Techniques for measuring impurity and dopant concentrations in Si and III-V compounds such as GaAs and AlGaAs in the parts per billion range would also aid in the understanding and development of better solar cells. Development of GaAs wafers with low dislocation count and of sufficient size and shape to economically yield 2X4cm cells will also aid in implementing GaAs solar cell technology.

Address to which proposals will be mailed/hand delivered: Refer to 92

99. TITLE: High Voltage, High Power Rectifiers

DESCRIPTION: High voltage superconducting generators require rectification, but the high voltage, high power rectifier package is several times larger than the generator. Development of improved thermal management and lightweight packaging of rectifiers that might include liquid hydrogen cooling is a very important requirement for high power systems. The rectifier stacks are required to withstand 10's to 100's of kilovolts and should be designed with unique thermal management approaches that are compatible with space heat rejection.

Address to which proposals will be mailed/hand delivered: Refer to 92

100. TITLE: Advanced Composite Structure for Cryogenic Magnets

DESCRIPTION: Development of cryogenic magnet structures that are high strength and high stiffness, while retaining low thermal and electrical conductivity are essential to low loss super conducting power systems. Opportunities exist to develop component parts for superconducting generators and pulsed energy storage magnets for eventual incorporation in high power electrical machines.

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101. TITLE: Intercalated Graphite

DESCRIPTION: Research on filamentary intercalated graphite conductors is required to develop a conductor that is lighter weight and higher strength than copper and aluminum. Thermal stability questions and improved order in graphite filaments are two of the most pressing problem areas to be investigated.

Address to which proposals are to be mailed/hand delivered: Refer to 100

102. TITLE: Pure Metal Conductors

DESCRIPTION: If large quantities of liquid hydrogen are available, it is possible to use pure metals for generator windings and magnets at greatly reduced resistance losses. Development opportunities exist for designing and building cryogenic magnetic devices at low losses for high power applications.

Address to which proposals will be mailed/hand delivered: Refer to 100

103. TITLE: Superconductivity

DESCRIPTION: High power electrical power generation, energy storage and switching can be accomplished by proper application of superconductivity. Limits on superconductor performance are imposed by Air Force missions that require fast-rising transient magnetic fields. Specific areas of interest in superconductor development include high current density, multifilament superconductors that can function in high loss environments in the 6-15°K temperature range. Dielectric insulations that permit efficient heat transfer are important for superconductor applications with high transient heat loads. Research on transient heat transfer from superconductors to liquid helium is required to determine acoustic impedance matching between insulated superconductors and liquid helium. Superconducting device efforts of interest include inductive energy storage devices, fast repeating superconducting opening switches, and rotating flux pump current generators.

Address to which proposals will be mailed/hand delivered: Refer to 100

104. TITLE: Passivation of Boron Particles

DESCRIPTION: The use of boron fuels could substantially increase the performance of the solid fuel ramjet engine. To achieve this increase in performance, it is necessary to efficiently burn the boron particles in the combustion chamber. One of the major causes of inefficient boron combustion is the formation of an oxide coating on the boron particle. This coating prevents oxygen from reaching the boron particle surface, thus preventing efficient combustion. The oxide coating is usually formed on the boron particle during ingredient processing. Processing methods which results in boron particles with no oxide coating need to be developed. These methods must also protect the boron particles from oxide coating during the time between ingredient processing and the incorporation of the boron into the fuel formulation.

Address to which proposals will be mailed/hand delivered: Refer to 100

105. TITLE: Ramjet Investigations

DESCRIPTION: The objective of this program is to conduct analytical and experimental studies of the fluid dynamics, chemical kinetics and combustion dynamics relevant to the development of advanced ramjet propulsion systems. These propulsion systems include the solid fuel ramjet and ducted rocket, for strategic and tactical missiles. Technology areas of particular interest include efficient combustion of high energy metallized fuels, throttling approaches for solid fuel ramjets, and the development of flow visualization techniques applicable to water tunnel and bare wall combustion tests. Unique ideas and approaches will be screened analytically. Promising approaches which survive the screening will then transition to experimental investigations.

Address to which proposals will be mailed/hand delivered: Refer to 100

106. TITLE: Antioxidant Specification Development with Acceptance and Effectiveness Testing

DESCRIPTION: Aviation jet fuels, specifically JP-4, are increasingly being refined from hydrotreated feedstocks. Consequently, the Air Force expects and has experienced fuel degradation in the form of peroxidation, gum formation, and thermal instability. A military specification was developed to require antioxidant addition to hydrotreated fuels in order to prevent this degradation. However, much research work remains in the area of antioxidant addition to fuels.

This research project should include development of a test method and criteria for acceptance of minimum effective and maximum allowable amounts of antioxidant. These limits must also be established. Also, a method for determining the amount of antioxidant present and its continued effectiveness should be developed.

Address to which proposals will be mailed/hand delivered: Refer to 100

107. TITLE: Fuel Combustion Modeling

DESCRIPTION: Existing fuel combustion models, such as the Teaching Elliptic Axisymmetric Characteristics Heuristically (TEACH) code, are inadequate in their approach to mixing, by ignoring the effects of large scale structures and relying on gradient diffusion. New submodels are needed that can be used with TEACH codes to take into account the mixing that occurs due to large scale structures and countergradient diffusion.

Address to which proposals will be mailed/hand delivered: Refer to 100

108. TITLE: Combustion Diagnostics

DESCRIPTION: Although major advances have been made in nonintrusive diagnostics during the past few years, it is still difficult, if not impossible, to deduce combustion flow fields from single point measurements. High speed cine photography of flames is hampered by the lack of adequate lighting. The application of an image intensifier to high speed cine cameras would enable cine photography to be made at sufficiently high frame rates (3000 frames/s) to enable the structure of flames to be easily studied. The availability of simultaneous, multi-point, high frequency response diagnostics to measure velocities and turbulence would also be a significant advantage. Difficulties in obtaining uniform seeding rates when using laser Doppler anemometry (LDA) is a continuing problem; a nonintrusive technique to measure fluid velocities in turbulent recirculating flows that requires no seeding would be a major advance.

Address to which proposals will be mailed/hand delivered: Refer to 100

109. TITLE: Fuel Spill/Vapor Migration Model

DESCRIPTION: Realistic ground safety criteria will enable the Air Force to increase the combat sortie generation rate. The need exists for a sound analytical model to be used in establishing "safe" separation distances for ground operations involving aircraft, fuel, and support equipment. A "wrong" decision can lead to a catastrophic event such as--fire and loss of aircraft and personnel. Fuel vapor migration from equipment vents and fuel spills must be considered in conjunction with wind, ground conditions, equipment locations, fuel type, ignition sources, and related parameters. Results will lead to risk assessment criteria and "safe" ground aircraft operations and will be directly applicable to system safety engineering analysis (SSEA) of various weapon systems and to Technical Order development.

Address to which proposals will be mailed/hand delivered: Refer to 100

110. TITLE: Wear Studies of Corrosion Resistant Alloys

DESCRIPTION: Current work with industry has demonstrated that commercially available, high chrome corrosion resistant bearing material such as CRB-7 (14% chrome, molybdenum steel) displayed mechanical properties equal to or better than M50 except in wear resistance. Under two different programs with Pratt and Whitney Aircraft it was found that the wrought as well as powder processed CRB-7 alloy exhibited unfavorable wear resistance when compared to VIM VAR M-50 the current turbine engine bearing material. A program is suggested to investigate the friction and wear mechanisms in different rolling element bearing materials such as CRB7, BG42, and M50. The objective of the program should be to assess the effect of various compositions and microstructures on the wear properties of these materials.

Address to which proposals will be mailed/hand delivered: Refer to 100

111. TITLE: Traction Modeling of Military Oils

DESCRIPTION: A program is suggested to develop a model that can predict the traction behavior of MIL-L-7808 lubricant used in rolling element bearing analysis. A large data base of traction profiles (traction coefficient vs slide/roll ratio) has been developed on a number of military lubricants using a two disc type tester operating at various loads, temperatures and rolling speeds. This program would use the data base to develop a reliable traction model to be used in bearing programs such as dynamics of rolling element bearings (DREB) and Tribo 1.

Address to which proposals will be mailed/hand delivered: Refer to 100

112. TITLE: Investigation Into the Cause of Bearing Micro-Spalling Surface Distress

DESCRIPTION: Conduct a combined analytical/experimental investigation of the phenomena influencing the initiation of microspalling surface distress in main-shaft turbine engine rolling element bearings. The objective of this effort is to increase the understanding of the cause(s) of this surface-related failure mode that can occur in both ball and cylindrical roller bearing types. While primary consideration should be given to those factors now believed to be important, such as bearing operating conditions (load, speed and temperature), lubricant properties and film thickness, surface roughness of rolling elements and raceways, etc., the offeror is also encouraged to give consideration to other factors believed by him/her to be important and relevant to this investigation.

Address to which proposals will be mailed/hand delivered: Refer to 100

113. TITLE: High Temperature Solid Lubricated Bearing Development

DESCRIPTION: With the increasing importance of high temperature turbine engine technology, a need has emerged for solid lubricated rolling element bearings capable of operating at temperatures in the 1000-1500°F range at speeds typical of turbine engine mainshaft bearings. To develop this technology, there is a requirement for the development of high temperature lubricants and bearing

materials. Lubrication techniques need to be developed which can replenish the solid lubricants in a high speed bearing. Programs which address any of these aspects of high temperature bearing technology would help meet the goal of bearing technology required for advanced turbine engine designs.

Address to which proposals will be mailed/hand delivered: Refer to 100

114. TITLE: Compression System Design Methodology

DESCRIPTION: A major trend in compression system hardware is the increased utilization of low aspect ratio blading, blisks and 3-D design methodology. The primary and secondary flow system design capability must be extended fully into three dimensions to adequately exploit these trends. Therefore, there is interest in any new and innovative ideas addressing the above. Areas of prime importance include blade/vane sweep, shock/boundary layer interaction, secondary flow design, (including such areas as counterrotation, trenching, labyrinth seals and disc pumping), time unsteady features of the turbomachinery gas path and secondary flow systems. Additionally, such phenomenological areas as water ingestion, ice ingestion, steam ingestion, dust ingestion and full face overpressure are of interest. Models accurately describing the effects of external influences such as these are of interest.

Address to which proposals will be mailed/hand delivered: Refer to 100

115. TITLE: Individual Learning Curve Analysis

DESCRIPTION: Evaluate parameters of learning curves from complex cognitive tasks as predictors of skill and knowledge acquisition, decay, and reacquisition. Research can emphasize one or two aspects of learning curve analysis. The first is the statistical and psychometric analysis of cognitive task learning curve data. Questions of interest are: what family of equations best describes cognitive learning at the level of the individual learner; can the two goals of (a) characterizing individual learning paths, and (b) comparing parameters of learning curves for different individuals be made compatible; and what is the relationship between measurement error and individual differences and what is important information about knowledge and skill acquisition in the analysis of individual differences in learning?

The second emphasis is a more psychological analysis of the relationship between learning abilities in different content or process domains and the relationship between learning and aptitude. Questions to be answered are: is the fast learner in the verbal content area also fast in the spatial and numerical content areas; is the fast learning on tasks involving reasoning skills also fast on tasks involving the rate memorization of sequences of routine actions; and, what is the relationship between traditional factorial abilities and learning abilities?

Address to which proposals will be mailed/hand delivered:

HQ Aerospace Medical Division
AMD/RDO
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116. TITLE: Novel Human Abilities

DESCRIPTION: Develop and evaluate measures in new ability domains, that is, those which are not currently being assessed by standard psychometric instruments. An example of one such area is cognitive automaticity. Research should investigate individual differences in present levels of automaticity of various cognitive skills. Other areas are visual and spatial memory, attentional resources, dual-task capabilities (mental time-sharing), etc.

Address to which proposals will be mailed/hand delivered: Refer to 115

117. TITLE: Part-Task Trainers

DESCRIPTION: An effective method is needed for identifying newly emerging microelectronics technologies useful for developing training devices. A procedure is also needed to evaluate electronics media options for training aircrew tasks. At least three major variables interact in such determinations: (1) Task variables, the parameter's which define human behaviors associated with procedural/cognitive task accomplishments; (2) electronic media capabilities; and (3) instructional variables, the specifications required for optimal training interaction between learner, media, and task. A system should be developed by which the elements within each of the three categories can be related and matched in order to determine the essential characteristics of least-cost training systems required for given tasks.

Address to which proposals will be mailed/hand delivered: Refer to 115

118. TITLE: Logistics Support Analysis of Major Weapons Acquisition

DESCRIPTION: A model or series of models to analyze the supportability of a weapon system, which takes into consideration the entire logistics environment is needed. Small scale models to use with microcomputers would ease the analysis tasks confronting the logistics engineer. In Phase I, the effort would assess the current technologies and the practicality of implementing large scale models on microcomputers. If the effort is determined feasible, the documentation would include a description of the hardware and software requirements for implementation. Phase II would be a demonstration and validation comparison between the implemented models and the current mainframe models. Application on a current Air Force acquisition program would be accomplished.

Address to which proposals will be mailed/hand delivered: Refer to 115

119. TITLE: Training the Operational Readiness of Tactical C² and Logistics Support

DESCRIPTION: Subject-matter experts are a major component in developing wartime training requirements by their contributions to the data base. Phase I would involve the development and validation of task data collection methodology that can be used with subject matter experts to define their specific job tasks and the methods they should use in accomplishing these tasks in a wartime environment. Comparison-based prediction and advanced modeling techniques such as cybernetics, quantitative linguistics, and behavioral analysis methods may be used, although other methods may be proposed. Phase II would provide an automated data base that used the results of Phase I to allow easy and accurate sorting and analysis of the data as well as convenient and easy updating to allow for changes expected in the way tactical C² and logistics support personnel adapt to changes in system configuration or threat. The data base shall be demonstrated on a PDP 11/X4 computer system and transportable to a CP/M based microcomputer system.

Address to which proposals will be mailed/hand delivered: Refer to 115

120. TITLE: Analytic Interactive and Large Deformation Restraint System Model

DESCRIPTION: The predictive simulation of human body dynamics during various phases of high-performance aircraft operation and particularly during emergency escape can be effectively performed using sophisticated computer models of the human body. A critical aspect of these simulations is the appropriate analytic characterization of the harness algorithms have been developed and applied successfully with various human body models. There is, however, a deficiency in current harness algorithms for addressing large harness deformations and large human body displacements. Algorithms are required which can model large three dimensional deformations, possess proper elongation properties, interact normally and tangentially with body surfaces and be sufficiently concise to be interactively integrated into computer-based three-dimensional human body dynamics models.

Address to which proposals will be mailed/hand delivered: Refer to 115

121. TITLE: Pilot Loss of Conscious Monitor

DESCRIPTION: An infrared device which illuminates the orbit of the eye and measures the changes in reflected illumination will be developed to provide a metric of blink rate over a 20 second period and to provide an indication of eye closure. The infrared source will be pulsed to eliminate interference from spurious sources. The device will be micro-processor based and integrated into a standard flight helmet.

Address to which proposals will be mailed/hand delivered: Refer to 115

122. TITLE: Smart Stick Design - Negative Biomechanical Feedthrough

DESCRIPTION: This effort is to add computer technology into stick controller design. It has been empirically shown that the proper stick-G field interaction can improve tracking performance over static levels by a substantial amount. Specifically, in a close loop G_y condition, tracking performance can be enhanced by proper interaction of the G field and the biodynamic response of the arm. The in-house smart stick has been built mechanically but still needs the electrical control system to close the loop to make the stick adaptive. It is necessary to design the electrical system and the arm-stick impedance model (as a smart stick) in the static mode which must appear the same as the arm-stick impedance model under G_y .

Address to which proposals will be mailed/hand delivered: Refer to 115

123. TITLE: Investigation of a Choice/Sample Reaction Time Device

DESCRIPTION: This effort is to investigate the source of error in the determination of simple and choice reaction time from a device developed at AFAMRL. The technical rationale is to use a procedure involving EMG measurements to determine a more precise time period when a reaction to a stimulus occurs. The specific product will be the experimental method of measuring the true reaction time, which may have application in the STS-10 project using a similar device. This experiment will involve the placement of surface EMG electrodes on the arm of the subject. A correlation will be made between the stimulus and the first EMG burst in the arm muscle response. It will be necessary to use computer algorithms developed to process the EMG response data.

Address to which proposals will be mailed/hand delivered: Refer to 115

124. TITLE: Auditory Information Error Analysis

DESCRIPTION: The objective of this effort is to develop the necessary procedures and computer software to implement detailed item error analyses for use in conjunction with standard speech intelligibility measures suitable for military voice communication systems. An experimental linguist will be consulted to identify the individual phonemes or sound units in experimental word sets as well as to indicate the possible error on the basis of factors such as sound confusions. Once the performance has been verified using these error analysis techniques, initial data collection will begin on various systems and devices of known voice communication effectiveness.

Address to which proposals will be mailed/hand delivered: Refer to 115

125. TITLE: Discriminate Analysis Comparing Male and Female Head and Face Proportions

DESCRIPTION: Much of the protective equipment designed for the head and face has been designed to fit male head and face proportions. It is becoming evident, however, that many women occupy positions which require protection and that equipment designed for men does not fit them properly. This is not merely a problem of overall size differences, but is suspected to be due to a differences in proportions as well. A multi-variate discriminate analysis would quantify the separation between the two sexes while taking into account the relationships between dimensions. Among other things, this will aid in the development of sizing systems for male and females. A survey conducted by the U.S. Army in 1977 includes approximately 30 head and face dimensions on approximately 100 men and 200 women and would be a good candidate set of data for the study. This data set is available from AFAMRL. The discriminate analysis itself would require knowledge of anthropometric dimensions and their distributions in order to allow for meaningful interpretations of the results.

Address to which proposals will be mailed/hand delivered: Refer to 115

126. TITLE: Artificial Intelligence Techniques in C³I Speech Understanding

DESCRIPTION: Speech recognition systems offer a more natural means of communication with computer based systems over typing systems, such as a keyboard or keypad, or pointing systems, such as a lightpen or mouse. However, even the speech systems require the use of constrained languages due to the fact that the words to be recognized must have unique sounds as well as unique meanings. Natural speech is not that way. Words are often detected, then recognized and understood due to the context in which they are used. Natural language processing technology in artificial intelligence holds promise to speech understanding. This effort will be directed at evaluating the utility of semantic and pragmatic grammars, syntax trees, and parsing techniques to aid speech understanding in the C³I environment.

Firms responding should have understanding and experience in the areas of artificial intelligence, C³I operations, and human factors.

Address to which proposals will be mailed/hand delivered: Refer to 115

127. TITLE: Human Factors Engineering (HFE) Test and Evaluation

DESCRIPTION: Information is sought concerning techniques and methodologies of testing and evaluating the total HFE design of major weapon systems. Although the adequacy of specific hardware may be evaluated in a reasonably straight forward manner by reference to applicable human engineering design standards, the adequacy of the man-machine combination in the total systems context is a more difficult determination. Meaningful performance test/evaluation criteria and requirements must be established well before the formal T&E stage of system acquisition. Novel approaches are sought to predicting, observing, quantifying and relating human performance in the operational environment to total mission and system effectiveness.

Address to which proposals will be mailed/hand delivered: Refer to 115

128. TITLE: Display for Low Level Terrain Following Flight

DESCRIPTION: This project consists of improving the display format(s) used by aircrews when performing terrain following (TF) flight. No systematic engineering approach has been utilized to test candidate display formats. Human factors considerations were not adequately assessed in development of the TF display formats currently in use, thus the formats do not effectively present the required information to insure mission demanded (200-500 feet above ground) pilot performance when flying manual TF. Purpose of this project is to take such factors as aircraft performance, available avionics processing capability, current display technology, and human information processing and tracking capability into consideration; then test out candidate format designs.

Address to which proposals will be mailed/hand delivered: Refer to 115

129. TITLE: Advanced Techniques for Generating High Quality Visual Stimulus Material

DESCRIPTION: Visual contrast sensitivity function (CSF) measuring techniques have been developed which measure the ability of the human to perceive contrast as a function of the number of resolution elements or spatial frequency (number of resolution cycles per degree) subtended at the eye. In laboratory and field trials, subjects' performance in various vision oriented tasks such as aircraft target detection have been shown to correlate highly with each subject's contrast sensitivity function. It is expected that these techniques will replace or at least supplement the use of conventional eye charts (e.g., Snellen eye chart) which usually employ high contrast letters of various sizes. The main problem in implementing this new testing technique is the production of the stimulus material. One effective technique is to use an electronic display with a special purpose sine-wave grating generator to produce spatial patterns at various frequencies and varying contrasts which when viewed and responded to by the subject yields his unique contrast sensitivity function. However, these existing electronic techniques are bulky, expensive and do not lend themselves to adverse environments such as use in spacecraft.

It is highly desirable to produce a new set of eye charts which implement the CSF technique without requiring complex electronics. Photographic techniques have been used to produce large charts with an array of sine wave "patches" with varying spatial frequency and contrast, but great difficulty has been experienced in controlling the uniformity of the patches and the sine wave distribution of luminances across the grating. Furthermore, it is desired that these grating charts be miniaturized so as to be used as rear illuminated test charts in a hand held vision tester. Since photographic techniques have been shown to be limited for this application, consideration should be given to nonphotographic means of producing the gratings such as modern printing technology (ink jet or engraving), wherein the distribution of densities can be better controlled.

Address to which proposals will be mailed/hand delivered: Refer to 115

130. TITLE: Predictive Equations for Estimating Segmental and Whole-Body Surface Areas

DESCRIPTION: The surface area of the human body is widely used by anthropologists, physiologists, and engineers in design applications and mathematical modeling. At present, the most popular predictive equation is based upon analysis of five (5) cadavers and it may be used for estimation of whole-body surface area only. Required is the development of new predictive equations for the surface area of various body segments, as well as for the entire body. In a recent study combining stereophotometric and anthropometric techniques, a total of 31 men and 46 women were photographed and measured. These data have been analyzed to determine body segmental volumes, centers of volume, and principal moments of inertia for application in design of test devices, restraint systems, and body prostheses. The development of appropriate computer graphic techniques and software, the analysis of the digitized stereophotometric data on densely spaced intervals along the longitudinal axis of the body segments are required to yield a series of regressions for estimating regional and whole-body surface area. The derived equations should furnish not only an improved statistical base, but also should provide a means of reliably estimating segmental surface for the first time. The estimations should also reflect more accurately the living condition. Principal users of the predictive equations produced by this effort will be involved in studies of acceleration, windblast, and radiation effects, biothermal modeling and biomechanics in general. The stereophotometric and anthropometric data required for this effort are available from the Air Force Aerospace Medical Research Laboratory.

Address to which proposals will be mailed/hand delivered: Refer to 115

131. TITLE: Solid State Oxygen Sensor

DESCRIPTION: The USAF School of Aerospace Medicine is constantly looking for new and innovative ideas/techniques in biotechnology R&D. In FY 84, the School of Aerospace Medicine has an interest in solid state oxygen sensor development. This technology would enhance the current development of aircraft on-board oxygen generation systems by providing an oxygen sensor small in size, insensitive to pressure and temperature changes, not affected by acceleration, and yet provide a rapid and accurate analysis of the breathing gas produced by these new oxygen generating systems. Some fundamental research has already been conducted in this area with recommendations that a joint industry-university program undertake the oxygen solid state sensor development.

Address to which proposals will be mailed/hand delivered: Refer to 115

132. TITLE: Chemical Warfare Agent Detectors and Alarms

DESCRIPTION: There is need for fieldable technologies for point detection and measuring of chemical agent vapors in air. Specific needs are for (1) Sensitive and selective reagent systems for colorimetric, fluorescent, chemiluminescent and other chemical and enzymatic techniques for measuring the nerve and blister agents, and (2) reagent packaging systems (such as agent active chemically impregnated film and tapes, coatings on fiber optics, etc) on which to base development of electro-optic monitoring devices and industrial hygiene type dosimeters. General needs are for (1) a small, extremely sensitive but specific aircraft cockpit organophosphorous detector and (2) an indicator to warn that CW-agent filter protection is about to end.

Address to which proposals will be mailed/hand delivered: Refer to 115

133. TITLE: Chemical Agent Filter

DESCRIPTION: This research would develop a filter for complete removal of chemical warfare agent vapor and aerosols from air and oxygen. The filter must be small and lightweight to be worn by aircraft and ground crew, must have universal capabilities to stop passage of all known types of agents, and most importantly must show nearly zero breathing resistance.

Address to which proposals will be mailed/hand delivered: Refer to 115

134. TITLE: Development of Chemical Agent Decontaminants for Personnel

DESCRIPTION: Various decontaminants used for removal of chemical agents cause harmful effects when employed directly on personnel and clothing. This research would lead to effective decontaminants for nerve, blood, and blister agents which have no harmful side effects when used on personnel or their clothing.

Address to which proposals will be mailed/hand delivered: Refer to 115

135. TITLE: Particle Sizer for Laser Velocimeters

DESCRIPTION: The quality of laser velocimeter data is directly dependent on the ability of the small particles entrained in the fluid to follow the actual fluid flow. This ability is a strong function of the size of the particles entrained in the flow. In order to assess the quality of laser velocimeter data and to allow for particle dynamic correction, the need exists to measure the particle size distribution in the fluid coincident with the laser velocimeter measurements. Thus, a near-real time on-line nonintrusive method of determining particle size in the .01 to 10 micro range is required. This particle sizer should be capable of operating in the same environment and with the same optical access as required by current LV's, and interface with existing data collection systems and traversing systems at AEDC.

Address to which proposals will be mailed/hand delivered:

AEDC/DOT
Building 900
Mail Stop 900
Arnold AFB TN 37389

136. TITLE: Spectrally Resolved Chamber Contamination Monitor

DESCRIPTION: A need exists to determine outgassing components from space systems as well as from the ground test space vacuum chamber itself. Quartz crystal microbalances can provide mass deposition in the 10^{-8} gm region; however, species identification is difficult if not impossible. A spectrally resolved; i.e., species specific device such as an attenuated total reflectance plate with linear filter, light source, and linear detector, or some such scheme is required for future chamber work. End product must be able to spectrally resolve thin film deposits in-situ in semi-real time.

Address to which proposals will be mailed/hand delivered: Refer to 135

137. TITLE: Interface Measurement System for Perforated Wall Wind Tunnel

DESCRIPTION: Successful implementation of transonic adaptive wall wind tunnel technology and wall interference assessment and correction techniques requires an accurate, fast, and preferably, non-intrusive means to measure two flow variables in the vicinity of the wind tunnel walls. Currently, measurements of pressure and flow angularity are made with static pipes and flow angle probes. The pipes and probes are located in the freestream just outside the tunnel wall boundary layer. The accuracy and ease of implementation of this measurement technique appears to satisfy research requirements but may not fully meet operational transonic perforated wall wind tunnel requirements. Concepts to measure two flow variables in the vicinity of perforated walls suitable for use in operational wind tunnels must be defined and evaluated against speed, accuracy, and complexity criteria. Detailed assessment of feasibility will be accomplished for the most promising concepts which appear to satisfy operational facility requirements. Development and demonstration of single concept will be accomplished if warranted.

Address to which proposals will be mailed/hand delivered: Refer to 135

138. TITLE: Human Factors Influencing Wind Tunnel Productivity

DESCRIPTION: The application of computer technology has dramatically improved test article control and data acquisition. In fact, data are now produced so rapidly that it is difficult for the test engineer to evaluate the information and make timely decisions. Select portions of the massive quantities of data produced must be used to monitor progress, detect abnormal conditions, and optimize the test matrix while the test is in progress. An examination of the human factors that affect the productivity of wind tunnel tests is needed to reduce the time and cost of tests. Such factors as information overload, data display control room layout and communications should be considered.

The contractor will study the wind tunnel control rooms, define specific problem areas, propose improvements to alleviate the problems, and evaluate the feasibility and benefits of implementing the proposed solutions.

Address to which proposals will be mailed/hand delivered: Refer to 135

139. TITLE: Wide Range Fuel Flowmeter

DESCRIPTION: Existing engine fuel flow measurement systems typically require the use of three sizes of flowmeters to cover the flow measurement range. Remotely actuated valves are used to select the proper size flowmeter depending on the flow rate. This technique is not adequate for transient flow measurements (engine accels. etc.) wherein the fuel flowrate varies over a wide range. The large size flowmeters must be selected for these type transients in order to handle the highest anticipated flowrate. As a result, flow measurements at the low flow rates (at the beginning of the accel) are of extremely poor quality. A flowmeter capable of covering the total measurement range (typically 500 to 70,000 pounds/hour) and providing 1.0 percent measurement uncertainty is needed.

This item is being investigated as part of the FY 83 technology effort.

Address to which proposals will be mailed/hand delivered: Refer to 135

140. TITLE: Icing Monitoring Equipment

DESCRIPTION: The propulsion test units conduct simulated altitude testing of turbine engines with inlet air temperatures ranging down to -80°F. Ice formation, with subsequent ingestion by the engine, is a potential hazard at these low temperatures. Instrumentation currently in use to warn of potential or actual icing conditions include pressure drop measurements across the inlet screen, airstream dew point temperature measurements and vibrating reed ice detectors. Each of these instrument systems has limitations in either response, reliability or safety. Additional techniques are needed which are non-intrusive and reliably provide a warning at the initial onset of icing. These techniques should operate at airstream temperatures of -80°F to +40°F. The air flow velocities are from 0 to 600 FPS at pressures from 2 to 20 PSIA. Operations up to 1000 hours total in vibration environments of 10 g's peak, from 20 to 2000 Hz without service, are needed.

Address to which proposals will be mailed/hand delivered: Refer to 135

141. TITLE: Sneak Circuit Design

DESCRIPTION: Investigate the feasibility of designing sneak circuits into Very Large Scale Integrated (VLSI) circuits for receiving devices (radios, radars, sonars, etc) such that certain transmissions into these receivers can disable or otherwise alter the outputs of the VLSI circuit.

Address to which proposals will be mailed/hand delivered:

HQ ESD/PKR
Bldg 1520, Rm 325
Barksdale St
Hanscom AFB MA 01731

142. TITLE: Millimeter Wave Emergency Communications

DESCRIPTION: Investigate the feasibility and desirability of using small millimeter wave radios with servo-driven antennas to set up emergency line-of-sight communications systems to replace destroyed communications capability. Investigate transmission and reception techniques which can be used to drive the transmitting and receiving antennas through a search mode to lock-on, to indicate break-lock, and to serve the power output and transmission frequency (around the oxygen absorption band) so that there will be an extremely low probability of intercept beyond the receiver station. Investigate parametric bonds on equipment, such as transmission capacity for small battery-powered radios, size and power requirements versus transmission distance.

Address to which proposals will be mailed/hand delivered: Refer to 141

143. TITLE: External Aerodynamics

DESCRIPTION: This research includes investigations of fluid flow phenomena that strongly influence the aerodynamic performance and efficiency of current

and future flight vehicles. It includes experimental and theoretical studies of continuum flows in which the effects of viscosity, turbulence, strong pressure gradients, compressibility, and temperature gradients may be important. Currently, we are interested in research in computational fluid dynamics, viscous and interacting flows, and turbulent jet flows relevant to powered lift concepts. Research in computational fluid dynamics includes improved ways for predicting steady three-dimensional flow past geometrically complicated configurations, and methods for automatically generating solution-adaptive computational grids. Research in viscous and interacting flows encompasses the study of separated three-dimensional boundary layers, including the interactions of the shock wave-turbulent boundary layer for a range of shock Mach numbers and the frequent separation from wings and wing and body configurations. Research in turbulent jet-dominated flows includes studies in improving experimental and theoretical models capabilities of deflected engine exhaust jets that may interact with solid surfaces and encounter cross flows. Of particular interest are the characteristics of turbulent jets in regions of high strain. This is a basic research effort.

Address to which proposals will be mailed/hand delivered:

AFOSR/XOT
Bldg 410, Room A113
Bolling AFB DC 20332

144. TITLE: Turbulent and Unsteady Flows

DESCRIPTION: This research is directed toward understanding the structure of turbulence in shear flows. Emphasis is on experiments oriented toward identifying and characterizing turbulent structures and their interactions in free and bounded shear layers. We expect that future research will involve numerical simulation of time-evolving turbulence features and new methods for passively, actively, or interactively controlling turbulence characteristics. Another major objective is to understand the behavior of attached and separated unsteady shear layers affected by time-dependent boundary conditions. This combined analytical, experimental, and computational program is oriented toward productively exploiting the unsteady flow characteristics that will improve aerodynamic efficiency and enhance performance (with emphasis on improving maneuverability in the post-stall flight regime). Current research involves studies of dynamic stall on two- and three-dimensional lifting surfaces and generic characteristics of driven, unsteady separated flows and unsteady boundary layers. This is a basic research effort.

Address to which proposals will be mailed/hand delivered: Refer to 143

145. TITLE: Internal Fluid Dynamics

DESCRIPTION: The objective of this research is to improve the understanding of and capability to predict the flow in internal passages of arbitrary shapes, particularly the flow in axial compressors and turbines. The need exists to understand how viscosity, turbulence, compressibility, nonsteadiness, and temperature affect the flow. Of interest is the study of aerodynamically forced response of stator blades and in learning how to improve the methods for predicting cooling effectiveness for actively cooled turbine blades and for numerically computing on- and off-design flows in low aspect ratio and high pressure ratio

compressor blade passages. Also of interest are flows in internal passages in lasers, including molecular scale mixing in turbulent and transitional shear layers, effects of shear layers on optical characteristics, and low Reynolds number supersonic diffusers. This is a basic research effort.

Address to which proposals will be mailed/hand delivered: Refer to 143

146. TITLE: Structural Mechanics

DESCRIPTION: This research deals with the fundamental principles that underlie the behavior of aerospace structural systems in a variety of environments. This behavior includes the response of the structure to environmentally derived loads, such as aerodynamic and gust loads, impact loads, and thermal and electromagnetic fluxes, or the complex interactions between the structure and environment that result in time varying effects, such as flutter. Of special interest is the role of nonlinearities that are internal and external to the structure. Similarly, we are interested in the ability to control the behavior by design optimization, damping, and active control. The research typically involves analytical and experimental work aimed at identifying the major mechanisms that underlie specific phenomena; and analytically modeling such mechanisms or assessing material and configuration concepts for enhanced behavior. An integral part of the research is the influence that new materials have on structural characteristics. Research should try to improve experimental, theoretical, and numerical methods in support of structural mechanics. Finally, we are seeking techniques that optimize structural behavior in order to enhance aerospace vehicle performance. This is a basic research effort.

Address to which proposals will be mailed/hand delivered: Refer to 143

147. TITLE: Structural Durability

DESCRIPTION: This research is concerned with the long term durability and reliability of structures subjected to the type of load spectra and environments that current and potential aerospace vehicles encounter. Emphasis is on fatigue and fracture damage mechanisms, including models for predicting damage growth and structural life, especially stochastic aspects. Considerable effort is on composite structures because of their high strength to weight potential and their increasing use. This is a basic research effort.

Address to which proposals will be mailed/hand delivered: Refer to 143

148. TITLE: Civil Engineering

DESCRIPTION: The objective of this research is to better understand the engineering properties and behavior of civil engineering materials and structures. It supports development of new materials or new approaches that will lead to the survivability of strategic structures in a nuclear weapons environment, rapid repair of tactical and logistical aircraft launch and recovery surfaces during conventional warfare, and unique requirements for maintaining Air Force facilities worldwide. Tasks are in structural dynamics, soil mechanics, and construction materials. Research areas include developing

constitutive models for geotechnical and construction materials, studying the strength and fracture characteristics of brittle materials, investigating explosion-induced soil liquefaction, developing structural response models, and identifying and measuring in-situ soil properties. This is a basic research effort.

Address to which proposals will be mailed/hand delivered: Refer to 143

149. TITLE: Airbreathing Combustion

DESCRIPTION: This basic research effort includes the study of physical and chemical processes of combustion in airbreathing propulsion and weapon systems. Tasks include the following.

- Modeling turbulent fluid transport processes.
- Controlling the rate of combustion.
- Studying the causes, effects, and ways to reduce undesirable combustion products, particularly soot, in order to increase combustor life and reduce detectable plume signature.
- Developing photochemical and catalytic methods for more stable ignition and enhanced combustion of present fuels and future alternatives.
- Understanding and controlling instability phenomena that degrade the performance of ramjet combustors.
- Analyzing the combustion of liquid fuels, including atomization, droplet behavior, and interactions with gaseous combustion processes.
- Developing a capability for high energy slurry fuel combustion, particularly boron slurry combustion.

Address to which proposals will be mailed/hand delivered: Refer to 143

150. TITLE: Combustion Dynamics (Rockets)

DESCRIPTION: This basic research seeks a more complete understanding of combustion and reacting flow processes. Currently, the objectives are to eliminate combustion instability problems in solid and liquid rocket systems; to better understand the ways to control solid motors and to reduce the hazard sensitivity of solids and liquids; to investigate the complex roles of advanced energetic ingredients in solid propellant burning; and to improve the service life of solid motors. The tasks use new methods to analyze the stress of nonlinear viscoelastic materials; study the state of combustion products in plumes; and provide accurate standard data on the thermodynamic, kinetic, and transport properties of pure substances. Emphasis is on synthesizing and using advanced propellant ingredients to increase propulsion efficiency.

Address to which proposals will be mailed/hand delivered: Refer to 143

151. TITLE: Plasma Energetics (Space Propulsion)

DESCRIPTION: This basic research is related primarily to advanced space propulsion and is stimulated by the need to transfer very large payloads between orbits. It includes studies of the sources of physical (nonchemical) energy, the mechanisms of release, and the devices for converting energy. Emphasis is on

studying electrically conductive flowing gases (plasmas), which serve as a working media for converting either beamed or electrical energy to kinetic forms (for example, plasma acceleration). Included are the following.

Theoretical and experimental investigations of the phenomena of energy coupling and transfer of low plasma flows in electrode and electrodeless concepts under the plasmadynamic environments and conditions that orbiting plasmadynamic systems encounter.

Research on pulsed and steady-state, equilibrium and nonequilibrium flowing plasma; characteristics of electrical and hydrodynamic flows; instabilities of plasma bulk and wall layers; the interactions of plasma-surface, -electrode, -magnetic, and -electric field; losses to inert parts; plasma generated by high pressure detonation or solid explosion; plasmas at high magnetic fields and pressures; and plasma diagnostics (new and unique noninterference measuring techniques).

Address to which proposals will be mailed/hand delivered: Refer to 143

152. TITLE: Chemical Techniques

DESCRIPTION: This basic research is directed toward developing new techniques or improving known techniques for studying the basic properties of matter. Research areas are in electrochemistry and detection. In electrochemistry, the nature of electrodes and electrochemical reactions are stressed. Typical studies may include: understanding the role of the electron, determining the characteristics and the effects of charge transfer species, and understanding the relationship of chemical structure to ionic conductivity. In detection, studies seek to understand the chemical factors involved in sensing and detecting the chemical and physical properties of the environment and the properties of the materials that comprise it. Emphasis is on developing new and improved analytical instrumentation and methods.

Address to which proposals will be mailed/hand delivered: Refer to 143

153. TITLE: Structural Chemistry

DESCRIPTION: This basic research encompasses programs in polymer science and glass and ceramic chemistry. Research in polymer science includes studies of ultrastructure processing that lead to the development of unique electromagnetic and structural composites, liquid crystalline, extended chain polymers with special properties, polymer alloys, and ceramic-polymer composites. Glass research focuses on studying unique glass-polymer composites, glass and glass-ceramic systems with unique optical and mechanical properties, and chemical stability and fracture mechanics of surfaces. Research in advanced structural ceramics and ceramic composites explores surface control characterization. It focuses on developing innovative ultrastructure processing concepts and processes based on surface chemistry, including deriving ceramics from polymers, organometallics, sol gels, and other chemical precursors. The area of interest is physical chemical approaches that will lead to new and improved electro-optical materials, including single crystal fibers.

Address to which proposals will be mailed/hand delivered: Refer to 143

154. TITLE: Surface Chemistry

DESCRIPTION: This basic research deals with surface reactions and reactivity and thin films. Studies of surface reactions and reactivity encompass a wide variety of surface specialties, including gas and solid surface interactions (such as chemical and physical absorption, diffusion, and desorption studies); surface characterization (emphasizing structure and reactivity correlation); and surface reaction kinetics and mechanism. Emphasis in thin film surface studies is on characterizing thin films and studying the interaction and reactivity of gases with thin films, the stability of substrate and thin films interfaces, film nucleation and growth, and interactions of intense light and thin films.

Address to which proposals will be mailed/hand delivered: Refer to 143

155. TITLE: Molecular Dynamics

DESCRIPTION: This basic research is concerned with the dynamics of molecular interactions. The studies examine well-defined microscopic molecular systems in reactive and nonreactive molecular collisions by using the selected energy states of the reactants and analyzing the energy through available molecular energy levels or through emission of radiation. Detailed spectroscopic studies are pursued.

Address to which proposals will be mailed/hand delivered: Refer to 143

156. TITLE: Chemical Reactivity and Synthesis

DESCRIPTION: This basic research seeks new and better methods of synthesis and, through studies of associated reaction kinetics, explores reaction mechanisms and quantum chemistry. It characterizes and synthesizes new organic, inorganic, organometallic, and organometalloid compounds, particularly organosilicon and fluorocarbon substances. We are interested in novel approaches to making reaction intermediates that can be used to tailor chemical structures with desirable properties. Also of interest is in research on improving the quantum chemical calculations used for predicting properties of reaction intermediates and products. This research will provide the basis for systematically approaching the synthesis of desired chemical compounds.

Address to which proposals will be mailed/hand delivered: Refer to 143

157. TITLE: Atmospheric Sciences

DESCRIPTION: This basic research includes the study of the earth's environment from the surface boundary layer to orbital altitudes. It involves meteorology, atmospheric optics, aeronomy, ionospheric physics, and many other disciplines. The objective is to understand, model, and predict the natural environment and thus increase the ability to design and operate aerospace systems effectively. For example, micro- and meso-scale dynamics are understood better, forecasting can become more accurate; if atmospheric aerosols and cloud particles

are specified better, the design of optical and infrared systems can be improved. If the dynamics of the ionosphere can be better understood, our models and predictions used in developing communications systems, in studying nuclear effects, and in conducting satellite reconnaissance and surveillance programs can be improved.

Address to which proposals will be mailed/hand delivered: Refer to 143

158. TITLE: Information Electronics

DESCRIPTION: The objective of this basic research is to investigate how large volumes of data can be produced in real time, especially when the signals and images carry a lot of information and are produced very fast. Novel concepts and electronic components that potentially could increase the throughput rates of information processors are sought. Emphasis is on studying how optical, acousto-optical, and optical-electronic hybrids process information, particularly the real-time image processing of image-sensor data. Algorithms for images that vary with time also need to be found. This research is stimulated by the need to send timely and intelligent information to command centers or to automatic weapon systems, such as cruise missiles.

Address to which proposals will be mailed/hand delivered: Refer to 143

159. TITLE: Microwave Solid State Materials and Devices

DESCRIPTION: The purposes of this basic research are to conceive of solid state electronic components for generating, amplifying, and processing microwave signals and then to demonstrate how those components work. Emphasis is on developing submicron structures and devices that are highly efficient and environmentally insensitive, that can be integrated into other systems and operated at high frequencies, and that exhibit low noise but produce large signals. Devices that interact in bulk material and on surfaces or interfaces will be provided.

Address to which proposals will be mailed/hand delivered: Refer to 143

160. TITLE: Microwave Tubes

DESCRIPTION: This basic research includes theoretical and experimental investigations of microwave generation and amplification, analysis of the interaction of electron beams and microwaves, and studies of thermionic and cold cathodes. The objective is to provide a basis for developing Air Force systems that need high power microwave sources, which have ultrawide band widths and complex modulation, can be operated in many modes, emit very little spurious noise, and are highly efficient.

Address to which proposals will be mailed/hand delivered: Refer to 143

161. TITLE: Material Sciences

DESCRIPTION: Advances in low cost, reliable, and high performance systems depend on superior materials being available and being used effectively. The goal of this basic research is to understand these materials scientifically. Tasks include analyzing and synthesizing experimental materials and developing solid state and metallurgical theory. Research in cooperation with other directorates, including Aerospace Sciences, Chemical and Atmospheric Sciences, and Physical and Geophysical Sciences is also conducted.

Address to which proposals will be mailed/hand delivered: Refer to 143

162. TITLE: Metallurgy of Structural Materials

DESCRIPTION: This basic research addresses the metallurgy of structural materials and the mechanical and thermal behavior of these materials. Such behavior includes strengthening mechanisms, fatigue, plasticity, creep, fracture, shock loading, effects of stress states, kinetics of phase transformations, phenomena related to hydrogen, and the thermal dependence of properties. The goal of this research is to identify and explain the microscopic and macroscopic phenomena that determine the properties of materials. Emphasis is on finding improved structural alloys of titanium, aluminum, and nickel and thoroughly understanding the scientific principles governing their properties and behavior. The fundamentals of metalworking and processing need to also be understood.

Address to which proposals will be mailed/hand delivered: Refer to 143

163. TITLE: Environment Resistant Materials

DESCRIPTION: In hostile environments, metal surfaces oxidize, corrode because of stress, fail because of fatigue, exhibit effects from laser radiation and interfacial phenomena, and are subjected to friction and wear. Ceramic materials are used in extremely hostile environments in turbine engines, rocket nozzles, and electromagnetic windows of high velocity aircraft and missiles. Emphasis of this basic research is on improving the structural materials that are subjected to such severe hostile environments. Research in ceramics formation and heat treatment; development, strength, toughness, creep, and rupture of microstructures; and compatibility of multicomponents is desired.

Address to which proposals will be mailed/hand delivered: Refer to 143

164. TITLE: Nondestructive Evaluation (NDE) Science

DESCRIPTION: This basic research addresses nondestructive ways to study materials or components for flaws or imperfections that could lead to malfunction or failure. The phenomena involved, the quantitative relationship to the physical property being monitored, and the limits of applicability of the physical property need to be understood. Methods and instruments to improve the way signals are detected and to process easily interpretable data need to be developed.

Address to which proposals will be mailed/hand delivered: Refer to 143

165. TITLE: Microwave Materials

DESCRIPTION: This basic research deals with the synthesis and characterization of materials with a high potential for improving present solid state devices used in generating, amplifying, detecting, and processing microwave signals. Theoretical investigations that explore the electrical, magnetic, and acoustic properties of materials that have the bulk and the epitaxial or surface properties for microwave and millimeter wave application are desired.

Address to which proposals will be mailed/hand delivered: Refer to 143

166. TITLE: Novel Electromagnetic Materials

DESCRIPTION: This basic research deals with the synthesis and characterization of materials with potential for improving electronic and electro-optical devices. It advances the general understanding of bulk and interface electronic states, the epitaxial layer structure, the submicron structure, the metallurgy of electromagnetic materials, and the role of defects and impurities. The research includes surface electromagnetic radiation studies, studies of surface acoustic wave materials and devices, studies of diffraction electronic materials, non-contract evaluation of semi-conductor materials, innovative studies of resist materials, and studies of ways to prepare optical, acoustic, and electronic thin film layers with near bulk properties.

Address to which proposals will be mailed/hand delivered: Refer to 143

167. TITLE: Superconducting Materials

DESCRIPTION: This basic research seeks to enhance the physical properties of superconductors that can lead to the attainment of higher superconducting transition temperatures, higher upper critical magnetic fields, and higher electric current densities. It includes research in the growth and preparation of multi-element metallic compounds and alloys in novel ways; the crystallography and metallurgy of stable and metastable phases; and the characterization of electrical, magnetic, thermal, and mechanical properties. Emphasis is on synthesis and characterization of superconducting electronic materials, including thin films, composites, and barriers in multi-layered or special configurations suitable for tunnel junctions. Fundamental structure-property relationships of critical parameters to attain new or improved superconducting materials with optimal characteristics for potential application in micro-device concepts are desired.

Address to which proposals will be mailed/hand delivered: Refer to 143

168. TITLE: Optical Materials

DESCRIPTION: The purpose of this basic research is to investigate solid state materials with potentially novel properties in the extreme infrared spectral region of the electromagnetic spectrum. It addresses the ways infrared, non-linear, and optical energy is transferred in narrow bandgap, semiconducting compounds. It also seeks to define how this energy may be used to generate

coherent infrared and submillimeter tunable sources of radiant energy, how it may be used to explore the dynamics of electron-hole plasmas for picosecond pulsing and switching, and how it may be used to study elementary excitation-interaction effects of picosecond phenomena. Nonlinear optics have a high potential for secure communications, high-speed switching for signal processing, and optical phase conjugation.

Address to which proposals will be mailed/hand delivered: Refer to 143

169. TITLE: Molecular Solids

DESCRIPTION: This basic research includes synthesis and characterization of potentially novel electromagnetic materials for potential use in electromagnetic devices. Emphasis is on understanding the electronic structure and properties of metallic glasses, which are amorphous molecules with short-range order, and of intercalated graphite compounds, which are crystalline molecules with long-range order. These materials have unique insulating, conducting, and magnetic anisotropic electronic structures and optical properties. We are also seeking to understand the relationships between the electronic structure of these materials to their special physical properties and their crystallographic structure.

Address to which proposals will be mailed/hand delivered: Refer to 143

170. TITLE: Physiology

DESCRIPTION: In modern Air Force systems, people work in environments in which they must attend to diverse and rapidly changing information, quickly analyze situations, and respond accordingly. Physiological characteristics determine to a large extent how well people work in these demanding environments. Human-machine systems that are not well matched to human physiological characteristics cannot operate optimally. To elucidate the links between physiological characteristics and human performance requires basic research on the mechanisms that control neuronal responsiveness. The current focus of this program is on neuronal regulation and adaptation, including control of neuro-transmitter release and postsynaptic response, activation of second messengers and ion channels, and influence of neurohormones. Emphasis is on studies that relate events at the different levels of organization molecular, cellular, neuronal-circuit, and behavioral, involved in regulating the state of responsiveness of the intact organism.

Address to which proposals will be mailed/hand delivered: Refer to 143

171. TITLE: Environmental Protection and Toxicological Hazards

DESCRIPTION: Air Force operations may result in the release of physical and chemical agents that may be harmful to Air Force personnel, the surrounding populace, and the environment. This basic research is stimulated by the need to protect people and the environment against the harmful effects of these agents. Its objective is to obtain basic data on the toxic effects of these agents and

to elucidate the mechanisms of the toxic action. We want to discover the biological effects of exposure to electromagnetic radiations from pulsed and continuous wave sources and to clarify how organophosphates produce their toxic effects on the nervous system. Emphasis is on investigating the effects of sublethal doses of nerve agents on visual system functions. Studies are designed to discover the mechanisms of production of neurotransmitters and their interactions with pre- and post-synaptic receptors.

Address to which proposals will be mailed/hand delivered: Refer to 143

172. TITLE: Adaptive Networks in Machines and Neuronal Systems

DESCRIPTION: This program supports basic research on adaptive networks in biological systems and machine systems. Emphasis is on research that brings together information gained from biological studies at the cellular level with information from studies of artificial intelligence. One goal is to elucidate the neuronal mechanisms underlying goal-directed behavior, pattern recognition, learning, and associative memory. Another goal is to stimulate new approaches to the design of adaptive networks for intelligent machines.

Address to which proposals will be mailed/hand delivered: Refer to 143

173. TITLE: Visual Information Processing

DESCRIPTION: The goal of this basic research program is to develop a quantitative description of human visual processing. Special emphasis is on those aspects of visual processing that are most relevant to aircrew performance, selection, and training; to rapid and accurate interpretation of visually displayed information; and to the development of robotic visual systems.

Address to which proposals will be mailed/hand delivered: Refer to 143

174. TITLE: Biocybernetics/Workload

DESCRIPTION: Characterization of human factors that determine how well Air Force personnel can perform in human-machine systems under high workload conditions is required for optimal design of these systems. This basic research is oriented toward elucidating the stages of information processing and allocation of attention during work tasks. Emphasis is on noninvasive techniques for monitoring neural activity during performance of sensory, cognitive, and motor tasks.

Address to which proposals will be mailed/hand delivered: Refer to 143

175. TITLE: Control Theory

DESCRIPTION: This basic research seeks to develop a body of fundamental mathematical knowledge for identifying, analyzing, designing, and optimizing control systems. Emphasis is on the control and identification of distributed parameter systems, time delay systems, and stochastic models (with particular interest in large

space structures). The current program supports research in robust control, adaptive control, stability theory, optimal control, stochastic control, filtering, and nonlinear control, and identification and optimization of lumped and distributed parameter systems. Future research to develop analytical methods, computational algorithms, and approximation techniques for identifying and controlling dynamic systems is expected.

Address to which proposals will be mailed/hand delivered: Refer to 143

176. TITLE: Mathematics of Flight Control

DESCRIPTION: This basic research addresses the application of analytic modeling theory and multivariable optimal control theory to high-order coupled dynamic systems, such as large space structures, large flexible aircraft, and highly augmented aircraft, where integration of flight, propulsion, and other control functions is desirable. Analytic models/methods that include the pilot as part of the dynamic system are also of interest. The analytic theories must consider system stability, modeling error, and disturbances.

Address to which proposals will be mailed/hand delivered: Refer to 143

177. TITLE: Optimal Control and Estimation for Tactical Missiles

DESCRIPTION: This basic research deals with modern control and estimation theory as it may pertain to the guidance functions of tactical weapons. Emphasis is on advanced control laws, modern methods of autopilot design, and new techniques for extracting maximum information from available measurements to accurately estimate critical system parameters.

Address to which proposals will be mailed/hand delivered: Refer to 143

178. TITLE: Computer Science

DESCRIPTION: The goal of this basic research is to expand the understanding and applications of computers. It focuses on distributed and parallel processing, programming theory, artificial intelligence, and data management systems. The distributed and parallel processing research explores the use of multiple processors for efficient and reliable computer processing, investigates network architectures, studies consistency in distributed data bases, analyzes network performance, investigates and analyzes distributed algorithms, and investigates languages for distributed and parallel processing. The programming theory research explores how to improve the power, quality, reliability, and transportability of computer software; how to improve software verification, data structures, and operating systems; and investigates new algorithms, the complexity of algorithms, programming and specification languages, and software development tools. The artificial intelligence research investigates the nature of intelligence and tries to represent knowledge and reason with this knowledge. The data management research investigates techniques for maintaining, organizing, and recalling large amounts of information and defines natural interfaces that allow casual users to use data management systems.

Address to which proposals will be mailed/hand delivered: Refer to 143

179. TITLE: Computational Mathematics

DESCRIPTION: The goal of this basic research is to develop algorithms that can be coded reliably, efficiently, robustly, or automatically for serial, vector, and parallel computers. We are especially interested in ways to numerically solve partial differential equations and algebraic equations. Emphasis is on solving three-dimensional equations that occur in fluid dynamics, structural mechanics, combustion, etc., and on developing algorithms to exploit and influence the design of emergent computer architectures.

Address to which proposals will be mailed/hand delivered: Refer to 143

180. TITLE: Physical Mathematics

DESCRIPTION: The goal of this basic research is to develop new analytical models and methods for solving physical and applied mathematical problems in aerodynamics, aeroelasticity, electromagnetic theory, etc. Specifically, compressible fluid flow in all flight regimes; boundary layer theory; the stability and turbulence of flows; wave propagation and impact; shock wave theory; structural stability; gas dynamics; and electromagnetic scattering, diffraction, and propagation are of interest. The mathematical methods use the techniques of contemporary analysis and other related mathematical techniques such as the use of the computer to manipulate symbols and to experiment with numbers in solving nonlinear differential and integral equations.

Address to which proposals will be mailed/hand delivered: Refer to 143

181. TITLE: Probability and Statistics

DESCRIPTION: This basic research addresses new methods and the expansion and generalization of existing methods in probability theory, stochastic processes, and statistics. It seeks to evaluate the design, testing, and performance of systems, components, and personnel. We are interested in problems that affect reliability, availability, and maintainability; in statistical communications theory, stochastic processes, and model building; in the design and analysis of experiments; and in multivariate analysis, time series analysis, and nonparametric inference.

Address to which proposals will be mailed/hand delivered: Refer to 143

182. TITLE: System Science

DESCRIPTION: This basic research deals with the areas of mathematics in which engineers need to improve and extend their procedures for designing aerospace vehicles and designing, analyzing, and synthesizing complex systems, including electronic systems used in communications and automatic control. Some of these areas include optimal filtering, prediction in signal processing, information theory, the constraints in optimization, and graph theory in network analysis. Currently, we are interested in communication theory, mathematical system theory, optimization theory, and large scale decentralized systems.

Address to which proposals will be mailed/hand delivered: Refer to 143

183. TITLE: Optical Physics

DESCRIPTION: This basic research addresses optical physics in the vacuum ultraviolet to the near millimeter range of the spectrum. Emphasis is on coherent light and its interactions with matter. We are particularly interested in advanced linear and nonlinear spectroscopic techniques for analyzing and diagnosing important phenomena, laser techniques for developing precision time and frequency standards, a wide variety of nonlinear optical phenomena, and research that could lead to coherent sources with interesting and potentially useful properties. For example, under spectroscopic techniques research, we are interested in new techniques for photoacoustic spectroscopy and for detecting and measuring velocity of very small concentrations of species in various environments. Under the time standards research, we are interested in stored ion spectroscopy and sources for submillimeter frequency standards; under nonlinear optical phenomena research, uses of nonlinear phase conjugation; and under coherent sources research, resonator theory, stimulated Raman scattering; free electron laser studies, and studies of laser induced energy transfer.

Address to which proposals will be mailed/hand delivered: Refer to 143

184. TITLE: Particle-Beams, Pulsed-Power, and Space Prime-Power Physics

DESCRIPTION: Interdisciplinary studies include research in materials, thermodynamics, plasma flows, energy conversion, etc. Particle-beam physics research includes investigations of intense, high-energy charged and neutral beams and studies of negative ion sources (especially those heavier than hydrogen), collective field acceleration processes, the propagation of neutral and charged particles in atmospheric and low pressure domains, beam sensing physics, and the interaction of intense beams with materials. Pulsed-power physics investigations center on electron-beam and laser-triggered and sustained switching, the spectroscopy of switch plasmas, an understanding of high-power repetitive opening switches, and an understanding of the ways switch electrodes and insulators break down and erode. Space prime-power research includes investigations of the physical processes that limit the amount of electrical power and energy that can be generated in space.

Address to which proposals will be mailed/hand delivered: Refer to 143

185. TITLE: Atomic and Molecular Physics

DESCRIPTION: This experimental and theoretical basic research deals with the properties and interactions of atoms and molecules. Among the topics are studies of: intrinsic and induced electric and magnetic moments; electronic, vibrational, and rotational energy levels and transitions; selection rules, spectra, and oscillator strengths; scattering and collisional interactions; cross-sections, excitations, and resonances; theories and ways to calculate atomic and molecular properties, orbitals, and wave functions (with emphasis on electron correlation effects); and molecular structures and symmetries. This research does not include the study of the internal structure of the atomic nucleus or the study of aggregate matter, such as fluids, plasmas, surfaces, or crystals.

Address to which proposals will be mailed/hand delivered: Refer to 143

186. TITLE: Collective Effects in Electromagnetism

DESCRIPTION: This basic research includes theoretical and experimental investigations of interactions in the plasma and condensed phases. Topics of interest include the study of the collective effects of low temperatures and the physical processes associated with producing radiation at X-ray, soft X-ray, millimeter wave, and microwave frequencies.

Address to which proposals will be mailed/hand delivered: Refer to 143

187. TITLE: Detonation Science

DESCRIPTION: This basic research is motivated by the need to improve the performance of explosives and to reduce the danger of unwanted detonation. It addresses the physical processes that occur when an explosive is detonated. Topics seek to define the nonlinear and nonequilibrium processes that occur during energy release and energy transport, and the statistical and quantum mechanical processes involved in detonation.

Address to which proposals will be mailed/hand delivered: Refer to 143

188. TITLE: Terrestrial Sciences

DESCRIPTION: Seismic and geokinetic effects will limit how missile guidance systems are initially aligned. This basic research is stimulated by the need to guide and control missile systems, conduct advanced tests of components, site silos, discriminate among the sources of nuclear explosions, and conduct reconnaissance and surveillance missions. The scientific disciplines that are involved are geodesy, gravity, geology, and seismology. Tasks include theoretical and laboratory investigations and actual field measurements of geophysical parameters.

Address to which proposals will be mailed/hand delivered: Refer to 143

189. TITLE: Space Physics

DESCRIPTION: The objective of this basic research is to study the particles, electric and magnetic fields, and radiation that affect the environment of near-earth space. The region of contributing phenomena extends from the ionosphere out to the stars. Experimental and theoretical methods are used to study the following.

- Celestial background radiation.
- Ways to improve the resolution of space object images.
- Solar conditions and their propagation to the earth.
- Distribution of plasma and magnetic fields within the magnetosphere.
- The earth's radiation belts and their responses to natural and artificial disturbances.
- The effect of the space environment on spacecraft systems.
- Ways to specify and forecast solar wind and magnetospheric conditions with ground-based measurements, such as radio star scintillations and geomagnetic pulsations.

Address to which proposals will be mailed/hand delivered: Refer to 143

190. TITLE: HCL Vapor Monitoring Device

DESCRIPTION: A real time HCL vapor/aerosol monitoring device is required to assess post-STs launch acid vapor concentrations. Acid fall out effects on the environment have been a serious concern with STS launches from KSC and are expected to be worse at VAFB. The device should be simple, operable with minimal attention and relatively inexpensive so that a number of devices could be strategically located. No such device is currently available.

Address to which proposals will be mailed/hand delivered:

AFSTC West Coast Office OL-AB
PO Box 92960
Bldg A2/Rm 2205 (S. Wagner)
Worldway Postal Center
Los Angeles CA 90009

191. TITLE: Intermediate Protective Clothing

DESCRIPTION: The purpose of this effort would be to develop a new generation of protective clothing for use during routine maintenance operations. A lighter weight ensemble is desired that could be worn comfortably during the course of a normal work day. Currently there is no development program addressing this area, and consequently, workers are working on a daily basis, unprotected, in areas where the potential for propellant leaks exists. Phase I output would be definition of the required clothing and sufficient samples for testing in an STS ground environment.

Address to which proposals will be mailed/hand delivered: Refer to 190

192. TITLE: Emergency Breathing Apparatus

DESCRIPTION: The purpose of this research effort would be to develop an emergency air supply unit to be used by workers during unique and potentially dangerous operations. Current devices, e.g., Robert Shaw Air Capsules, have limited capability in that they only give a 5 minute supply of air. This effort would concentrate on developing a light weight air supply unit that would sustain a worker for an extended period of time.

Address to which proposals will be mailed/hand delivered: Refer to 190

193. TITLE: Personal Propellant Vapor Detector

DESCRIPTION: A real time personal hypergol vapor detector device is required for monitoring worker exposures to the hydrazines and NO₂ (two separate devices). These rocket propellants are extremely toxic compounds with threshold limit values (TLV's) in the sub ppm and few ppm ranges, respectively. The device should be (a) inexpensive, (b) light and compact (shirt pocket size), (c) inter-

ference free, (d) quick response, (e) sensitivity to 50% of TLV, (f) equipped with adjustable dual alarm capability, and (g) possess minimal baseline drift characteristics.

Address to which proposals will be mailed/hand delivered: Refer to 190

194. TITLE: Shuttle Mid-Deck Payload Cooling Unit

DESCRIPTION: Design and build a unit that provides controlled cooling for mid-deck shuttle experiments. It will utilize the existing coolant quick disconnects and must include coolant pumping, filtering, instrumentation and control. It must be re-flyable and easily installed and removed.

Address to which proposals will be mailed/hand delivered: Refer to 190

195. TITLE: DOMSAT Terminal AJ Test Definition Study

DESCRIPTION: Analyze and develop test specifications and identify generic hardware considerations for use in protecting domestic satellites from jamming threats.

Address to which proposals will be mailed/hand delivered: Refer to 190

196. TITLE: Low Cost, Microprocessor, Space Qualification Experiment

DESCRIPTION: Develop low cost space shuttle demonstration for space qualifying current and advanced generation microprocessors. Present techniques for space qualifying microprocessors discourage microprocessor manufacturers from space qualifying their equipment due to high cost and low market potential. Currently there are only two microprocessors on the market which are space qualified, both of which are primitive by current standards. Significant cost savings and greatly increased performance could be achieved by developing a low cost alternative to current space qualifying procedures.

Address to which proposals will be mailed/hand delivered: Refer to 190

197. TITLE: Survivable C³ Approaches for Space Systems

DESCRIPTION: The purpose of this effort is to identify innovative approaches to enhancing the ground C³ segment survivability of space systems. This study effort will include concept formulation, analysis, and threat assessments. Logistics supportability should be a primary consideration.

Address to which proposals will be mailed/hand delivered: Refer to 190

198. TITLE: Spaceborne Active Radar Detection Systems

DESCRIPTION: Presently manned bombers and, in the future, cruise missiles present a very severe airborne threat to the United States. The detection of

these air vehicles by ground-based detection systems in time to give early warning of an attack is so difficult and expensive as to be almost impractical. Only spaceborne detection systems have sufficient coverage from a single sensor to give the possibility of effective and economical air vehicle detection. This air vehicle detection problem can be addressed with either spaceborne active radar detection systems or spaceborne passive infrared detection systems. Each system has its own strengths and weaknesses. Both types of systems have the problem of detecting faint targets against an interfering earth background.

There are major factors to be considered in designing a radar system to detect a faint target against the earth background. A general system study to collect and assess the available information on targets and background (small emphasis), fundamentals of target detection (moderate emphasis), data processing algorithms (great emphasis), the interaction of all this (great emphasis), the resulting data processing loads (great emphasis) and hardware requirements (moderate emphasis) would be extremely useful.

The study should also go into the interaction between background characteristics and algorithm performance. The main justification for the study would be to round out the system designer's understanding of the total radar system.

Address to which proposals will be mailed/hand delivered:

HQ AFSTC/XN
Attn: Ms Hindi
Bldg 497, Room 122
Kirtland AFB NM 87117

199. TITLE: Improved Solar Cells

DESCRIPTION: Photovoltaic solar cells supply the power needed to operate modern spacecraft. Currently, silicon (Si) cells are used and Gallium arsenide (GaAs) cells are undergoing extensive development work.

Research is needed to identify and demonstrate approaches to improve the performance, scale and survivability of both Si and GaAs cells. Performance refers to operating lifetime, cost, and weight or specific power. Scale refers to electrical distribution, structure volume, array stability and array size. Survivability addresses threats from nuclear and directed energy weapons.

In this effort, the small business concern will apply their unique capabilities and talents to research and improve Si and/or GaAs photovoltaic cells in one or more of the areas identified above.

Address to which proposals will be mailed/hand delivered: Refer to 198

200. TITLE: Improved Satellite Batteries

DESCRIPTION: One of the major components of the power subsystem used on satellites is the battery. Currently nickel cadmium (Ni/Cd) rechargeable batteries are used and extensive development of nickel hydrogen (Ni/H₂)

rechargeable batteries is being performed.

Research is needed to identify and demonstrate methods to provide rechargeable batteries with improved performance and survivability. Improved performance refers to higher energy densities, longer cycle lives, smaller volume, less weight and lower costs. Survivability is the capability to resist damage from nuclear or directed energy weapons.

In this effort, the small business will research Ni/Cd, Ni/H₂, sodium sulfur (NaS) and/or lithium alloy-iron sulfide battery applications and recommend approaches for improvement.

Address to which proposals will be mailed/hand delivered: Refer to 198

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201. TITLE: Paint and Coatings Industry Survey for Barrier Technology

DESCRIPTION: The primary objective of this program is to define and research materials used in the paint, petrochemical, applied coatings, and related industries for direct applications in solid rocket motors as moisture barriers, organic liquid barriers, or corrosion preventers.

Barrier materials slow down or stop migration of organic liquids from the propellant and liner into the insulation. In addition, barriers inhibit moisture from the air, as well as entrapped moisture, from attacking the propellant bond system. Migration and moisture attack often create hard or soft layers in the propellant. What results is a bond system which has a weak bond and is very susceptible to cracking on motor ignition or during thermal cycling. Research into new barrier materials is needed to increase the reliability and service life of rocket motors.

Corrosion preventative measures currently employed on air-launched rocket motors are adequate at best. No severe operational failures are directly attributable to corrosion. However, an increasing number of air-launched motors are being returned to depots with a significant amount of exterior corrosion. On one recent flight test, corrosion in wing attach ports of a missile very nearly caused an inflight mishap by freezing the control surfaces. Identification of new materials and processes will also increase propulsion system reliability and service life.

Address to which proposals will be mailed/hand delivered:

AFRPL/TSTR (Chris Degnan)
Bldg 8353/Rm 117
Edwards AFB CA 93523

202. TITLE: Thermal Switch for Cryogenic Refrigeration Systems

DESCRIPTION: The storage of cryogenic fluids in space for long periods requires the use of redundant refrigeration systems operating at 20° K. To tie multiple refrigerators to the same load requires a means to effectively switch from one refrigerator to another without a large thermal penalty. This program is to develop a highly reliable, switching and isolating device. The device is to be thermally activated and would be suitable for switching between refrigerators and for isolating a refrigeration system operating in a non-continuous duty cycle mode.

Address to which proposals will be mailed/hand delivered: Refer to 201.

203. TITLE: Electro-Optical Segmented Mirror Control

DESCRIPTION: The Air Force Rocket Propulsion Laboratory would like to initiate a program to study the control system of a micro-electronic mirror. The mirror, which is being developed under contract by Jet Propulsion Laboratory, is "inertia-less" in that the angle of reflection is controlled thermo-electronically using thin film semi-conductor technology. The completed mirror will consist of a very large number of facets, each of which will require a specific electrical output. The tasks in the study are:

1. develop a method for sensing the direction of each facet or groups of facets;

2. design a hierarchical control system for facets and groups of facets on the mirror;

3. develop the necessary hardware to feed the optical sensing outputs from Task 1 to the control system of Task 2; and

4. design a method of calibrating the accuracy of facets/groups of facets on the mirror.

Address to which proposals will be mailed/hand delivered: Refer to 201.

204. TITLE: Advance Control Concepts

DESCRIPTION: The Air Force Rocket Propulsion Laboratory would like to initiate a research program/project to develop a new approach to the analysis of large space structure dynamics and control.

The desired characteristics of the method(s) are:

1. a different approach than finite element/modal analysis;
2. computationally efficient; and
3. accuracy of the method can be evaluated numerically.

The new method(s) developed in this program will be used to establish a reference baseline against which proposed control laws can be compared/evaluated. The starting point for this study will be the solutions to the p.d.e describing the dynamics of beams and cables. These will be extended to analyze complex space structures.

Address to which proposals will be mailed/hand delivered: Refer to 201.

205. TITLE: Large Scale Optical Mapping in the Polar Cap

DESCRIPTION: Recent studies have shown that localized regions of ionospheric F-region plasma, which are characterized by intense ionospheric irregularities, are also characterized by an optical emission signature. Because of this relation, regions of irregularities which cause amplitude and phase fluctuation on satellite communication systems can be monitored by remote optical measurements. A network of three ground based all-sky imaging systems will operate at polar latitudes during 1983/84 winter observing season to measure 6300 A airglow and auroral emissions in the polar cap. The stations are located at Thule and Sondrestrom, Greenland and Ny Alesund, Spitsbergen. In addition, a fourth system on the AF Geophysics Laboratory Airborne Ionospheric Observatory will operate during part of this period. The 6300 A images measured at two minute intervals are recorded on 35 mm film.

The objective of this research is to develop techniques to digitize the 6300 A images to convert the all sky lens geometry to geographic coordinates, and to display the three (or four) simultaneous images on a single polar plot. Software techniques are thus required to perform coordinate conversion (using assumed or measured airglow emission heights), to generate polar plots using grey scale or false color intensity scales and to produce hard copy of the final output. Using this technique, the large scale ionospheric

structure over a large fraction of the polar cap can be established. The location and dynamics of polar cap auroras, or convecting plasma patches, should be apparent using this display technique.

This technique will provide an important framework in which to interpret DNA HILAT satellite, Sondrestrom Incoherent radar and other experimental measurements in terms of large scale polar cap structure and dynamics.

Address to which proposals will be mailed/hand delivered:

AFGL/XOP
Attn: Ms. Noreen Diamond
Bldg 1107, Rm 300
Hanscom AFB MA 01731

206. TITLE: Multiangular Electrostatic Analyzer Readout System

DESCRIPTION: This research is to develop a readout system for microchannel plates or other detectors for use with a multiangular electrostatic analyzer. The design should include thin film discrete anode array, incorporating a minimum of 128 elements and encoding electronics utilizing hybridized charge sensitive amplifier discriminators.

The system must be compatible with requirements of space flight. These include high level of reliability in space environment, compactness, and low power dissipation.

Address to which proposals will be mailed/hand delivered: Refer to 205.

207. TITLE: Field of View Monitor for Balloonborne Lidar

DESCRIPTION:

A lidar (laser radar) system will be flown as a balloon payload to study atmospheric properties in the altitude region from the balloon (35 km, 115,000 ft) to the ground. Because of signal to noise problems which occur in sunlit hours, the balloon flights will occur at nighttime precluding the use of visible sensors to give auxiliary information on such factors as the presence of clouds or haze or information on the nature of the ground terrain beneath the balloon, e.g. water, vegetation, etc. Knowledge of these factors, particularly the presence of clouds, will aid significantly in the analysis of the lidar returns.

A sensor and associated electronics (imaging is desirable but not required) is needed which will, on a moonless night, give a clear indication of the presence of clouds in the airspace directly below a balloon flying at 115,000 ft. Data from the sensor will be transferred to a PCM telemetry system for transmission to the ground (the telemetry interface will be provided under this contract but the balloon telemetry system is GFP). Time resolution of the sensor will be consistent with a balloon traveling at 40 mph relative to the ground. The sensor will be co-aligned with the lidar receiver and should have a field of view larger than that of the receiver (6 arcminutes) but small enough to discriminate cloud structures.

Address to which proposals will be mailed/hand delivered: Refer to 205.

208. TITLE: Cumulus Cloud Cover from Satellite Data

DESCRIPTION: Outline in detail an automated technique for measuring cumulus cloud cover over land and sea backgrounds using LANDSAT data. The technique is to operate on visual channels to give total cloud cover for areas of 3, 6, 12, and 25 n.mi. squared. Cloud cover, spacing, and size are also needed for sub- 3 n.mi. scales. Details of the selection of the routine for cloud/no cloud decisions are crucial. Innovative ideas for accomplishing these decisions are sought. Background brightness values from sources other than LANDSAT may be used. A detailed report is required which will include a thorough description of the technique, examples of its characteristics over a variety of backgrounds, as well as its merits over other alternatives. Cloud climatologies are not sought. A full survey of the range of background brightnesses is not sought. Solutions for snow and ice surfaces are not sought. The information sought here is needed since small-scale clouds are poorly resolved in cloud climatologies which are currently used to evaluate military systems. In addition, this technique is needed to support studies for making better assessments of meteorological satellite data. Assessments of LANDSAT data will be used as a ground-truth for the much coarser meteorological satellite data.

Address to which proposals will be mailed/hand delivered: Refer to 205.

209. TITLE: Antenna Coplane Scan Converter

DESCRIPTION: Design and fabricate a coplane scan converter which will enable a weather radar antenna to scan on planes other than horizontal or vertical. The converter is intended to enable the radar to collect data jointly with another radar on planes intersecting the baseline between the two radars. Inputs to the scan converter are to include: 1. azimuth of the baseline between the two radars relative to true North; 2. elevation angle of the scanning plane (the coplane angle), and, 3. instantaneous Azimuth angle of the radar antenna which is independently controlled. All inputs are to be in digital BCD form. The converter will continuously output appropriate evaluation angles (BCD) to the antenna, based upon the above inputs, while the antenna is continuously scanning in azimuth.

Address to which proposals will be mailed/hand delivered: Refer to 205.

210. TITLE: Flight Demonstration of In-cloud Supersaturation Device

DESCRIPTION: Measurements of water supersaturation within clouds are required for understanding fundamental cloud physics processes, for use as initiating and verification information in simulation models, for attenuation calculations, and for investigations of the effect on communications of small scale changes of atmospheric index of refraction. A fast response instrument is desired for airborne measurements of absolute humidity and temperature with resolutions of at least $.01 \text{ g/m}^3$ and $0.05 \text{ }^\circ\text{C}$ respectively, and with circuitry for obtaining supersaturation at response times of less than 0.1 seconds. The instrument must be designed for use on an aircraft similar to a Queenair. A demonstration flight through clouds should show spatial resolution of less than 10 meters.

Address to which proposals will be mailed/hand delivered: Refer to 205.

211. TITLE: Design and Test a 3-30 MeV Electron Detector

DESCRIPTION: Design and test of a 3-30 MeV electron detector is needed and should include the following features:

1. Replace the Bismuth Germate (BGO) scintillator of the second fluxmeter (to be Government Furnished Property, GFP)—currently being fabricated by Panametrics, Inc.—with a SiO₂ Cerenkov radiator.

2. Measure the response of the SiO₂ unit to electrons up to 20 MeV at the AFGL Linac. These tests would include measurements of detection efficiency with several thicknesses of the front shield to determine how well the front solid state detector (SSD) can be shielded from the intense flux of lower energy (< 2 MeV) electrons.

3. Measure the response of the SiO₂ unit to up to about 150 MeV at a Cyclotron. These tests will verify that the SiO₂ scintillation efficiency is low enough to eliminate response to low energy (< 350 MeV) protons.

4. On the basis of the above tests, a more detailed design for a flight unit will be made. Depending on the amount of shielding for the front SSD, the lower response limit for electrons may be above 3 MeV but should be less than 5 MeV. Some preliminary estimates for using the detector for ions heavier than protons will also be made.

5. A report summarizing results will be submitted.

Address to which proposals will be mailed/hand delivered: Refer to 205.

212. TITLE: Determination of Cloud Properties from Satellites

DESCRIPTION: Investigate the extent to which it is possible to determine cloud properties from LANDSAT-D satellite data. Employ the archived LANDSAT-D thematic mapper data, i.e., the 7 spectral bands in the visible, the near infrared, and the infrared to determine cloud amount, cloud height, cloud phase (ice/water) and cloud thickness. Cloud phase in theory can be inferred from bands 4, 5, and 7 since, in band 4, ice and water reflect sunlight about equally, whereas bands 5 and 7 reflect varying amounts of sunlight depending on whether the particles are ice or water. Thus, a qualitative nature of clouds can be exhibited.

Address to which proposals will be mailed/hand delivered: Refer to 205.

213. TITLE: Fluxgate Magnetometer for Space Flight

DESCRIPTION: Construct a tri-axial fluxgate magnetometer suitable for use on an earth-orbiting spacecraft. Each axis will have a range of $\pm 50,000$ nT (nT = 10^{-9} T = 10^{-5} gauss). The outputs will be analog voltages in the range 0V to 5V with an accuracy of better than ± 0.05 mV. Each axis will be mutual orthogonal to an accuracy of ± 0.1 degree. Weight will be less than 2 lbs for the sensor unit and less than 3 lbs for the electronics unit. The power usage will be less than 2 watts at 15 VDC regulated voltage. All components used will be capable of operating after absorbing 10^5 rads of particle radiation.

Address to which proposals will be mailed/hand delivered: Refer to 205.

214. TITLE: Simulated Ground Response Using Non-Linear Elastic Moduli

DESCRIPTION: Microearthquake site response has been found to correlate with susceptibility to earthquake damage (Espinosa and Algermissen, Microzonation Conference, Seattle, 1972). Further, it has been suggested that site-specific earthquake ground response could be estimated by evaluation of the site response to microearthquake activity. This idea was flawed by the failure to consider the variation of elastic moduli with strain amplitude and other factors. However, several empirical equations relating elastic moduli and strain amplitude have been introduced and could be used to modify the microearthquake response spectra for higher strain amplitudes (Seed and Idriss, University of California, Berkeley, Report No. EERC 70-10, 1970).

The proposed work would be to determine the feasibility of and to develop a technique for the modification of microearthquake site response to large strain earthquake response using strain amplitude compensation equations for the elastic moduli. Limitations of the technique should be considered. The final product of this work would be a technical report.

Address to which proposals will be mailed/hand delivered: Refer to 205.

215. TITLE: Design Specification for Microwave Moisture Sounder

DESCRIPTION: The initial effort will consist of developing models simulating water vapor profiles to determine the response of a multi-frequency microwave radiometer (183 GHz Range) to a realistic range of variables encountered in the atmosphere. The results of this effort will be used to design and prepare the specifications for a satellite borne multi-frequency microwave radiometer capable of obtaining water vapor profiles in clear and cloudy atmospheres.

Address to which proposals will be mailed/hand delivered: Refer to 205.

216. TITLE: SONDA IV Water Recovery System

DESCRIPTION: A water recovery system for the SONDA IV* needs to be developed. The system should be based on an existing USAF recovery system design which contains a 46-foot diameter paraform main parachute and a 12 X 6 foot diameter conical ribbon drogue. These parachute combinations have been successfully flown on Black Brants and the MSMP target module.

A deployable flotation system with location aids must be developed as an independent supplement to the parachute pack. The work effort required would include design, fabrication and testing of a reusable working prototype. The system should be able to float a minimum of 700 lbs. It must include an RF location aid with an operating life of 24 hours.

*The SONDA IV is a Brazilian built rocket that AFGL plans to utilize on certain upper atmospheric experiments. There is currently an international agreement covering joint programs utilizing sounding rockets between AFGL (Air Force Geophysics Laboratory) and CTA (Centro Technico Aeroespacial - Aerospace Technical Center). This recovery system would enhance the SONDA IV's utilization potential to AFGL.

Address to which proposals will be mailed/hand delivered: Refer to 205.

217. TITLE: Development of a Proton Beam Detector

DESCRIPTION: The AFWL is seeking innovative approaches to develop a proton beam detector which can withstand high fluences of the order of 10^{14} p/cm²/sec and beam currents from 10 ma to 1 amp. This detector must be small enough to be used with a pneumatic rabbit injection system. The detector must be able to characterize the spatial and temporal parameters of a proton beam in real time and, from the information supplied by the detector, must be able to (either directly or indirectly) calculate the dose (silicon) within 10 percent.

Address to which proposals will be mailed/hand delivered:

AFWL/PRP
Attn: Mr. Dionne
Bldg 497, Room 241
Kirtland AFB NM 87117

218. TITLE: Blast and Shock Instrumentation

DESCRIPTION: Sensors and means for outputting the data obtained are required for measuring the blast and shock effects in air, earth materials, and structural materials. Of interest are peak stresses/pressures in the range of about 10GPa (100 k bar), and motions in the range of acceleration 10^3 m/s², velocities of 10^7 m/s² and displacements 10m. Determination of the peak value and, preferably, the complete time history is required. Transducer designs and various means of outputting the signal to a suitable recording system are desired.

Address to which proposals will be mailed/hand delivered: Refer to 217.

219. TITLE: Laser Non-Intrusive Diagnostics

DESCRIPTION: The AFWL is soliciting innovative approaches to development of the following diagnostics.

a. A non-intrusive diagnostic to measure the vibrational energy states of singlet delta oxygen ($O_2(\Delta)$) to an accuracy of $1 \times 10^{-1.5}$.

b. A non-intrusive diagnostic to measure the particulate concentrations in a supersonic ($M > 1.5$) and low density ($P < 5$ torr) gas flow. The diagnostic should have an accuracy of 1 micron or better. Particular interest is in oxygen and iodine gases.

Address to which proposals will be mailed/hand delivered: Refer to 217.

220. TITLE: Laser Optics Fabrication Techniques

DESCRIPTION: A need exists for the development of high speed fabrication techniques (at least a factor of two faster than current techniques) applicable to production of high energy laser optical components. The components of primary interest are mirrors with high efficiency heat exchangers, ranging in size and shape from 25cm diameter flats to complex conics and torics 70cm and large in diameter. High speed fabrication

techniques applicable to large (> 1m diameter) uncooled mirrors and windows are also of interest. Both substrate fabrication and surface finishing techniques are of interest. Finishing techniques must result in optical surface figure errors of less than 60nm RMS with surface roughness less than 1.5nm RMS.

221. TITLE: Laser Flow Mixing

DESCRIPTION: Improved HF/DF chemical lasers require advanced mixing techniques. Flows currently are laminar because of the low pressures in the supersonic flow laser cavity. Techniques to develop turbulent mixing in reacting flows and advanced laminar mixing techniques are needed to improve performance. However, they must work in such a way that the kinetic processes can still be controlled. Full mixing of two high speed flows with pressures less than 50 Torr and temperature less than 400K should take place in approximately 5 cm. Large scale hardware (characteristic lengths of the order of 3 cm) are needed.

Address to which proposals will be mailed/hand delivered: Refer to 217.

222. TITLE: Laser Window Materials and Designs

DESCRIPTION: High energy laser window materials and design concepts are needed which will allow the transmission of large amounts of laser power with negligible optical distortion. High quality windows are needed for lasers operating at wavelengths of 3600-4200nm, 1315nm, and 300-600nm. Transmission of 99.9 percent is desired. Materials and concepts must be scalable to sizes which allow transmission of megawatts of power with less than 0.05 waves R.M.S. of optical distortion, across the full aperture, at the design wavelength.

Address to which proposals will be mailed/hand delivered: Refer to 217.

223. TITLE: Laser Optical Coatings and Application

DESCRIPTION: Optical thin film coatings are required for a number of high energy laser applications in the ultraviolet, visible and near infrared portions of the spectrum. Such coatings must be pinhole free and have optical properties of the bulk materials. Coatings must have low scatter losses (< 100 PPM), low absorption (< 1 cm⁻¹), and high optical damage thresholds with either pulsed or continuous irradiation. Innovative approaches to the application of optical coatings are desired.

Address to which proposals will be mailed/hand delivered: Refer to 217.

224. TITLE: Concerted Optimal Estimator Package Developments

DESCRIPTION: Among a number of developments in this area, there has been little crosstalk. While optimization criteria may differ, a number of the facets of best signal recovery techniques should be invariant. Among them, quality control indicators (QCI) of the instrumentation input and estimator output greatly affect the amount of logic required. A study for

standardization of these QCIs and flags of data goodness/reliability is needed. This is a standardization of how data are preprocessed to determine what optimal estimator are best suited for extracting the best signal.

Address to which proposals will be mailed/hand delivered:

Armament Division
Air Force Armament Laboratory (DLXB)
Programs Branch, Bldg 13, Room 264
Eglin AFB FL 32542

225. TITLE: Development of Inertial Navigation Unit for Tactical Weapons

DESCRIPTION: Inertial navigation is an attractive alternative to tactical weapon guidance because it is completely autonomous and cannot be jammed. The problem with the use of inertial guidance is the high cost associated with sufficiently accurate systems. One approach which should be investigated is the use of newly developed low cost inertial instruments (gyros and accelerometers) in a gimballed platform system. In a gimballed platform the low cost instruments would be subject to a more benign environment than they encounter in present strapdown systems. The platform environment would increase sensor accuracy and reduce computational requirements, but would increase mechanical complexity. A systems approach is necessary to determine the most cost effective approach.

The necessary effort would be a study to assess the feasibility of this approach and to construct, if promising, a unit which would be tested to determine the level of performance which could be achieved.

Address to which proposals will be mailed/hand delivered: Refer to 224.

226. TITLE: Application of Composite Materials to Light Weight Munition Dispenser Structures

DESCRIPTION: The objective of this program is to identify feasible composite materials and their applications in munition dispenser designs, with a goal of reducing parasitic structural weights by more than 30 percent.

Address to which proposals will be mailed/hand delivered: Refer to 224.

227. TITLE: Develop a New Sealing System for Munitions Containers

DESCRIPTION: Investigate new gasket materials, water lip design and any innovative method for sealing munitions containers. This research is critical to increasing service life of munitions and meeting the "wooden round" concept.

Address to which proposals will be mailed/hand delivered:

AD/CZO
Management Operations
Bldg 1, Room 109
Eglin AFB FL 32542

228. TITLE: Develop a New Closure System for Closing Munitions Containers

DESCRIPTION: This research would investigate new latch design construction to effect a more positive method for securing tops on munitions containers.

Address to which proposals will be mailed/hand delivered: Refer to 227.

229. TITLE: Microwave Warhead Technology

DESCRIPTION: To determine the susceptibility of Soviet equipment to large microwave pulses of energy, to specify the transmitter, antenna and waveform for such a warhead, and to establish the feasibility of such a warhead design.

Previous work on EMP waveforms have shown that equipment can be destroyed using large pulses of electromagnetic energy. The EMP waveform is restricted in terms of its spectrum and the target(s) susceptibility to this EMP spectrum. It appears feasible to generate large amounts of RF-power and tailor the waveform such that resulting spectrum is that required for target destruction. The newer Soviet equipment will be designed using "chips", transistors, MICs and computers, all vulnerable to either RF interference or destruction. It is the purpose of this study to establish this feasibility of waveform generation and target susceptibility so that a future utility analysis can be accomplished.

A preliminary investigation into equipment vulnerability will be conducted to determine the types of weaknesses inherent in Soviet design to RF-pulsed energy. This will establish a general range of desired spectrums and intensity levels required to develop an RF-warhead. The feasibility of generating these waveforms, antenna, power supplies and standoff ranges (from the target) will then be determined.

Address to which proposals will be mailed/hand delivered: Refer to 227.

230. TITLE: Visual Target Vector Kit (VTVK)

DESCRIPTION: Project purpose is to conceptualize and evaluate VTVK options which will provide target range, azimuth and evaluation (RAE) information for transfer to a wing-mounted, guided weapon prior to launch. Such a VTVK would provide direct cockpit-to-weapon RAE data transfer without the need for hard wiring and extensive/specialized aircraft modification. Such a VTVK would include a helmet with integrated processor, power supply, and reference system sensors, and cockpit hardware to facilitate reception of helmet processed outputs and optical transmission to a receiver on the weapon. This effort should provide support analysis to determine risk, payoff, technology needs and further study focus.

Address to which proposals will be mailed/hand delivered: Refer to 227.

231. TITLE: Office Automation Cost/Effectiveness Study

DESCRIPTION: The study should contrast the cost/effectiveness of current word processing and scientific computation machines to an alternative approach that would take advantage of recent advances in microcomputer technology.

The current approach includes three basic steps: (1) word processing- the purchase of 1 or more word processing machines to be shared by clerical personnel; (2) chart production - the purchase of 1 or more graphics machines with storage screen displays and hard copy plotting output capability; and (3) scientific/engineering application - the purchase of 1 or more desk-top computers to be shared by engineering personnel.

The alternative would be to purchase 1 multiuser, multitasking, or networking microcomputer which would allow easy expansion in on-line storage, number of users, and I/O devices. Such a system would lend itself to easy inter-user communication which would ultimately lead to significant office automation.

Address to which proposals will be mailed/hand delivered: Refer to 227.

232. TITLE: Active Modulator Compensation Techniques

DESCRIPTION: Signal fidelity requirements in high performance tactical and strategic surveillance systems put stringent voltage specifications on the final amplifier power supply. Previously, modulator/power supply pushing factors were minimized via the construction of "stiffer" power supplies. The size/weight constraints of "state-of-the-art" systems precludes such an approach. Alternative methods of maintaining amplifier signal fidelity in the ground and airborne environment must be developed which will minimize size and weight while maintaining performance commensurate with 50 to 60 db MTI cancellation ratios and high reliability and maintainability.

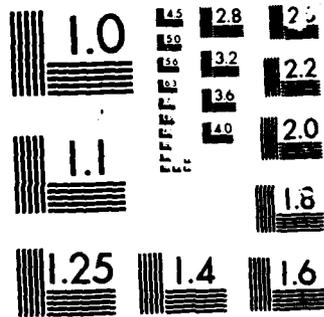
Address to which proposals will be mailed/hand delivered:

Headquarters Rome Air Development Center
Program Element Management Section (DORM)
Attn: Mr. M. Donovan
Griffiss Air Force Base, New York 13441

233. TITLE: Improved Time Delay Units for Phased Array Antennas

DESCRIPTION: Wideband phased arrays for military applications require non-dispersive time delay units which operate in the microwave frequency bands. Variable time delays up to 30 nsec are required with a resolution on the order of 1/carrier frequency of the radar. Instantaneous bandwidths of 10 percent of the carrier frequency are necessary in devices with significantly less loss than found in current acoustic and switched line devices. It is desirable that the time delay device be in a form which permits integration into monolithic microwave amplifier structures. The research should address the objective.

Address to which proposals will be mailed/hand delivered: Refer to 232.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

234. TITLE: Modulated High-Current Electron Guns

DESCRIPTION: Recent advances in the development of high current (tens of amperes) electron guns suggest that it may be feasible to exploit their use in the ionosphere for the generation of ELF/VLF/LF radiowaves. Such use would require the development of techniques to modulate high-current/energy electron beams over wide frequency ranges. New and novel beam modulation techniques and instrumentation are especially needed for frequencies above 10KHz.

Address to which proposals will be mailed/hand delivered: Refer to 232.

235. TITLE: Design of a Rough Surface with Known Statistical Properties

DESCRIPTION: The prediction and analysis of radar performance in the presence of terrain induced clutter and multipath are important requirements for systems such as the ATR and AASR. The relevant scattering from ground features is a statistical phenomenon related to the random features of the scattering surface. Models depend on assumed statistical behavior of the terrain. It would be an important contribution to the validation of radar scattering analyses if a surface with known statistical properties could be used to verify theoretical predictions under carefully controlled experimental conditions. The techniques of random number generation (Lennon and Papa, 1981 ADA103956) having the desired statistical properties will be adapted to the characterization of the surface. Additional constraints such as the degree of correlation among the heights and the surface slope characterization will then be included. The conversion of the set of heights to a spatial surface will then be accomplished and the required specification for developing the surface model will be generated. Applications related to nonGaussian surfaces which will be more difficult to characterize will also be investigated. Techniques such as computer aided graphics and computer aided design of machine tool parts will be researched to establish appropriate steps for the fabrication of the surface. The type of materials which could be used in this construction will be determined taking into consideration dielectric constants for typical rough surface types and including metallic and nonmetallic materials. Size constraints will limit the appropriate frequency regime consistent with roughness parameters; it would likely be in the X-band or K-band regime. The need for several statistical correlation lengths governs the minimum surface size.

Address to which proposal will be mailed/hand delivered: Refer to 232.

236. TITLE: Compensating for Feed and Lens Distortion in the Space Based Radar Antenna

DESCRIPTION: One version of a Space Based Radar uses a low sidelobe space fed lens antenna. This antenna would be deployed from the space shuttle in package form. It will unfold from the small package into an L-band lens 60 m in diameter with its much smaller feed about 60 m away. Since the antenna is self-deploying, the feed and/or lens may not be properly aligned. Thus, the antenna's sidelobes and gain may not meet performance expectations. One way of solving this problem is to adjust the phase shifters in the feed and lens to compensate for any distortion or misalignment of the feed and lens. In order to accurately perform the compensation, the degree of

physical distortion in the feed and lens must be accurately known. A method is needed that will detect and measure these deformations to within a fraction of a wavelength. In addition, the technique must distinguish between feed and lens deformations and must be able to function for all foreseeable types of deformations.

Address to which proposals will be mailed/hand delivered: Refer to 232.

237. TITLE: Reusable Software in Command, Control, Communication and Intelligence (C³I) Systems

DESCRIPTION: C³I systems have traditionally been designed and coded in a manner such that it is impossible or difficult to reuse the software having the same functional requirements for other systems. Reuse of application software is limited because in general the software is not designed with reuse in mind. For example, the code is often not sufficiently documented to determine if functionally similar software exists and is developed without clean interface specification to facilitate reusability. Throughout C³I system development, there may exist many areas in which software can be reusable. For example, real time executives, file management subsystems, display software, man-machine interfaces and report generators represent similar functional capabilities, yet are developed independently. The new DoD programming language, ADA, provides facilities for documenting code and specifying interfaces for reusing code. In many cases, reuse of software is not feasible since it may be machine and/or system dependent. In such circumstances, the software design may provide a machine independent specification for system development. Software design is an important and costly phase of software development. Developing a method for designing systems such that individual components of a design are reused on other system developments may provide savings in terms of cost and development time. In order to reduce software development costs, there is a need to investigate techniques for the design and development of software that can be reused on various C³I system developments. Although all software and design components cannot be reused, some C³I functions are common throughout many system developments. These functions need to be identified and methods for design, code and documentation need to be investigated to facilitate reuse in the ADA programming language.

Address to which proposals will be mailed/hand delivered: Refer to 232.

238. TITLE: Advanced Computer Processing for Decision Aids

DESCRIPTION: Existing decision aid technology will be examined to identify the languages currently being used. Key language features will be categorized as a basis for establishing the capabilities needed for the "decision aid language." Similarly, the required processing capabilities will be identified and compared to existing or planned computer capabilities in the operational environment. A recommendation will be provided on how we can best develop aids that offer hardware compatibility. If no existing capability is sufficient, recommendations will be made for modifying or supplementing current hardware. This effort will provide recommendations for reducing the time, cost, and risk in the testing and integration of decision aid

tools and methods in the laboratory environment and the time and cost of transitioning the technology to operational status. Also, recommendations for extending the utility of hardware entering the operational arena and reducing software support requirements and costs will be included.

Address to which proposals will be mailed/hand delivered: Refer to 232.

239. TITLE: Decision Aid Information Portrayal

DESCRIPTION: An analysis should be performed of the information requirements that must be satisfied by decision aid displays. This will provide a basis for developing alternative methods of information portrayal. The information portrayal methods must consider the cognitive styles of the operational personnel for whom the aids are intended. Another key issue that must be addressed is that the aids often provide "relative" measures, but the relative to what "aspect" is not always readily apparent. Confidence weights are also used, but the scales do not easily convey the feeling of "goodness" of the weights.

Address to which proposals will be mailed/hand delivered: Refer to 232.

240. TITLE: Read/Write/Erase Materials for Optical Digital Disk Applications

DESCRIPTION: The development of the read/write optical disk for mass storage systems logically leads toward the need to update and upgrade stored information. The ability to selectively erase and rewrite information would greatly reduce the cost of the optical disk. Future proliferation of the optical disk in mass storage systems, coupled with increasing data rates and storage requirements, will necessitate using a reusable optical disk instead of a non-erasable optical disk in real-time mass storage areas. This effort will identify a material and provide quantification/assessment of its suitability for use in reusable read/write/erase optical disk applications.

Address to which proposals will be mailed/hand delivered: Refer to 232.

241. TITLE: Artificial Intelligence (AI) for Image Exploitation

DESCRIPTION: The pattern recognition efforts for automatic feature extraction from digital imagery, multi-dimensional image processing, and multi-imagery exploitation (MIE) are addressing image processing and artificial intelligence applications within existing processing systems. However, these efforts are not adaptable in AI problem situations more complicated than a simple neighborhood situation. The objective of this effort is to define the target detection and pattern recognition problem, in terms of artificial intelligence rules, and to develop a plan for application to the imagery hierarchy and a knowledge base for the most difficult of image pattern recognition problems. The research should define the process of pattern recognition (target detection and identification) such that a computer can rapidly go from the image problem situation to the particular AI rules that it suggests. A plan should be developed that will determine how the AI techniques should be best applied to the imagery hierarchy. Based on the plan and processes defined, a knowledge base should be developed that represents the image patterns to be recognized, including the most difficult of image pattern recognition problems such as CC&D targets,

seasonal changes and ambiguities representative of all imagery types. This program will provide a pattern recognition and target detection knowledge base and rules for global pattern recognition in a digital image.

Address to which proposals will be mailed/hand delivered: Refer to 232.

242. TITLE: Development of Radiation Hardened Graded Index Optical Fiber for High Data Rate, Long Range Transmission

DESCRIPTION: Because of the well recognized advantages of optical fibers, notably EMP/EMI immunity and high bandwidth to weight/volume ratio, they are being incorporated into many new C³I and weapons systems designs as replacements for conventional metallic cables. However, all optical fibers available today that can meet mechanical and thermal systems requirements show significant permanent and transient losses in transmission when subjected to nuclear radiation. Except for those systems utilizing relatively short lengths of optical fibers, i.e., less than a few hundred meters, presently available fibers are not compatible with the nuclear vulnerability requirements of many systems. Without a dedicated and consistent program for the development of radiation hardened optical fibers for DoD applications, it is unlikely that any significant improvement in radiation tolerance will occur in the foreseeable future. This effort will develop new fiber compositions and/or manufacturing techniques which will allow production of radiation hardened optical fibers.

Address to which proposals will be mailed/hand delivered: Refer to 232.

243. TITLE: Ion Deposition of Diamond-Like Carbon Coatings for Protection of Fluoride Glass Surfaces

DESCRIPTION: Recent advances in materials processing have provided the optics community with a wide array of low distortion, low loss optical materials. However, many materials which are chemically stable in inert environments may be subject to corrosion and/or erosion in operational environments. Moreover, many materials which are otherwise attractive for multispectral applications are compromised by some susceptibility to corrosion in even relatively benign environments. For such materials to be suitable in operational environments, their surfaces must be protected in some fashion without affecting the optical properties of such materials. The heavy metal fluoride glasses (HMFG) are good examples of such materials. The coating must be transparent in the mid infrared region (2 to 6 um) and have a high degree of adherency to the glass surface. Diamond-like carbon coating should be deposited on polished surfaces of HMFG of different compositions, sizes and shapes. The techniques should be applicable to both bulk and fiber geometrics.

Address to which proposals will be mailed/hand delivered: Refer to 232.

244. TITLE: General Purpose Automatic Pulse Measuring System

DESCRIPTION: A large number of radars now being developed by DoD are of

the active phased array type. Active arrays employ a transmit/receive module to drive each element in the array. This will require several thousand T/R modules to be evaluated for each array. Since testing is a large part of the modules' cost, a general purpose test system must be developed to perform this function. This general purpose test system must be capable of measuring both magnitude and phase with a pulsed test waveform. This effort will lead to the design and construction of an automatic pulsed measuring system for use with radar type waveforms.

Address to which proposals will be mailed/hand delivered: Refer to 232.

245. TITLE: Accurate and Discriminating Rapid-Response Chemical/Biological Agent Detectors

DESCRIPTION: An overall deep basing system concept may require closed operation for up to 1 year. The release of chemical/biological warfare agent(s) in a deep base would present a significant, possibly system negating, non-nuclear threat. A qualitative method of detecting low concentrations of airborne chemical and biological warfare agents is desired; such a detector should be capable of responding immediately to the presence of a chemical/biological agent and be capable of determining the class of chemical or biological agent involved (i.e., bacterial, viral, rickettsial or fungal biological agent or nerve, blister, blood or choking chemical agents). To support system operations such a detector should experience a near zero percent false positive response. A detection method such as the described detector would have enormous use potential for the civilian and military sectors.

Address to which proposals will be mailed/hand delivered:

USAF Ballistic Missile Office (BMO)/PMX
Bldg 525, Room 500
Norton AFB CA 92409

246. TITLE: Low Toxicity Chemical/Biological Agent Decontaminants

DESCRIPTION: In the event that chemical/biological warfare agents are released in the environs of a deep base, some technique/process/mechanism for neutralizing and removing (i.e., decontaminating the threat agent) is preferred to abandoning the base. A decontaminant having the following characteristics is desired:

- a. effective (quick acting);
- b. little or no special handling or storage requirements;
- c. low personnel toxicity;
- d. compatible for use with state-of-the-art electronic equipment;
- e. compatible with other decontaminants;
- f. minimum cost; and
- g. easily neutralized by the environmental control system.

The atmospheric environment in a deep base where such a decontaminant would be used may very likely consist of high relative humidity and dry bulb temperatures near or above 100° F.

Address to which proposals will be mailed/hand delivered: Refer to 245.

247. TITLE: Waste Water Treatment and Purification in a "Buttoned-Up" Manned Deep Base

DESCRIPTION: A method of treating, purifying, and managing waste water (i.e., liquid domestic, industrial, and medical waste) is desired during an extended period (up to 1 year) of post-attack operation for a deep base. The post-attack configuration of a deep base would be that of a completely self-contained environment. A suitable waste water treatment and purification process would have the following characteristics:

- a. low power requirements;
- b. minimum dissipated heat;
- c. low maintenance requirements;
- d. high operating efficiency;
- e. minimum cost; and
- f. minimal residue storage;

Address to which proposals will be mailed/hand delivered: Refer to 245.

248. TITLE: Rapid and Accurate Personnel Identification

DESCRIPTION: During the extended period of peacetime operation projected for a deep base (on the order of 15 years), it would be reasonable to assume that modifications to update old equipment will occur at fairly regular intervals. In addition, personnel will be rotated in and out of the deep base at intervals presently estimated as being between two weeks and two months. This relatively constant flow of large numbers of personnel make it essential to be able to identify individuals quickly and with a high degree of confidence. Present systems (such as having a check of picture I.D. cards) are too slow and unreliable for the demanding needs of a deep base. A system is needed that is quick, reliable, very secure, and relatively easy to update. Provisions for construction personnel, assigned personnel, and visitors must be included as a minimum.

Address to which proposals will be mailed/hand delivered: Refer to 245.

249. TITLE: Physical Security During Construction of a Manned Deep Base

DESCRIPTION: The construction of a deep base will necessarily involve large numbers (possibly thousands) of construction workers over an extended span of time. A security system that will preclude acts of sabotage by construction workers or other personnel is desired. The magnitude and seriousness of the problem renders the possibility of obtaining adequate security clearances for all the personnel involved ineffective,

inefficient, and expensive. The system should provide a sophisticated and portable rapid response mechanism that is capable of ensuring that no foreign material or device deleterious to the base will enter the base during construction. The system should also be one that is capable of withstanding extreme climatic conditions for long periods of time under constant use, providing gross surveillance of construction activities. In addition, the physical security system should have the following characteristics:

- a. provide a complete "Security Network" for the construction site;
- b. expand easily for a parallel construction process;
- c. provide sufficient redundancy to act as back up to a permanent security system;
- d. minimize requirements for security and maintenance personnel;
- e. to the extent practicable, be capable of conversion to a post construction permanent security system; and
- f. minimize cost.

Address to which proposals will be mailed/hand delivered: Refer to 245.

250. TITLE: Through the Earth Communications

DESCRIPTION: One of the critical problems to be addressed concerning a deep underground ICBM base is how to maintain direct, accurate, real time communications (post-attack) with a command authority located on the surface at a protracted distance. One suggested method includes direct, through the earth communication (TEC). Current TEC concepts have inherent range, data rate, and power consumption constraints. A proposed concept should be rugged, easily maintainable, and able to transmit and receive at hundreds of bits per second (or more).

Address to which proposals will be mailed/hand delivered: Refer to 245.

251. TITLE: Post Attack Damage Assessment for a Manned Deep Base

DESCRIPTION: Following a nuclear attack on a deep base, it will be necessary for damage control personnel to be able to quickly assess the location, nature, and extent of damage to the base itself and to the contiguous surface areas. The investigation should develop a system that can determine the location and extent of initial damage, and then continue to monitor the damage sites or equipment until repairs are made. The system should also be capable of presenting a "picture" of the state of the surrounding geological structures, as well as an ability for plotting egress routes through undisturbed or minimally fractured ground.

Address to which proposals will be mailed/hand delivered: Refer to 245.

252. TITLE: Meteorological Considerations for RV Flight Testing

DESCRIPTION: Research is necessary to:

evaluate requirements for a remote weather sampling system applicable to remotely piloted vehicles (RPVs). The specification of the RPV will be supplied. Data can be telemetered or stored on-board. The instrumentation used, method of data correlation, data rate, etc., must be considered. Objective is to obtain weather data including cloud statistics, particle size/water content information, density and if possible, wind information.

Further research is needed in the area of developing a total atmospheric water content meter for airborne measurements. This effort would design and analyze a method(s) for measuring the freestream particulate water content from an aircraft flying through a cloud environment. The method must have an anticipated real time readout capability suitable for telemetry to ground station. Values of particulate water content of from 10^{-3} to 1 grams/m³ are of interest. Low electric power consumption is highly desirable.

Research efforts are also necessary in the area of weather characterization. This research would develop hardware concepts and identify software techniques for characterizing weather in a 1000 cubic kilometer volume of the atmosphere, and for forecasting cloud motion and distribution for one hour.

Address to which proposals will be mailed/hand delivered: Refer to 245.

253. TITLE: RV Boundary Layer Plasma

DESCRIPTION: Current codes for RV boundary layer plasma generation at low altitudes do not provide the real gas parameters that are of first order importance to the electromagnetic wave interaction problem (electron density and collision frequency). The objective of this Phase I effort is to develop a plan for modifying the reference code.

Address to which proposals will be mailed/hand delivered: Refer to 245.

254. TITLE: Radar Measurements of Particulates

DESCRIPTION: This research would develop a data base which provides detailed radar cross section measurements of irregularly shaped dust particles. These measurements will encompass several common soil types and cover the particle size range from 10um to 1 cm. Measurements of each particle size will be taken in the radar frequency range of approximately 3 to 50 GHz. Measurements will include but not be limited to radar frequencies of 3, 5.5, 9.4, 24, and 35 GHz.

Address to which proposals will be mailed/hand delivered: Refer to 245.

255. TITLE: RV Coatings for Nuclear Environments

DESCRIPTION: For creditability after a nuclear encounter, small RV decoys must avoid metric discrimination. The mass, shape and materials on the decoy all contribute to the necessity for a coating to preserve metric replication. The research should identify low impulse coatings which can be removed by a selected altitude to replicate metric behavior while preserving other functional behaviors.

Address to which proposals will be mailed/hand delivered: Refer to 245.

256. TITLE: Directed Energy Weapon Hardening

DESCRIPTION: Space based lasers and other directed energy weapons offer a potential threat to reentry vehicle survival. While the current thermal protection system offers some protection, it is vulnerable to isolated point failure (single point failure will result in demise). Advanced heatshields incorporating a method to decrease single point vulnerability are needed to improve the survival of RV's against a directed energy attack. Phase I should explore new laser material hardening concepts of RV's.

Address to which proposals will be mailed/hand delivered: Refer to 245.

257. TITLE: Radar Scattering

DESCRIPTION: A high-resolution analytical model of radar scattering from layered dielectric sphere cones should be developed. RF wave interaction with dielectrically clad vehicles is becoming increasingly important. Wave lengths of interest range from $.3 \leq \lambda(\text{cm}) \leq 30$ for dielectric thicknesses on the order of 1-2 cm. The objective of the research is to show the approach to these kinds of calculations (with some examples).

Address to which proposals will be mailed/hand delivered: Refer to 245.

258. TITLE: Reentry Vehicle On-Board Instrumentation Considerations

DESCRIPTION: Research is required in the following areas.

a. The response of on-board reentry vehicle acoustic monitors to the impact of particulates in hydrometeor environments which may be encountered on reentry needs to be investigated. The acoustic monitor is a piezoelectric crystal mounted on the back face of a 12-inch long nosetip of radius 0.25 inches which is composed of FWFP carbon/carbon material. The investigation should include a calibration of the acoustic monitor/nosetip system in an erosive environment (arc jet facility with capability to emit particulates) to determine the acoustic response from the impact of a given size particle. This investigation will also involve a spectral analysis of the acoustic response to the impacts. This signal processing is necessary because of the presence of high level "white" noise and the limited telemetry bandwidth of no more than 20 kHz available.

b. A novel method should be developed for accurate measurement of roll torques on reentry vehicles. The method selected must not put the survival or first order performance of the RV at risk. Characteristic roll torque coefficients (approx. 10^{-5}) dictate the sensitivity of the device. The study report should include plans for ground proof testing.

Address to which proposals will be mailed/hand delivered: Refer to 245.

259. TITLE: Reentry Vehicle On-Board Instrumentation Considerations (cont)

DESCRIPTION: Research is needed in the following areas:

c. The acoustic propagation through small diameter nosetips of reentry vehicles needs to be mathematically modelled. The research should investigate and model (mathematically) acoustic propagation through FWPF carbon/carbon materials. The acoustic wave will be generated at the back face of a 12-inch long nosetip of radius 0.25 inches, will propagate through the nosetip to be reflected at the tip, and will be received at the back face where it was generated. The acoustic propagation model will address the relationship between acoustic return and changes in the nosetip shape due to ablation. Modeling efforts will consider boundary layer noise spectrum from 10 k thru 10^4 Hz.

d. Techniques need to be developed to determine in-situ nosetip surface roughness element size. In-situ environments are typically those that are obtained in steady arc ablation facilities or on the ballistic range. Analytical investigation with results that predict a large margin for error (factor 2) out of the environment is a requirement. Roughness elements ranging from .030 inches (glassy materials) to 10^{-4} inches (graphics) are of interest. Aerodynamic environmental specification will be supplied to proof of concept calculation or "bench type" experiments.

Address to which proposals will be mailed/hand delivered: Refer to 245.

260. TITLE: Material Properties at High Temperature

DESCRIPTION: Research is needed in the following areas.

a. Potential epoxy coatings to eliminate sporadic drag effects needs investigating. Current material outgases at a high rate during reentry, which produces unwanted stochastic vehicle dynamics. The object of the effort will be to analyze flight and ground test data to determine the blowing rate, to correlate this to aerothermal parameters and to suggest, based on these findings, material improvements.

b. An effort is needed to investigate/measurement of high temperature (4-9000 ° F) material properties. A knowledge of the behavior of graphite in the vicinity of its melting point is needed to analytically define the limits of usage of graphitic nosetips. Data needed are the triple point determination, the viscosity of the liquid, and the heat of fusion. These data need to be determined experimentally or derived values experimentally validates.

Address to which proposals will be mailed/hand delivered: Refer to 245.

261. TITLE: Material Properties at High Temperature (cont)

DESCRIPTION: Research is needed in the following areas.

a. High temperature (4-9000 ° K) material properties need further investigation/measurement. At a velocity $\geq M = 6$, fin thermal heating plus attachment to the parent vehicle is a major problem. To date, detailed designs have not been accomplished, which is the objective of this effort. Specifications of the aerothermal environment will be provided by BMO/SYMS.

b. An innovative technique for determining the melt temperature and heat of fusion of graphite or carbon-carbon needs investigation. These parameters, especially for supplied carbon-carbon, are of interest to high performance vehicle programs. Methods devised must be of reasonable cost with a reasonable probability of success. Some experimental effort is highly desired.

Address to which proposals will be mailed/hand delivered: Refer to 245.

262. TITLE: Development of Simulation Model of ABM Components

DESCRIPTION: This research should enable the provision of software components for the evaluation of offense penetration performance of ICBM and SLBM reentry systems against specific defense components. An ability to model both optical and radar defense elements, their functional interaction and the overall "system effectiveness" of combined systems, e.g., overlay/underlay, is required. The models should be of sufficient detail to enable them to be used for the evaluation of ICBM and SLBM penetration effectiveness against various defense component design parameters, including a prior knowledge of assumptions about the attacking system component performance.

Address to which proposals will be mailed/hand delivered: Refer to 245.

263. TITLE: Effectiveness Study/Kill Level for the Cruise Missile Family of Weapons Using Submunitions

DESCRIPTION: The cruise missile family of ground launched, sea launched, and air launched weapons can be utilized as submunitions dispensers. The medium range air-to-surface missile (MRASM) has a design for runway closure using submunitions, and submunitions may be effective against other target types. A variable kill level effectiveness study is required for submunitions against the following.

a. Land Targets. Develop the methodology for estimating target vulnerability and then evaluating graduated F to K kill effectiveness indexes of anti-armor/fragmentation submunitions against enemy air defense command and control radars. The methodology shall be capable of being used by researchers to estimate effectiveness indexes for conceptual and developmental submunitions whose properties are not fully defined. In addition to traditional small, high fragment density kill mechanisms, this methodology shall be capable of considering anti-armor (self-forging fragment and shape charge) kill mechanism and limited numbers of large, heavy fragments for submunitions similar to the proposed AMIS family.

b. Ship Target for Topside Kills. Develop methodology for estimating ship vulnerability to and effectiveness of small submunitions against ships. Kill criteria shall be focused on ship fire power kills, i.e., SAM and SSM disabling. Methodology shall consider both anti-armor and fragmentation kill mechanisms and shall be capable of being used by researchers to estimate effectiveness of conceptual and developmental submunitions whose properties are not fully defined.

Address to which proposals will be mailed/hand delivered:

Joint Cruise Missiles Project
Director of Contracts (JCM-28) (SBIR Program)
Washington DC 20363

264. TITLE: Effectiveness Study of Two-Dimensional TERCOM

DESCRIPTION: Study the improvements to the TERCOM system of adding an additional dimension utilizing a scanning Radar and using existing DMA map data from high resolution and low resolution sources. The study will evaluate the performance improvements as a function of terrain smoothness and the effects of unmapped features such as structures, trees, etc. Note: the third dimension is provided by vehicle motion.

Address to which proposals will be mailed/hand delivered: Refer to 263.

265. TITLE: Fuel Neutralization to Prevent Flashback on Aircraft Fires

DESCRIPTION: An agent needs to be developed that during an aircraft ground fire could be sprayed onto running aircraft fuel and would prevent the fuel from igniting. A study will be performed to assess the feasibility of developing fire suppressant agents to neutralize fuel in fuel fires. If the study results appear promising, a follow-on effort would develop concepts for suppressant formulation. Trial tests would be run to demonstrate concepts and performances and to adjust formulations and application techniques. Small scale testing would also be conducted.

Address to which proposals will be mailed/hand delivered:

HQ AFESC/RDX
Tyndall AFB FL 32403

266. TITLE: Pavement Design Models for High Pressure Tire Loadings

DESCRIPTION: It is likely that in the near future the Air Force will be using aircraft tire pressure loadings as high as 400 psi. Existing runway pavement design mixes were not intended for such high loadings and new design mixes need to be developed. The initial effort will develop a laboratory procedure for proportioning the bituminous binder and aggregate. This procedure must provide relationships between mixability and other mix characteristics such as density and voids. The second phase is definition of the aggregate and bituminous properties and the aggregate grading so that the mixt will not consolidate under ultrahigh tire pressures (400 psi). Small test sections will be used to relate laboratory properties to field performance.

Address to which proposals will be mailed/hand delivered: Refer to 265.

267. TITLE: Identification of Micro Flora in Ground Water

DESCRIPTION: In support of ongoing biodegradation research, groundwater sampling at Carswell AFB TX, shall be conducted to identify, quantify, and characterize the existing microorganisms. The aquifer underlying the base has been contaminated with a variety of organic pollutants. The concentration of the pollutants varies by several orders of magnitude in different areas on the base. The high concentration of several of the pollutants provides an opportunity to study concentration dependent degradation. These high concentrations will also be evaluated for microbiological toxicity. Microbiological characterization of the different sampling sites shall identify potential organisms capable of degrading the various contaminants present at the sampling site. Lab investigations of pure and mixed cultures of organisms with single and multiple organic chemical combinations shall be conducted to determine sole source of carbon utilization, substrate specificity and co-metabolism. Microbiological enumeration and identification, laboratory scale degradation studies and organic chemical analysis capability are required.

Address to which proposals will be mailed/hand delivered: Refer to 265.

268. TITLE: Removal Mechanisms for Phenols

DESCRIPTION: The Air Force has several large aircraft maintenance facilities stripping paint from aircraft and discharging the phenolic stripper waste water into publicly owned treatment works (POTW). Removal mechanisms decrease the concentration of the phenol in the sewer system thereby reducing the phenol load on the POTW. Removal of the phenol by biological degradation in the sewage/sewer system shall be investigated using laboratory scaled systems to simulate sewer conditions, e.g., flow rate, mixing aeration, phenol concentration and temperature. Sorption of the phenol onto organic matter in the municipal waste represents another mechanism of removal and shall be evaluated in the simulated sewer system. These removal mechanisms shall be quantified in laboratory scaled testing and the treatment capacity of mixing the phenolic waste with municipal waste shall be evaluated. Determination of the capacity of the municipal waste for biodegradation and sorption of phenols will aid the Air Force in calculation of acceptable phenol discharge to POTW; a preferred alternative to treatment on the Air Force base. Laboratory scale microbiological testing experience, waste water treatment experience and organic chemical analysis capability are required.

Address to which proposals will be mailed/hand delivered: Refer to 265

269. TITLE: Narrowband Secure Digitized Voice (10 khz)

DESCRIPTION: In the digital mode, after COMSEC processing, operating channels in Intra-Base Radio (IBR) (in both the lower and upper UHF band) may require 25 khz or more of bandwidth. Congestion in several worldwide locations indicate a need for such operations to work on 10-12.5 khz channels. Research is needed to develop data compression schemes for secure voice and data to enable IBRs to operate on these narrowband channels.

Address to which proposals will be mailed/hand delivered: Refer to 141

270. TITLE: Exploitation of Lower Cost Satellite Terminals at SHF

DESCRIPTION: Research is needed to develop wideband and narrowband SATCOM terminals and satellite payloads that operate at 10.0-15.0 GHZ. The technology in this frequency band is fairly well understood and many components are available today. Performance, data throughput and atmospheric penetration are better than, or equivalent to, EHF at substantially lower cost.

Large quantity users could be serviced by a lower cost, high capability that meets or exceeds current needs.

Address to which proposals will be mailed/hand delivered: Refer to 141

271. TITLE: Improved HF Propagation Using Coding

DESCRIPTION: Research is needed to develop coding schemes to enhance HF propagation in environment that have 50 percent error rates due to fades and/or media disturbance of all types. These schemes should apply to both data and voice. These approaches will lead to substantial increases in channel reliability, lower power levels, lower probability of intercept and increased data throughput.

Address to which proposals will be mailed/hand delivered: Refer to 141

272. TITLE: Tactical Air Control Systems for Airland Battle 2000

DESCRIPTION: The Army Airland Battle 2000 concept envisions the use of highly mobile rapidly deployable forces which can be moved to world trouble spots on short notice, and which can pursue aggressive military actions in support of allies or national interests. There are several key points to this concept: first, short notice rapid deployments; second, operations in completely new geographic areas; and third, the need to rapidly deploy and fight under very primitive conditions.

The technical implications of the Airland Battle 2000 are the need for light, easily deployable, effective tactical air control system (TACS) equipment and systems. Commanders in deployment situations will probably want to maintain the minimum structure required to accomplish their missions. Modularity, flexibility of use, and light weight all become highly important design considerations.

The study objective is to examine the 2000 concept and to define the equipment configurations and system architectural options for a rapid deployment, contingency operation TACS for conditions in the 1990-2010 time period. Special emphasis should be placed on possible applications of existing or planned systems. Topics which may be considered include air and ground surveillance methods and systems, identification, force management, ground-to-ground communications within the theater and TACS and with the Army, air-ground-air communications, and communications out of the theater of operations.

Address to which proposals will be mailed/hand delivered: Refer to 141

273. TITLE: Tactical Air Control System Vulnerability/Survivability Analysis

DESCRIPTION: The surveillance, force management and communications systems of the Tactical Air Control System (TACS) will become increasingly vulnerable to both physical and electronic attack as the technical capabilities of potential adversaries increase. All Services can expect that command and control systems will become important targets for disruption or destruction, and that weapons systems will be able to locate and attack them. There are many possible attack scenarios ranging from the NATO Central Region to Rapid Joint Deployment Force Contingency operations in completely unexpected areas of the world.

Survivability can be enhanced by physical fortification, by mobility, by electronic decoys and deception, and by improving operational procedures. The first question in examining survivability is to look at vulnerability and ask precisely how vulnerable is a given system to attack, disruption or destruction in a given scenario.

The study objective is to examine the extent/degree of detection and attack of the parts of the TACS which will be deployed in the 1990-2010 time frame. This will entail an examination of the physics of the detectable signatures, i.e., visual, electronic, infrared, etc. and estimation of the conditions under which these could be used to locate them by means of existing/planned detection systems (either ours or someone else's). Vulnerability of the TACS can then be translated into implications for equipment and system designs. A TACS which is subject to a smaller threat can be lightened, or used in a low threat scenario at smaller cost than a TACS designed to survive a highly sophisticated threat.

Address to which proposals will be mailed/hand delivered: Refer to 141

274. TITLE: Advanced Sensor Technology

DESCRIPTION: Air traffic control has traditionally used radar to positively track and control aircraft. This is acceptable for peacetime, and has been acceptable during past conflicts. However, the increasing threat from anti-radiation and other smart stand-off weapons will make radar extremely vulnerable in future conflicts. Jamming will probably render most radar and voice communications unusable or unreliable. This research would explore sensor and communications technology and recommend ways to accomplish positive air traffic control in future conflicts.

Address to which proposals will be mailed/hand delivered: Refer to 141

275. TITLE: Cost Modeling for Product Assurance During the Systems Acquisition Process

DESCRIPTION: Product assurance activities must be adequately budgeted for during various funding phases of the systems acquisition process. A variety of industry accepted and proven techniques that represent key elements of this assurance process exist and must be tailored to each DOD systems acquisition effort. These activities consume acquisition dollars which, if properly executed during demonstration/validation, full scale engineering development, production, and field support, can reduce the total life cycle costs by a considerable amount. Simply stated, properly funded assurance activities executed at appropriate stages result in enhanced system

reliability with reduced operating costs incurred by the Government.

With this as a background, sufficient data exist to relate:

a. the costs of product assurance in the systems acquisition process; and

b. the savings appreciated by the Federal Government because of enhanced system reliability and the corresponding reduction in support required during fielding.

DOD personnel understand this seemingly obvious relationship, but are pressed to attach some specific dollars or percentages that would be relevant to their respective programs. Therefore, a small and innovative business could consolidate existing DOD funding data and provide guidelines such as: (1) product assurance efforts, when properly tailored to a particular DOD system acquisition process, add a specified percentage onto the total acquisition cost; and (2) the total system support costs or life cycle costs could be potentially reduced by a specified percentage due to the application of these tailored product assurance activities.

Address to which proposals will be mailed/hand delivered: Refer to 141

276. TITLE: Accelerated Life Testing During the DOD Systems Acquisition Process

DESCRIPTION: Life testing methods used to measure systems reliability are often too costly and time consuming to perform properly. This results in improperly structured or prematurely truncated life testing on complex electro-mechanical systems needed by DOD. More analytical research is needed to further develop cost effective methods for performing life tests used to assess systems reliability. Stated differently, small business may be of assistance in surveying present techniques for performing routinely contracted methods of life testing per existing MIL-STDs. This survey should focus then on existing and newly evolving accelerated life test methods that could potentially reduce test times while still being able to predict true field reliability performance despite its accelerated nature.

Such techniques do exist but are not highly publicized. Other technical methods for accelerating life characteristics and systems reliability measurements are evolving at present and may have potential application. Significant time and resources could be saved if properly planned, accelerated life testing during full scale engineering development occurred as opposed to today's present test methodologies used by DOD contractors. Potential improvements in this area of accelerated test are possible and could be advanced by small business involvement.

Address to which proposals will be mailed/hand delivered: Refer to 141

277. TITLE: Local Area Network (LAN) Components

DESCRIPTION: The Air Force needs LANs that can survive and operate in the harshest military environments, can handle digital and analog wideband signals, have multi-level security features, can interconnect with existing wide-area military networks (e.g., ARPANET, AUTODIN) and are inexpensive enough to use in normal peacetime commercial applications. Low cost, high performance LAN components are the key to this capability. These components

include connectors, transmission media, bus interface units, encrypter/decrypters, and gateways and front-end processors. Ideally, these components should be highly compatible with existing standards (e.g., EIA, CCITT, and ISO) and commercial systems to increase the market for standard components, drive costs down, and allow contingency connections to civilian systems.

Address to which proposals will be mailed/hand delivered: Refer to 141

278. TITLE: Embedded Computer Software: Microcode Generation Tools and Techniques

DESCRIPTION: The Services need efficient microcode generators to customize VLSI, and eventually VHSIC, devices for embedded signal and data processors. These microcode generators will be used during weapon system engineering development and product. They could also be used in field applications to rapidly reprogram weapons, C³I, ECM, sensor and guidance systems to respond to new threats or to exploit enemy weakness.

Address to which proposals will be mailed/hand delivered: Refer to 141

279. TITLE: C³I System Design for Cost Effective Use of Fiber Optics

DESCRIPTION: This research would select a few systems programmed, or in development, and propose cost effective use of fiber optics. Design needs, potential cost savings and capability improvements would be identified. Prototype investment strategy in conjunction with or in support of RADC and small scale component fabrication and testing would also be investigated.

Address to which proposals will be mailed/hand delivered: Refer to 141

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submitting Proposals

The responsibility for carrying out the DARPA SBIR Program is vested in the Program Management Office. The DARPA Coordinator and Manager of the program is Dr. John K. Meson.

DARPA invites the small business community to send proposals directly to DARPA under the following address:

Defense Advanced Research Projects Agency
Program Management Office
ATTN: Dr. John K. Meson
1400 Wilson Boulevard
Arlington, VA 22209

The proposals will be processed in the Program Management Office and distributed to appropriate technical offices for evaluation and action.

DARPA identified 17 technical topics to which the small business can respond. A brief description of each topic is included below.

1. High Resolution Semiconductor Analytical Techniques

Compound semiconductors, such as the GaAs-based III-V alloys, and HgCdTe, potentially will have widespread use in DoD systems. Rapid, high spatial resolution ($\sim < 1$ MICRON) instruments are needed for materials development and quality control purposes if these materials systems are to be developed to maturity suitable for manufacturing purposes. Proposed concepts/approaches should have one or more of the following potential capabilities: (1) Measure lateral alloy uniformity to ± 0.002 mole fraction with a lateral spatial resolution $\sim > 1$ MICRON \times 1 MICRON and depth resolution $\sim < 200\text{\AA}$; (2) Alloy composition vs. depth to ± 0.002 mole fraction with depth resolution $\sim < 50\text{\AA}$ and lateral resolution $\sim < 50$ MICRON \times 50 MICRON; (3) Minority carrier properties (e.g., lifetime and mobility) with spatial resolution similar to those stated in (1) and (2) above. The Proposed techniques should be compatible with commercialization (e.g., not dependent on a fixed major facility), and incorporation and use in an electronics manufacturing environment.

New Microscale characterization techniques which may not meet the spatial resolution goals described above, but would provide novel and unique insight into the nature and properties of compound semiconductor structures, also will be considered. First priority, however, will be given to new techniques which do offer the potential to meet the spatial resolution goals.

2. Military Applications of Conducting Polymers

In the later 1970's, the materials field of conducting and semiconducting organic polymers was opened with discovery of the Prototype material, doped polyacetylene, $(\text{CH})_x$. In broad terms these materials have conceptual applications as classical semiconductor device structures, lightweight wires, electro-magnetic shielding, transparent conducting coatings, batteries, and perhaps optical fibers. While the stability and other Properties of $(\text{CH})_x$ initially precluded "real world" use of conducting $(\text{CH})_x$ in these applications, subsequent development of other much more robust conducting polymers (as well as advances in $(\text{CH})_x$ itself) suggest that these materials now deserve detailed consideration for applications to military systems and problems. This task seeks to identify and develop specific concepts for the application of conducting polymers in military systems. Proposals must elucidate clearly and concisely the potential advantages of using conducting polymer materials compared to any presently used material, and/or elucidate a unique system capability which will result. Polymers which exhibit electronic or ionic conduction are of interest. Proposals which comprise largely of research and characterization of potential new conducting polymer systems will not be considered in this task.

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3. High Power Density Electro-Chemical Energy Sources

Many military systems would benefit greatly from electro-chemical power sources that are well beyond the Present state-of-the-art in power density and that have one or more other unique properties; e.g., minimal volume or weight and/or conformability. Examples include man portable systems, undersea vehicles and space systems. While the theoretical bounds on power density are well defined by thermodynamic and physical properties, the degree to which one can approach the theoretical bounds is determined by constraints imposed by electrodes and packaging ("container") materials and design. This task seeks innovative concepts for materials and package design which will make possible a substantial advance in the power density of fieldable electro-chemical power sources. Here an electro-chemical power source can mean a battery or a fuel cell; also, both primary and secondary power sources are of interest. The ultimate goal is a power density of 400 watts/kg in a fully packaged power source. While the task goal is stated in terms of power density (watts/kg), concepts which might lead to other unique attributes (watts/cm³, conformability, etc.) or unique combination of such properties also will be considered.

4. Electro-Optic Techniques for VLSI Interconnect

A major limitation to achieving significant speed increases in VLSI lies in the metallic interconnects. They are costly not only from the charge transport standpoint but also from capacitive loading effects. The Department of Defense, in pursuit of the fifth generation supercomputer, will be investigating alternatives to the VLSI metallic interconnects, especially the use of optical techniques to transport the information either inter- or intrachip. Interests include such areas as source and detector integration onto a VLSI chip, the optical control of integrated electronic devices, optical switching elements, reconfigurable optical channels, and all-optical generalized crossbar switching networks.

Guided channels may be considered for intrachip interconnects, but the advantages of unguided optical channels should play a major role in solving interchip and interprocessor communications. Once the electronic signals have been converted to optical signals, optical imaging and holography may be used to guide the optical beam to its destination which would likely be a photo-detector to another chip. One may go so far as to envision reprogrammable interconnects employing the optical phenomena of four-wave mixing. The bottom line in realizing opto-electronic interconnects is a need for research into nonlinear optics because it is the nonlinear aspect of optics that lies at the root of many of the desired operations -- from integrated light sources, through optical switched and reconfigurable channels, to four-wave mixing. Consideration will be given to proposed studies into nonlinear optical materials, new device concepts, optical/electronic integration schemes, and interconnect architecture.

5. Lightweight Robot Manipulator Technologies

There is a need for robotic arms and end effectors which are lightweight, fast and accurate. This new generation of robots will probably be constructed from carbon-reinforced epoxy, metal matrix composites, or non-rigid metallic frame. Target performance characteristics are as follows: accuracy ± 200 micrometers; speed - 3 to 5 meters per second; and carrying capacity - 100 kilograms. Other desirable innovations include non-linkage design with continuous degrees of freedom and lightweight direct drive actuators with distributed power.

6. Air Deployed Fiber Optic Cable Flat Winder

A number of government agencies, including DARPA, have been developing the techniques for rapid deployment of fiber optic cable from aircraft and missiles for guidance, telecommunications and sensor applications. The fiber optic cables used in these applications normally consist of a low-loss fiber, a buffered jacket, and a strength member applied around the jacket. The strength member would typically consist of a Kevlar/epoxy matrix or S-glass compound. The cable is usually less than one tenth of an inch in diameter, may be from 8 km to 50 km in length and is precision wound on a cylindrical or truncated conical mandrel. Two methods of deployment are in use: the outside wind, where the cable is peeled off the mandrel in reverse order to which it was wound, and the inside wind, where the mandrel is removed and the cable is peeled from the inside of the now rigid winding. While both techniques have particular advantages for various applications, a third method, pancake wind, is postulated to have distinct advantages for both high and low speed payouts. In pancake wind, instead of building a cable pack by laying successively larger cylinders of cable on top of the other (like thread on a spool), the layers are built up as flat discs which are stacked one after the other (not unlike a stack of phonograph record, or, yes, pancakes). The winding sequence would begin by winding the first layer on a spiral pattern, inside an upright cylindrical tank, say inside to out. When this layer was finished, the next layer would be wound, outside to in, and so forth, in alternating, flat disc layers. When deployed, the cable would be peeled off the flat face of the cylinder. This payout method would appear to have less chance of hockling, more even peel-point stress, and greater flexibility in combining cable packs.

To our knowledge, unfortunately, such a flat winder does not exist. The purpose of this effort would be to develop or adapt such a winding machine, and wind fiber optic cable (government supplied) using a variety of glue and matrix compounds. The resulting packs would be tested on a government high-speed payout testing device to verify adequate performance.

7. Distributed RF Sensor Systems For Battle Group Defense

In light of the growing cruise missile threat posed by both air- and submarine-launched weapons to naval carrier battle groups and surface action groups, there is a substantial need for early warning and perimeter defense against sea-skimming missiles that may appear at any azimuth. Given present number limitations on surface ship and air assets, a potential solution to this problem may lie in the use of a distributed network of remote, offboard sensors capable of air threat detection by electromagnetic means, such as passive electronic support measures (ESM), active or semi-active radar, including monostatic or multistatic approaches, or some adjunct to planned Over-the-Horizon Radar (OTHR) systems. An important element of such an approach would be a system architecture/command and control concept that would provide for deployment, position determination, and control of the sensor net, as well as data processing and display, target tracking, and fusion of the resulting output with the conventional surveillance product. New approaches are sought to solve the surveillance problem described above. It is anticipated that investigation of candidate systems would be pursued in two phases:

- (1) Conceptual system formulation and design with theoretical and analytical feasibility estimates derived from the existing knowledge base and relevant experimental data. Required critical experiments and technology developments needed to validate the concept would be identified.
- (2) Given a favorable outcome in the first phase, the second phase would support fabrication of prototype equipment sufficient for demonstrating the concept in limited at-sea experiments and bringing it to a maturity adequate to support further development decisions.

8. Advanced Technology Decision Aid For The Land Combat Commander

The land combat commander in a combined arms battlefield has an extremely complex task to perform. This task will become incalculably complex in a high intensity, rapidly mobile, diverse characteristic battlefield. Some of the time and labor intensive functions which the commander must perform include: mission, terrain analysis, weapons emplacement, enemy actions and likely future actions, force structure integrity, future force capability and support requirements, potential of additional resources, alternative concepts of operation, integration of sensor derived information. Many of these efforts have been simulated for training purposes. What is needed is technology to support the operational commander using 1985-87 generation off-the-shelf pocket computing power. Concepts which can provide user-friendly decision aid capability as outlined above are solicited.

9. Passive Low Cost Identification Friend Or Foe (IFF) For Land Combat Systems

Immediate, passive, non-cooperative identification and recognition of battlefield elements remains a critical component of the high intensity mobile battlefield. As it is a recognized problem in defense against high performance aircraft, it is also a serious problem with respect to nap of earth helicopters and combat vehicles. The worst case situation may be the need to provide positive IFF against a force which has common hardware components to that of the friendly fighting force. Concepts and technologies which may address some or all of the above problem definition are solicited.

10. Armor Combat Vehicle Technology For Defeat Of Advanced Anti-Vehicle Munitions

Future armored combat vehicles may be attacked by munitions which span a wide range of delivery velocities and which present to the target armor a range of lethality mechanisms including chemical energy shaped charges, kinetic energy penetrators and packaged combinations of lethal momentum and energy. What is desired is to identify promising concepts and technologies which, from the perspective of the target armor, passively (or very short range active) detect the imminence of a defeating munition and implement an action which deflects, destroys, or neutralizes the munition prior to the time that such munition can be effective. The concepts and/or technology should apply to a wide range, of all of the attacking velocities and lethality mechanisms.

11. Improved Accuracy for Munition Projectiles

Munition projectiles achieve a degree of dispersion when fired from their launchers and as a result of their flight characteristics. One technological means for solving this problem is to incorporate a terminal guidance system into the projectile. This approach is feasible but expensive. Another perhaps much more economical approach is to eliminate these sources of dispersion through other means than terminal guidance.

New approaches that offer economical, reliable means for eliminating the sources of dispersion of either conventional or nuclear rounds are sought. Candidate proposals should include a description of the concept, a preliminary estimate of the production cost of the envisioned system, an initial discussion of the accuracies achievable, and a detailed discussion of the technological issues which must be solved.

12. Robotic Devices For Crew-Served Weapons

The manning of defensive lines and perimeters, such as the Forward Line of Troops (FLOT) and installation perimeter guards, is a fundamental requirement of combat. However, the combat units called upon to perform these tasks invariably operate at levels below their authorized strengths and frequently are assigned areas of responsibility larger than is considered doctrinally sound. This combination results in defensive positions being spread too far apart or the creation of dangerously large gaps between units. Either condition allows for rapid penetration and defeat of the defending unit, localized collapse of the front, or destruction of key headquarters or facilities.

A possible solution to this problem is the use of remotely-controlled, limited-purpose robotic devices which occupy unmanned defensive positions and fire a weapon upon command. Design plans for any of three such devices are sought. The first device must be capable of firing and adjusting the flight path of a wire-guided anti-tank missile, and reloading the launcher. Tracking of the missile would be accomplished by a soldier remotely located who would man a control that is connected fiber-optically to several launchers. The second and third devices must be capable of firing while traversing (laterally and in depth), reloading, and correcting basic jamming conditions for a machine gun mounted on a stable platform (such as a tripod) and for an automatic grenade launcher, respectively. All robots must be capable of receiving fire/cease fire commands from the remotely located control site.

The desired product must include detailed designs of both the robotic and the control devices, specific modifications required (if any) for applicable weapon systems currently fielded or under development, and cost estimates in 1984 dollars for producing a working demonstration model. Follow-on-support for fabrication of a demonstration system will be considered for promising designs.

13. Lightweight Hypervelocity Gun for Anti-Armor and Air-Defense Weapons

Very high velocity projectiles have the potential of greatly increasing the lethality of anti-tank and anti-aircraft gun systems. Current solid propellant gun systems can usually achieve muzzle velocities in the 4000 to 5500 ft/sec range. Muzzle velocities in the 7,000-10,000 ft/sec or higher velocity range have been achieved in very bulky, complex, two-stage, "light-gas" guns and Electromotive Launchers (EM-GUNS). The development of a practical, lightweight, two-stage "light-gas" gun could significantly alter the capabilities of current anti-aircraft gun systems in the 20 MM to 40 MM class. The objective of this project is to develop a compact, practical, two-stage light-gas gun, using conventional cannon propellant as its energy source and obtaining high performance with a helium or hydrogen gas second stage. This effort should be targeting toward the development of a small caliber (20 MM to 40 MM), high rate of fire weapon for air defense or defense of ships against sea-skimming

or diving high velocity missiles and should demonstrate muzzle velocities in the 7,000 to 10,000 ft/sec range. This two-stage light gas gun would greatly improve probability of hit against all targets (maneuvering and non-maneuvering) and greatly enhance lethality and range as compared to currently fielded solid propellant guns.

14. Visual Models for Computer Graphics

Advances in computer graphics hardware have opened new opportunities for portraying complex processes, data, and spatial relationships in new and interesting forms. Computer graphics machines will increasingly be able to render complex pictures in real or near real time. These pictures can be of three dimensional spaces, for example the interiors of a building; they can show the interactions of several variables in complex dynamic processes, such as the aerodynamic forces on an airfoil; or they might present an interpretation of data, as in a graphic portrayal of the risk of a certain action given data collected about that action. While there are conventional techniques for graphically illustrating each of these, some not using computers at all, it is believed that the increased power of the next generation of graphics computers will stimulate many innovative approaches to portraying these and similar types of information.

It is the intention of this research initiative to stimulate novel, unique applications of computer graphics for conveying information. No constraint on the topic matter is implied, as creative ideas might come from medicine, business, aerospace, the research sciences, or architecture, as examples. Special emphasis should be placed on applications that increase the natural transfer of information to the observer, that is, where complex information is presented in such a way that only the minimum amount of cognitive processing by the observer is needed to interpret the graphic presentation. For some applications, certain graphic attributes or features could contribute to this by using special effects, stylization, abstraction, surrealism, exaggeration, and so forth, if the result is a rendering that is rich in information transfer.

As this effort is visual in nature, proposals should include illustrations representative of the approach being proposed. Proposals for dynamic processes should try to show key ideas with sequences of illustrations. While ultimately the most promising ideas will be implemented on computer graphics systems, the products of the initial research do not necessarily have to be demonstrated on such systems, although it is desirable.

15. Precision Diamond Tools

Improved precision diamond tools are required to support the machining of large optical surfaces with the DARPA-developed Large Optics Diamond Turning Machine (LODTM). Tools are required where crystal orientation, edge perfection, mounting in tool holder, etc. to levels consistent with optical

tolerances. At present, the quality of an optical surface produced in a diamond turning machine is largely dependent upon the microscopic quality of the single crystal diamond tool used in the process. The optical engineer performs expensive sorting activities to identify the few diamonds that meet his requirements. Two distinct problems are present: the perfection or sharpness of the cutting edge and the geometry or roundness of the tool edge. The best sharpness, which determines the "roughness" of the surface being machined on a microscale, is achieved by skillful sorting of the diamonds used for the tools followed by careful lapping to achieve a very fine finish with minimum imperfections. The tool roundness affects the perfection of the depth of cut as different parts of the tool edge are presented to the surface during machining. Roundness can be controlled by careful jiggling, perhaps using air bearings, during the lapping process. In each case, advances in technique and innovative approaches are needed to produce better diamond tools and to produce them more consistently than is possible today.

16. Lightweight Flexible Waterproof Slide Closure

A lightweight flexible waterproof closure which will withstand two atmospheres pressure and can be incorporated in an outer garment or diving suit is required in the Special Operations arena. This item needs to be long-lived, and capable of repeated opening and closing without loss of waterproof quality.

17. New Techniques Applicable to Bio-Chemical Technology

The Advanced Bio-Chemical Technology Program develops and exploits the physical and chemical properties of both naturally occurring and genetically or synthetically modifiable biological materials to enhance the performance of man-made devices and systems. Current interest focuses on exploring/exploiting the piezo-, pyro-, and ferro-electric properties of biopolymers; developing improved methods for both cell fusion and in-vitro hybridization; and enhancing techniques for the cloning of genes for physiological receptors sites and developing methods for the reconstitution of such sites on stable artificial membranes.

SUBMITTING PROPOSALS ON DEFENSE NUCLEAR
AGENCY TOPICS

The Defense Nuclear Agency is seeking Small Business firms with a strong research and development capability and experience in nuclear weapons effects and nuclear weapons phenomenology areas. Proposals should be submitted to:

Headquarters
Defense Nuclear Agency
ATTN: OAAM/SBIR
Washington, DC 20305

Handcarried proposals should be submitted to:

Headquarters
Defense Nuclear Agency
ATTN: OAAM/SBIR
6801 Telegraph Road
Alexandria, VA 22310

Questions concerning the research topics should be submitted to:

LtCol John Keane
(202) 325-7300

The research categories proposed for study under this program are:

1. Nuclear Weapons Effects.
2. Nuclear Effects Simulation.
3. Instrumentation.
4. Directed Energy Effects.
5. Nuclear Hardening and Survivability.
6. Security of Nuclear Weapons.
7. Operational Planning.
8. Nuclear Weapons Policy Issues.

These topics are further explained below.

Additional information beyond that provided herein may be obtained by request from the address given above.

1. TITLE: Nuclear Weapon Effects

DESCRIPTION: Exploratory Development: Nuclear weapons effects include air blast, thermal, ground shock, water shock, cratering, personnel, and dynamic loading. Of particular interest is the response of materials, structures, and systems to these nuclear weapons effects. Materials of interest include metals, ceramics and composites. Any new material capable of being used as a structural member is of particular concern for aircraft, missiles, ships (both surface and subsurface) and military vehicles. The response of underground structures, such as missile silos, command and control facilities and communications facilities are especially important. Also of interest are transient and permanent radiation effects on new types of electronics and sensors. Concepts and techniques which will improve the survivability (decrease the response) of systems to these nuclear weapons effects are required.

2. TITLE: Nuclear Effects Simulation

DESCRIPTION: Exploratory Development: International treaties preclude the testing of nuclear weapons in the atmosphere and hence we are unable to test military systems in an actual nuclear environment. To compensate for this, other test techniques are used to simulate the effects of the nuclear detonation. Nuclear weapons effects simulation includes: high explosive testing to simulate the mechanical effects, EMP simulation, thermal radiation simulation, and nuclear radiation simulation. Simulation techniques should be as realistic as possible, relatively inexpensive to perform and comparable to the threat environment. Improvements to nuclear simulations are required to address their possible use in a training and/or operational sense for combat troops. An extensive program currently exists for all areas of simulation and one should become familiar with those to see how they can be improved and/or combined in order to make the total process more realistic and more representative of the actual nuclear weapons effect being studied. Both destructive and non-destructive test methods are desired.

3. TITLE: Instrumentation

DESCRIPTION: Exploratory Development: Instrumentation is used for measuring nuclear weapons effects and phenomenology parameters and the response of test items exposed to these weapons effects. The instrumentation should be capable of operating under very harsh conditions, such as might be encountered in an underground nuclear test, a high explosive test, or test involving high levels of x-ray, gamma, or neutron radiation. The instrumentation should, for the most part, be survivable and include recording, data transmission and data analysis capabilities. Concepts are required for new instrumentation utilizing state of the art technology which will result in improved data collection with better accuracy at lower cost.

4. TITLE: Directed Energy Effects

DESCRIPTION: Research: The effects of directed energy (e.g., lasers) sources on materials, structures and systems are of interest. Of particular interest is the establishment of the correlation between nuclear weapons effects and directed energy effects, the identification of

materials which are capable of withstanding both nuclear weapons effects and directed energy effects, and mechanisms by which the directed energy effects actually interact with target materials/structures.

5. TITLE: Nuclear Hardening and Survivability

DESCRIPTION: Engineering Development: Techniques for nuclear hardening and survivability of systems/structures against nuclear weapons effects and, where compatible, directed energy effects are required. These techniques should protect the structure or system against the combined effects of blast, thermal and nuclear radiation in the cases of structures or materials, and should also provide protection against electromagnetic and radiation effects wherever any electronic capabilities are involved. In particular, the ability to harden communications facilities and surveillance sensors against electromagnetic pulses is required.

6. TITLE: Security of Nuclear Weapons

DESCRIPTION: Exploratory Development: Measures to improve the security of nuclear weapons against all possible threats are required. This includes the design of security features both for the actual weapons and for the facilities in which weapons are either stored or transported. These security measures should protect against all known or predicted threats and should be done in such a way as to avoid making the protected item visible as a target.

7. TITLE: Operational Planning

DESCRIPTION: Research: The nuclear employment planning capabilities of operational commanders in tactical, strategic and integrated warfare environments should be improved. Improvements desired include development of automated planning systems, techniques to determine target damage objective and criteria, post strike target damage assessment capabilities, and automated nuclear weapon employment codes.

8. TITLE: Nuclear Weapons Policy Issues

DESCRIPTION: Research: All aspects of policies relating to nuclear weapons are under constant scrutiny. These include considerations of employment, stationing, proliferation, third country use, etc. Studies are required which address these factors in various conflict scenarios and their affect on strategy, deterrence, and alternate employment concepts.

TO: SBIR Proposers

To prepare better informed proposals addressing any of the topics presented in this DoD SBIR Program solicitation, you may request bibliographies of technical reports produced by prior DoD-funded R&D projects related to appropriate topics; bibliographies will include references to other sources of related information. Additionally, you will receive, if available, information about related DoD-funded R&D projects in progress. You may also request a copy of any of the technical reports you select from the bibliographies.

DTIC authorization to provide this service expires 12 January 1984, the DoD SBIR Program Solicitation 84.1 closing date.

Please use the request form below; fold, staple, stamp and mail it back to us. Type or print legibly complete and accurate information. Be sure to indicate in the space provided that your firm qualifies as discussed in Section 2.0 of this solicitation document.

SMALL BUSINESS INNOVATION RESEARCH PROGRAM REQUEST FOR DTIC'S SERVICES

REQUESTER NAME/ADDRESS _____

NAME TITLE/POSITION

ORGANIZATION NAME

ADDRESS

CITY, STATE ZIP CODE Area Code / -

TELEPHONE NUMBER

Please send technical report bibliographies and other information on the following DoD SBIR solicitation R&D topics:

<u>DoD COMPONENT</u>	<u>TOPIC NO.</u>	PLEASE TYPE	<u>DoD COMPONENT</u>	<u>TOPIC NO.</u>
		OR PRINT		

Company status: I confirm that the small business concern identified above meets the SBIR qualification criteria presented in Section 2.2 of the DoD SBIR Program Solicitation No. 84.1.

Signature of Requester

STAPLE HERE

RETURN ADDRESS

PLACE
STAMP
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Defense Technical Information Center
ATTN: SBIR
Cameron Station
Alexandria, VA 22314

FOLD ON DOTTED LINE

Reference B

TO :
(Fill in firm's
name and mailing
address)

SUBJECT : SBIR Solicitation No. 84.1
(Fill in topic Topic No. _____
No.)

This is to notify you that your proposal in response to the subject
solicitation and topic number has been received by _____
(Fill in name of
organization to which you will send your proposal.)

(Signature by receiving organization) (Date)

Reference C

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(617) 451-4109
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