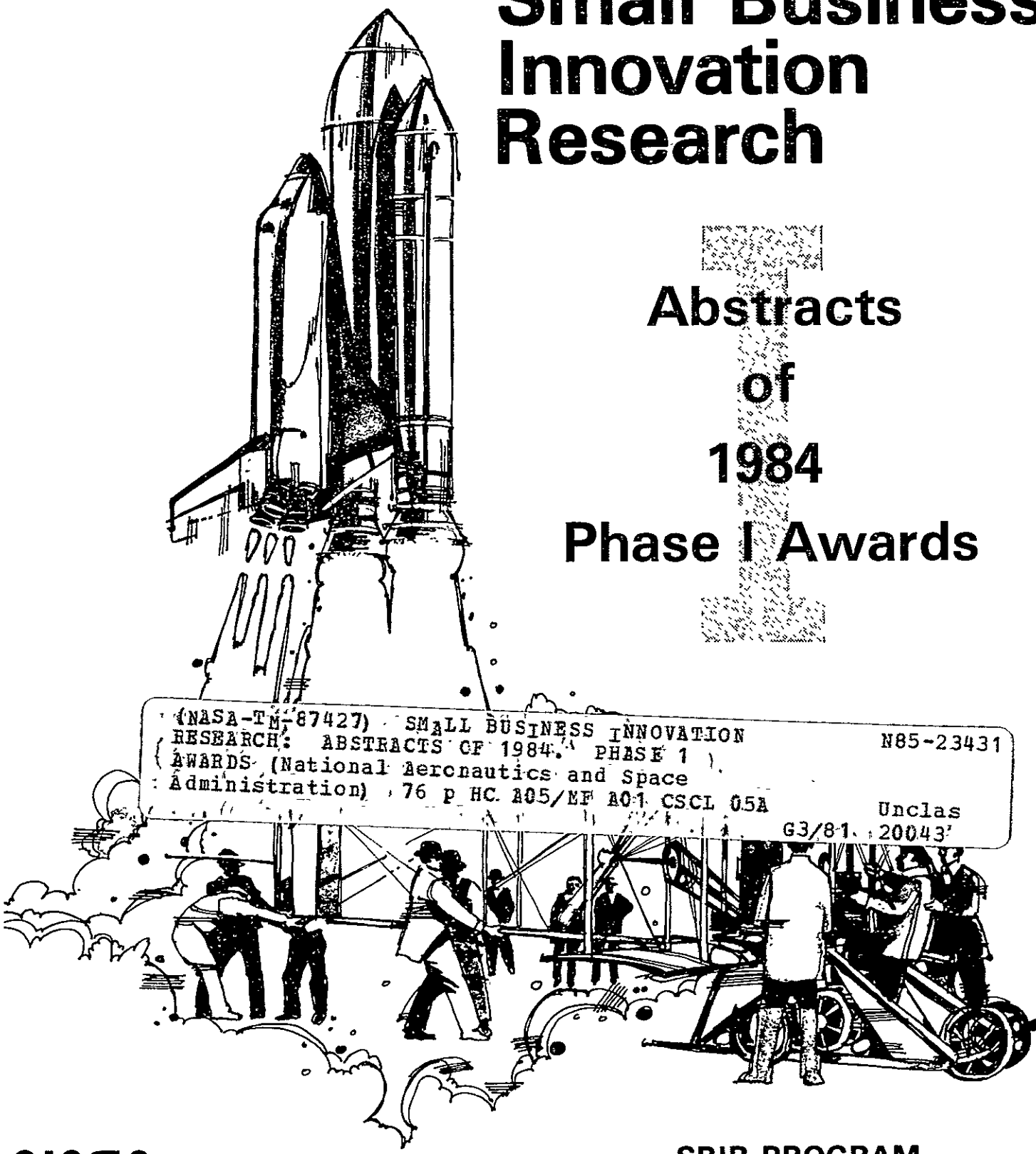
Small Business Innovation Research

Abstracts of 1984 Phase I Awards



NASA

January 1985

SBIR PROGRAM
WASHINGTON, D.C.
20546

TABLE OF CONTENTS

SUMMARY

On September 27, 1984, the National Aeronautics and Space Administration announced the selection of Phase I projects for the Small Business Innovation Research Program These awards resulted from the evaluation of proposals submitted in response to the 1984 Program Solicitation, SBIR 84-1 In order to make available information on the technical content of the Phase I projects supported by the NASA SBIR Program, this report presents the abstracts of those proposals which have resulted in awards of contracts In addition, the name and address of the firm performing the work are given for those who may desired additional information about the project

INTRODUCTION

On July 22, 1982, the Small Business Innovation Development Act of 1982 (15 U S C 638, P.L. 97-219) was enacted. The Act requires certain federal agencies, including NASA, to establish Small Buisness Innovation Research (SBIR) programs by reserving a statutory percentage of their extramural research and development budgets to be awarded to small business concerns for research and research and development on innovations. The purpose of the Small Business Innovation Development Act is to stimulate technological innovation; encourage small firms with expertise in science and high technology to participate in government research, and provide incentive for the conversion of research results into commercial applications

The Act defines a uniform process for implementing SBIR programs but gives each agency the authority and responsibility for conducting its program to best meet its needs. Each agency publishes, at least once a year, a solicitation that describes its research and development needs in the context of the SBIR program and requests proposals from small, high technology businesses These proposals should represent the first phase of a three-phase program as defined under this Act.

The three phases of the SBIR program are defined as.

Phase I: The majority of awards will be $50,000 or less for research projects to evaluate the scientific and technical merit and feasibility of an idea.

Phase II· As a result of Phase I, funding for those projects with the most potential will be continued. The majority of Phase II awards will be for $500,000 or less and will further develop the innovation Only Phase I contractors are eligible to complete for Phase II awards.

Phase III: Private-sector investment and support for any neces- sary development that will bring an innovation to the marketplace. Also under Phase III, federal agencies may award non-SBIR-funded follow-on contracts for products or processes meeting the mission needs of those agencies.

In April of 1984, NASA issued its second SBIR program solicitation, SBIR 84-1, requesting innovative ideas and Phase I proposals NASA accepted proposals through June 6, 1984 Evaluation and ranking of proposals by the NASA staff followed receipt of proposals leading to the announcement of those selected for award in September of 1984. As a result of this process, 105 small business firms were placed under contract by NASA Centers having cognizance over the technical area of work.

Presentation of the technical abstracts which describe the nature of these projects is the main purpose of this report. Proprietary information is not provided in these abstracts; therefore, technical details may be missing. For this reason, this report supplies the names of individuals in these small business firms who may be contacted should more information be needed on a specific project It also identifies the cognizant NASA Center for each project Several indexes are also provided to permit ready access to the information contained in this report.

TECHNICAL TOPICS

One key to the success of an SBIR program is the identification and description of technical topics which would attract the interest of small business firms and which are important to the mission and goals of the agency. In general terms, NASA plans, directs, and conducts civil research and development in both space and aeronautics. In space, NASA's goals are to develop technology to make operations more effective, to enlarge the range of practical applications of space technology and data, and to investigate the Earth and its immediate surroundings, the natural bodies in our solar system, and the origins and physical processes of the universe. In aeronautics, NASA seeks to improve aerodynamics, structures, engines, and overall performance to aircraft, to make them more efficient, more compatible with the environment, and safer.

The achievement of these goals involves a wide range of technical disciplines, a fact well represented by the 1984 NASA program solicitation, SBIR 84-1 That solicitation contained 157 subtopics which were organized into 15 technical topics. The technical topics (SBIR 84-1) are:

01. Aeronautical Propulsion and Power
02. Aerodynamics and Acoustics
03 Aircraft Systems, Subsystems, and Operations
04. Materials and Structures
05. Teleoperators and Robotics
06. Computer Sciences and Applications
07. Information Systems and Data Handling
08. Instrumentation and Sensors
09. Spacecraft Systems and Subsystems
10. Space Power
11. Space Propulsion
12. Human Habitability and Biology in Space
13. Quality Assurance, Safety, and Check-Out for Ground and Space Operations
14 Satellite Communications
15. Materials Processing, Micro-Gravity and Commercial Applications in Space

It can be observed that certain topics support aeronautics goals while others support goals in space systems technology. A number of topics, 04, 06, 07, and 08, apply to both aeronautics and space.

NASA required that proposals be directed to a specific subtopic within a technical topic in order to assure responsiveness to NASA needs Future solicitations will contain technical topics and subtopics reflecting changing Agency interests.

REVIEW AND EVALUATION OF PHASE I PROPOSALS

Phase I proposals were judged on a competitive basis in several steps All were screened to ensure that they meet stated solicitation requirements Proposals were then reviewed to determine whether they responded to the subtopic chosen by the proposer. Those found to be responsive were then evaluated by scientists or engineers knowledgeable in the topic area, using the criteria listed below Selections were made by NASA based on those evaluations and consideration of such other factors as possible duplication of other research, program balance, and the availability of funds.

The evaluation criteria applied to Phase I proposals were

1. The scientific/technical quality of the Phase I research proposal and its relevance to the proposal's stated objectives, 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, technical and/or economic, including potential for commercial applications, of the proposed research (Phase I and Phase II), if successful
4 Adequacy of the proposed work plan to show progress toward meeting the objectives of the Phase I effort

Reviewers based their conclusions only on information contained in the proposal.

PHASE II OF SBIR

Only Phase I awardees have the option of proposing for a Phase II continuation of their work in the SBIR program. Expected funding levels may permit approximately one-third of the Phase I projects to proceed into Phase II

Evaluation of proposals for Phase II will consider their technical and scientific merit and feasibility; the results of the Phase I work; the eventual value of the product process, or technology to the mission of NASA; the validity of the project plans for achieving stated goals; the ability of the project team; and the availability of required equipment and facilities.

For proposals of approximately equivalent merit judged according to the criteria listed above, NASA will give special consideration to Phase II proposals providing a contingent commitment for follow-on funding from non-federal sources. The commitment must provide that a specific amount of Phase III funding will be made to or by the small business and indicate the date the funds will be made available. The proposal must also contain any specific technical objectives upon which the funding commitment has been made contingent by its provider. The form of the commitment must be satisfactory to NASA to receive extra consideration. The terms of the funding commitment cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The commitment shall be submitted with the Phase II proposal In addition, the making of awards for Phase II will consider any special programmatic or schedule needs of NASA and, of course, the availability of funds.

ABSTRACTS OF AWARDS

The abstracts of the Phase I awards in the NASA SBIR program are listed under the technical topics identified in the solicitation (SBIR 84-1) They are identified by a proposal number in which the first four digits are the subtopic number. The listing also contains the contract number for each award and identifies the cognizant NASA Center The following descriptors for the Centers are employed:

ARC	Ames Research Center Moffett Field, CA 94035
GSFC	Goddard Space Flight Center Greenbelt, MD 20771
JPL	Jet Propulsion Laboratory Pasadena, CA 91109
JSC	Lyndon B. Johnson Space Center Houston, TX 77058
KSC	John F. Kennedy Space Center Kennedy Space Center, FL 32899
LARC	Langley Research Center Hampton, VA 23665
LERC	Lewis Research Center Cleveland, OH 44135
MSFC	George C. Marshall Space Flight Center Marshall Space Flight Center, AL 35812

A number of cross indexes are provided These are alphabetical lists of companies and principal investigators, awards by state, and awards at each Center.

NASA SBIR 84-I AWARDS

TOPIC 01. AERONAUTICAL PROPULSION AND POWER

Proposal Number: 01.01 0511A
Project Title: **Computation of the Tip Vortex Flow Field for Advanced Propellers**

Company: SCIENTIFIC RESEARCH ASSOCIATES, INC
P.O. BOX 498
GLASTONBURY, CT 06033

Principal Investigator: LEVY, RALPH

Contract Number. NAS3-24532 Amount. $49,763 NASA Center: LERC

Abstract. The blade tip vortex flow field has a significant impact on the aerodynamic performance and acoustic characteristics of aircraft propellers This project involves computation of tip vortex generation process for advanced propellers using a forward maching procedure The procedure would be used to compute compressible high subsonic, high Reynolds number turbulent flow field encountered in advanced propellers For this purpose, an existing computer code will be extended to compute the tip vortex generation process for compressible high subsonic turbulent flows A computation will be carried out to demonstrate the feasibility of computing the tip vortex flow field for advanced propellers. A subsequent Phase II effort will extend the method to actual propeller geometries The predictive procedure would be assessed against available data. Application of this viscous, three-dimensional procedure would present a new and promising approach to the problem of advanced propeller design flow fields.

Proposal Number 01 01 8500
Project Title **Optimized Aerodynamic Design for Advanced Turboprop**

Company: FLOW INDUSTRIES, INC
21414 68TH AVENUE SOUTH
KENT, WA 98032

Principal Investigator: JOU, WEN-HUEI

Contract Number. NAS3-24533 Amount $49,750 NASA Center: LERC

Abstract: In recent years, the turboprop propulsion system has received increasing interest due to the substantial savings that can be achieved in fuel consumption. Substantial resources have been invested in developing new technologies for aerodynamic design, aeroacoustic performance, aerodynamic structural design, power generation and power transmission. In propeller design, prediction codes are available to assist design engineers However, optimization of the design requires manual manipulation of the propeller configuration guided by experience and intuition. This project addresses an automated aerodynamic design code by combining a prediction code and a numerical optimization procedure Phase I will demonstrate the feasibility of the design procedure by optimizing the twist distribution of the blades Aerodynamic efficiency of the propeller will be chosen as the objective function in this phase of the study In Phase II, the capabilities of the code will be enhanced according to the needs of NASA and the aerospace industry. Multiple parameter optimization, including blade sweep and chord distribution, can be incorporated Beyond the scope of the Phase II work, it is possible to select other objective functions such as the level of acoustic noise. An acoustic analysis code will be needed for this purpose

Proposal Number: 01.02 7070
Project Title: **Turbulent Mixing of Gases in a Simulated Combustor**

Company: AEROCHEM RESEARCH LABORATORIES, INC.
P O BOX 12
PRINCETON, NJ 08542

Principal Investigator BERMAN, CHARLES H

Contract Number: NAS3-24534 Amount. $49,925 NASA Center. LERC

Abstract. This program is directed at experimentally increasing the understanding of the complex turbulent flow field mixing processes that occur in jet engine combustors. The major technical objectives are to design, construct, and operate a simulated combustor to obtain data on room temperature gas mixing. The degree of mixing will be found instantaneously from light detected from a laser photolysis/chemiluminescence process applied to small concentrations of nitric oxide and nitrogen dioxide used as tracers of neutral background gas motion. This technique has been previously used in both open and closed flow facilities Instantaneous velocity will be measured using split-film anemometer probes. An important goal is to obtain detailed measurements of the flow properties, in particular, the combustion chamber turbulent inflow characteristics, needed by numerical modelers to properly define a problem.

Proposal Number. 01 03 5052
Project Title: **Adiabatic Wankel Type Rotary Engines**

Company: ADIABATICS, INC
630 SOUTH MAPLETON
COLUMBUS, IN 47201

Principal Investigator. KAMO, ROY

Contract Number NAS3-24535 Amount. $49,965 NASA Center: LERC

Abstract: A considerable amount of R&D work has been done for the Wankel rotary engine application to automobiles, planes, etc resulting in significant progress. The performance, reliability and durability that the Wankel has demonstrated, however, falls short of the popular diesel engine The adiabatic, turbocompound concept that has been demonstrated for the diesel is thought to be more beneficial to the rotary engine Phase I is concerned with an analytical study of an advanced Wankel engine which will incorporate all the essential features of an adiabatic diesel engine. Some of these features include extensive use of ceramic wear coatings, turbocharging and compounding, higher compression ratio and faster combustion.

Proposal Number: 01.03 5444
Project Title: **Rapid Solidification of Low Density Alloys by Melt Overflow**

Company: RIBBON TECHNOLOGY CORPORATION
P.O BOX 30758
825 TAYLOR STATION ROAD
GAHANNA, OH 43230

Principal Investigator: DICKSON, JAMES

Contract Number: NAS1-17978 Amount: $48,662 NASA Center: LARC

Abstract. An evaluation of the combination of melt overflow for light weight, high performance, reactive alloys like aluminum, magnesium, beryllium, and titanium with vacuum induction melting is desired The need exists to demonstrate the benefits of these technique to improve current or develop new alloys for structures in vehicles or high temperature engines. Due to the cost of design engineering and fabrication estimates of

these high technology processing systems, Phase I of this concept is so restricted A Phase II of this program would be prototype fabrication and casting of selected alloys. Using the vacuum induction—displacement melt overflow equipment design on Phase I and fabricated on Phase II of this program, aluminum, magnesium, beryllium and titanium alloys will be cast This system for producing filamentary and foil products directly from molten materials has a very high quench rate and is the rapid-solidification technology most suited to application in deep space or on the moon.

Proposal Number 01.05 1753
Project Title: **A Design Concept for Reducing Dynamic Loads on Spur Gear Teeth**

Company: JAMES G. BOYKO
20 WEST WINKLEY STREET
AMESBURY, MA 01913

Principal Investigator. BOYKO, JAMES G

Contract Number NAS3-24536 Amount $47,065 NASA Center: LERC

Abstract: This project concerns a design concept for reducing the dynamic loads on gear teeth by adding torsional flexibility to the pinion/shaft connection. It is anticipated that this resilient mount will reduce dynamic forces by the following means. First, multiple gears can be secured on a single shaft and equally share the load This increase in face width allows smaller pitch diameters, thus reducing pitch line velocity and also lowering the cost of tooth profile accuracy. Second, the gearset mass is reduced by smaller pitch diameters and the decoupling of the connected masses. The project research goals are to develop a system model to analyze the design, to investigate noise and vibration characteristics, and to provide an economic evaluation to verify the value of this project to the gear industry.

Proposal Number: 01.05 3812
Project Title: **New Perfluoroether Fluids Exhibiting Excellent Oxidative and Thermal Stabilities**

Company: EXFLUOR RESEARCH CORPORATION
P.O. BOX 7807
AUSTIN, TX 78713

Principal Investigator: BIERSCHENK, THOMAS R

Contract Number. NAS3-23896 Amount. $50,000 NASA Center LERC

Abstract: General procedures for preparing low molecular weight perfluoroalkyl ethers have been developed. The fluorinated products, serving as model compounds for higher molecular weight polymers, will be used to determine stability parameters for higher molecular weight polymers. Simple molecules, typically dimethylether derivatives for the basic repeating unit of the polymer of interest, will be synthesized using a variety of techniques One procedure consists of first synthesizing the hydrocarbon analogue of the desired perfluoro compound, followed by replacement of the hydrogen with fluorine using a controlled reaction with elemental fluorine This procedure allows one to prepare fluorocarbon derivatives of essentially any hydrocarbon polymer or molecule. A second but very important general procedure involves fluorination of esters, followed by conversion of the linear perfluoroester to a perfluoroether using SF_4. This technology is especially well suited for preparing highly branched perfluoroethers and perfluoropolyethers as well as ethers containing more than two sequential carbons in the central chain of the ether/polyether Thermal stability studies performed on the model compounds should determine the useful temperature range for the polymers as well as provide mechanistic information concerning the way the various polymers of interest may decompose

Proposal Number: 01 05 8279A
Project Title: **High Energy Tribo-Elements**

Company RAI ASSOCIATES
432 STONEHENGE
ARLINGTON, TX 76014

Principal Investigator. IVERSON, ROGER

Contract Number: NAS3-24537 Amount $41,532 NASA Center: LERC

Abstract. A compact, planetary gear transmission design with low weight-to-horsepower ratio made possible through high energy clutch assemblies, has low impedance flow channels which facilitate rapid circulation of cooling fluid to transport heat away from friction surfaces Surrounding the clutch assemblies is a heat exchanger to transfer heat directly to the atmosphere During operation of the clutches, heat removal without residual heat buildup results in thermally stable operating conditions This operation eliminates the need for torque convertors/fluid couplers and tolerates long duration slippage. The results are a simplified transmission designed for variable speed output and forward/reverse rotation.

Proposal Number: 01 06 0252
Project Title. **Low Weight-to-Horsepower Ratio Electric Drive**

Company HOWLETT AND ASSOCIATES, INC
800 J CEDAR VALLEY
RADFORD, VA 24141

Principal Investigator: HOWLETT, JAMES F.

Contract Number. NAS3-23899 Amount $47,186 NASA Center. LERC

Abstract: This project will develop a high speed, dc brushless, permanent magnet traction motor using Neodymium Boron Iron as the permanent magnet material and an integral single stage planetary gear reduction The magnet material, newly introduced and discussed at the MMM Conference in Pittsburgh in November 1983 and the Intermag Conference in Germany in April 1984, holds the potential for significant size and weight reductions for a given level of output over any other currently available permanent magnet material. Magnetic circuit reductions of 50% below these achievable with $SmCo_5$ appear possible There are critical design areas, however, involving loss of remanence and coercivity with increasing temperature which need to be addressed. In addition to loss of flux, potential susceptibility to demagnetization from cross field magnetic motive force is an area for investigation. Means of thermally insulating the rotating magnet structure in order to minimize potential degradation are part of this project.

TOPIC 02. AERODYNAMICS AND ACOUSTICS

Proposal Number 02.01 0769
Project Title: **Aerothermodynamic Performance of Lifting AOTVs at High Altitudes**

Company VRA, INC
P O BOX 50
BLACKSBURG, VA 24060

Principal Investigator LEWIS, CLARK H

Contract Number NAS2-12102 Amount. $49,946 NASA Center· ARC

Abstract. In order to optimize the application of aeroassist concepts to maneuvering re-entry vehicles, it is essential to have a scheme that can accurately and simultaneously predict the vehicle's aerodynamic forces and moments, as well as the corresponding surface heat-transfer rates Phase I of this effort is intended to develop a fully three-dimensional

nonequilibrium Parabolized Navier-Stokes scheme This scheme will accurately predict the viscous forces and moments around a lifting maneuvering-type vehicle, and will also accurately predict the surface heat-transfer effects by accounting for surface catalysis-effects. Phase II of this effort will extend this scheme to include radiation effects and coupling with six degree-of-freedom trajectory calculations.

Proposal Number: 02.01 3844
Project Title: **Wiener-Hermite Simulation of Turbulence**

Company: DCW INDUSTRIES, INC
5354 PALM DRIVE
LA CANADA, CA 91011

Principal Investigator: WILCOX, DAVID C.

Contract Number: NAS2-12103 Amount: $50,000 NASA Center: ARC

Abstract: The primary objective is to apply the Wiener-Hermite method to statistically homogeneous, anisotropic turbulent flows which are approaching isotropy in the absence of mean shear or strain. The uniqueness of the approach lies in the fact that Reynolds numbers of practical interest will be used, a feat which should be easy to accomplish within the framework of the Wiener-Hermite method. Numerical simulation of three different approach-to-isotropy flowfields is proposed. Detailed comparisons with experimental data will be made to assess accuracy of the Wiener-Hermite expansion. Computations will be accomplished with a modified version of an existing program which embodies the method for isotropic and homogeneous turbulence. As a secondary objective, the feasibility of extending the method to homogeneous, anisotropic turbulence in the presence of uniform shear and/or strain will be assessed. The primary consideration will be establishing the amount of computing time needed for such computations

Proposal Number: 02.01 9457B
Project Title: **Rapid Computation with Nonlinear Numerical Algorithms**

Company: NIELSEN ENGINEERING AND RESEARCH, INC
510 CLYDE AVENUE
MOUNTAIN VIEW, CA 94043

Principal Investigator: KLOPFER, GOETZ H

Contract Number: NAS2-12088 Amount: $49,167 NASA Center. ARC

Abstract: Most of the numerical codes for solving the compressible Navier-Stokes equations or the Euler equations in use today are based on finite difference schemes. Most of these schemes are linear. Nonlinear schemes, however, have more desirable properties such as monotone preserving, increased accuracy, and improved stability. Thus numerical solutions based on the nonlinear schemes avoid the spurious oscillations at shock waves. For linear schemes such as MacCormack's scheme, artificial dissipation is required for stability and to damp out the spurious oscillations. While nonlinear schemes are superior to linear schemes, they are also much more expensive to execute on a computer. Typically, a nonlinear scheme requires about an order of magnitude more computer time than a linear scheme It is this increased cost that has prevented the development and utilization of better nonlinear schemes. This project concerns a program to develop a procedure whereby the execution of a nonlinear scheme can be made just as rapidly and efficiently as for a linear scheme.

Proposal Number: 02.02 0794
Project Title: **Fuselage Shapes for Natural Laminar Flow (NLF)**

Company: VIGYAN RESEARCH ASSOCIATES, INC.
28 RESEARCH DRIVE
HAMPTON, VA 23666

Principal Investigator: VAN DAM, CORNELIS P

Contract Number: NAS1-17926 Amount: $48,866 NASA Center: LARC

Abstract: Excellent opportunities exist for reducing the drag of aircraft by increasing the extent of laminar boundary-layer flow over the configuration Recent technological advances in airplane construction techniques and materials employing bonded and milled aluminum skins and composite materials allow for the production of aerodynamic surfaces without significant roughness and waviness, permitting long runs of natural laminar flow (NLF). Also, improved aerodynamic design and analysis methods facilitate the shaping of airplane surfaces to obtain flow conditions favorable to NLF. A major portion of the research effort for obtaining and maintaining laminar flow on airplane surfaces has focused on the delay of laminar-to-turbulent boundary-layer transition on airplane lifting surfaces Body shaping to increase the extent of laminar flow on airplane fuselages has received much less attention in the literature. A significant reduction in airplane drag can be obtained, however, when NLF is achieved on the fuselage of an airplane. The Phase I objectives are to evaluate the various computational design and analysis methods which can be applied for the development of low-drag aerodynamic fuselage shapes and to address the analytical design of body shapes of several fuselages at free-stream unit Reynolds numbers of 1.5-3 0 million per foot. The most promising configuration(s) will be wind-tunnel and/or flight tested during Phase II

Proposal Number. 02 02 8218A
Project Title. **Multi-Element Natural Laminar Flow (NLF) Airfoils**

Company. ESCON
ENGINEERING AND SCIENCE CONSULTANTS
101 HENRY LEE LANE
GRAFTON, VA 23692

Principal Investigator: VIKEN, JEFFREY K.
Contract Number: NAS1-17949 Amount: $50,000 NASA Center. LARC

Abstract. This project involves a design study and development of a multi-element high Reynolds number NLF airfoil that minimizes the turbulent separation problem at off design conditions. The concept development will utilize an integrated multi-element airfoil system to be designed to form a slot between the upper and lower surface in the turbulent recovery regions. This slot brings higher energy air from the lower surface to re-energize the turbulent boundary layer on the upper surface. Also because of the interaction of the elements formed by this slot, there are added benefits in reducing the onset of turbulent boundary layer separation. The pressure at the trailing edge of the main element is reduced while the maximum velocities on the flap are reduced Both these effects reduce the total pressure rise in the recovery regions. This new NLF airfoil is to be developed iteratively, based on the Viken-Pfenninger NLF(1)-0414F airfoil with 70% chord laminar flow, using potential flow, boundary layer, and laminar flow stability computer codes Emphasis will be made to get extensive laminar flow for as wide a lift range as possible and to get acceptable acceleration thrugh the slot at not only the high climb lift coefficients but also at the low cruise lift coefficients when there is very little pressure difference between the surfaces Laminar boundary layer stability will also be analyzed and the design will account for the effects of Reynolds number change on the airfoil.

Proposal Number: 02 02 8218
Project Title: **Supercritical Laminar Flow Control (LFC) and Hybrid Airfoils**

Company: ESCON
ENGINEERING AND SCIENCE CONSULTANTS
101 HENRY LEE LANE
GRAFTON, VA 23692

Principal Investigator. PFENNINGER, WERNER

Contract Number. NAS1-17950 Amount: $33,694 NASA Center: LARC

Abstract: Supercritical (SC) low drag LFC airfoils with high design Mach numbers offering an increased operating range, wider high speed buffet margins (preferably without boundary layer suction in the region of the spanwise bending material for composite wings) and smaller lift loss with turbulence at intermediate Mach numbers will be developed. Increased CLmax NLF and "hybrid" type SC laminar flow airfoils will also be developed which will include. natural laminar flow with accelerated flow over 50 to 70% chord without boundary layer suction; limited low drag suction in front of upper surface with a front negative pressure peak close to leading edge followed by an extensive flat supersonic pressure distribution to about (⅔) chord; and an additional low drag suction through rear pressure rise zone Furthermore, the investigations will continue into development of LFC and NLF wings laid out for somewhat lower flight speeds without extensive supersonic zones

Proposal Number: 02.02 8500A
Project Title **Generation of an "Artificial" Burst in a Turbulent Boundary Layer**

Company: FLOW INDUSTRIES, INC
RESEARCH AND TECHNOLOGY DIVISION
21414 68TH AVENUE SOUTH
KENT, WA 98032

Principal Investigator GAD-EL-HAK, MOHAMED

Contract Number: NAS1-17930 Amount $49,742 NASA Center: LARC

Abstract: It is generally agreed that the bursting phenomenon is the most significant dynamic event in a turbulent boundary layer About 80% of the momentum transfer occurs during these bursts To reduce viscous drag, the physics and structure of these events must be fully understood However, previous attempts to accomplish this have been frustrated by the fact that bursts occur randomly in time and space. In the present study, artificial generation of a bursting event will be attempted, thus controlling the time and position of its occurrence. The structural details of these bursts will be educed via measurements phase-locked to the artificial excitation. Experiments will be conducted using a zero-pressure gradient boundary layer that develops on a flat plate towed in an 18-m water channel Flow visualization and hot-film measurements will be conducted to educe the topological properties of the artificial bursts. The knowledge developed through this study may provide a conceptual approach to modulating the frequency and strength of natural bursts, thereby reducing drag

Proposal Number. 02.03 5903
Project Title: **Magnetic Suspension and Balance System for Wind Tunnels**

Company: MADISON MAGNETICS INC.
216 WALNUT STREET
MADISON, WI 53705

Principal Investigator BOOM, ROGER W

Contract Number: NAS1-17931 Amount. $50,000 NASA Center LARC

Abstract: This project investigates a superconducting magnet system to suspend airplane and missile models in wind tunnels without mechanical stings. The new opportunity is to achieve more powerful, more compact, less expensive, and more reliable suspension systems. The project objectives are to prepare and evaluate several advanced conceptual systems based on the preliminary work described in report NASA CR 3802. In that report a self-consistent preliminary design of 15 super-conducting coils operated in 4.2K liquid helium is presented for an 8 × 8 ft Mach 0.9 tunnel The advanced conceptual system research and development undertaken here includes such major options as magnet cooling by superfluid or supercritical helium, magnet and dewar and structure design for balance control frequencies other than 10 Hz, and extrapolations to tunnels other than 8 × 8 ft Mach 0.9. The anticipated result is the preliminary development of the best variety of new conceptual superconductive wind tunnel suspension systems and the development of a priority list of the absolute key items which would deserve experimental and theoretical research in Phase II.

Proposal Number: 02 04 0769
Project Title. **Nonequilibrium Flows and Catalytic Surfaces on Spacecraft Reentry**
Company VRA, INC
P.O BOX 50
BLACKSBURG, VA 24060

Principal Investigator LEWIS, CLARK H.

Contract Number: NAS9-17290 Amount $49,993 NASA Center. JSC

Abstract: In recent years the projected design of Advanced Orbital Transfer Vehicles has been evolving very rapidly These vehicles are to operate and decelerate in the low-density (high-altitude) flight regimes where the flowfield is more appropriately that of finite-rate chemically reacting air Apart from these, the flowfield around the Space Shuttle Orbiter also shows significant nonequilibrium effects Furthermore, it has been recently recognized that the surface catalysis plays an important role in the surface heat-transfer of spacecrafts under nonequilibirum flow conditions For these reasons (and more) significant studies are underway to better understand and simulate the nonequilibrium flows around hypersonic reentry vehicles Phase I of the effort will develop an axisymmetric parabolized Navier-Stokes code This will provide an accurate and efficient scheme to aid not only the various developmental studies, but to also provide a tool for the numerous aerothermodynamic design and analysis studies Phase II of this effort will extend this scheme to include vibrational and radiation nonequilibrium effects This will also include close collaboration with NASA and related researchers to develop better and more accurate aerothermochemical models.

Proposal Number: 02 06 4037
Project Title: **Shear Stress Sensor Development Using Surface Acoustic Waves**

Company. RAMAN AERONAUTICS, INC
734 MELVILLE AVENUE
PALO ALTO, CA 94301

Principal Investigator: RAMAN, K R

Contract Number. NAS2-12121 Amount $49,941 NASA Center ARC

Abstract: This project concerns the development of a small, reliable and universally acceptable surface shear stress (or skin friction) sensor for aerodynamic boundary layer research at subsonic to supersonic speed For this effort the surface acoustic wave (SAW) delay-line technique (Phase I) and resonator technique (Phase II) will be explored Deposition of interdigital transducers and bench testing (Phase I) and design of proper enclosure for the SAW element and wind tunnel testing (Phase II) are planned.

Proposal Number: 02.06 8477
Project Title. **A Pulsed Laser Holocamera for Wind Tunnel Testing**

Company: SPECTRON DEVELOPMENT LABS
3303 HARBOR BOULEVARD
SUITE G-3
COSTA MESA, CA 92626

Principal Investigator: TROLINGER, JAMES D.

Contract Number: NAS2-12120 Amount: $49,982 NASA Center. ARC

Abstract: This is a project to develop a pulsed laser which is specially adapted for application in a holocamera for use in wind tunnel testing. The absence of such a laser has severely restricted use of laser holography and photography in this application. Specializing the laser component will provide important advantages and features which have not been previously available

Proposal Number 02.08 8676
Project Title: **Optical Slip-Ring for High-Density-Data Communication Links**

Company: FLOW INDUSTRIES, INC.
AUTOMATION & CONTROLS DIVISION
1835 TERMINAL DRIVE
SUITE 100
RICHLAND, WA 99352

Principal Investigator: REICH, FREDERICH R

Contract Number: NAS1-17951 Amount $50,000 NASA Center: LARC

Abstract: The analysis of aircraft and helicopter propulsion system such as compressors, gas turbines, propellers and rotors requires the use of slip-ring devices to interface with the large arrays of sensing elements on the moving member. The conventional mechanical slip-ring devices are speed, noise, size and life-time limited. The objective of this effort is to develop a high-speed, electro-optic slip ring device that will expand the potential capability for analysis with rotating or moving systems and form the basis for a commercial device. The Phase I task shall demonstrate the feasibility of an optical slip-ring device based on the integration of high-speed electro-optical components with an optical link for data transfer from a rotating shaft. Modular components that form the basic elements of the slip-ring will first be developed and tested (multiplex/demultiplex modules, a high speed modulated source and receiver and a optical link) and then integrated into a laboratory mockup of a rotating shaft system to demonstrate the feasibility of the optical slip-ring concept This data will identify basic components, needs for special compact hybrid circuits, directions for Phase II and application areas for a universal slip-ring device.

TOPIC 03. AIRCRAFT SYSTEMS, SUBSYSTEMS, AND OPERATIONS

Proposal Number: 03.02 8477
Project Title: **Optical Technique: The Impact of Heavy Rain on Aircraft Performance**

Company: SPECTRON DEVELOPMENT LABS
3303 HARBOR BOULEVARD
SUITE G-3
COSTA MESA, CA 92626

Principal Investigator HESS, CECIL F.

Contract Number NAS1-17932 Amount $49,924 NASA Center: LARC

Abstract: The study of the effect of heavy rain on aircraft general performance requires knowledge of the size, velocity, and concentration of the rain drops affecting the aircraft. The program will develop and demonstrate a technique that will be used to obtain such data. The technique bases the measurement on the light scattered by the droplets and will be able to obtain non-intrusively and in real time velocity and size distributions of the droplet population A size range of 0 1 mm to 5 mm will be possible with this technique. Limitations resulting from heavy rain loads will be established and practical size and velocity ranges will be estimated for a given optical configuration.

Proposal Number. 03.03 8293
Project Title: **Expert Systems for Accident Investigations**

Company: APPLIED RESEARCH CONSORTIUM, INC.
7137 STETSON DRIVE
SUITE A
SCOTTSDALE, AZ 85251

Principal Investigator BATES, PETER D

Contract Number· NAS2-12124 Amount. $49,684 NASA Center ARC

Abstract· This project will examine the feasibility of a computer-based system that would emulate an accident investigation supervisor. Systems of this type are a product of artificial intelligence research, and are known collectively as "expert systems' This feasibility analysis will examine: the role of empirically derived (heuristic) decisions and procedures used during accident investigation, the required reasoning (inference) mechanism, human issues pertaining to introduction of an expert system, the mechanisms by which pertinent knowledge is accumulated and changed, the necessity for explanatory facilities, the potential for interface with the NASA Center-Wide Mishap Data Storage System, and a comparison of available delivery systems. The result of this study will be a report addressing each of these concerns, and preliminary specification of the required system(s).

Proposal Number. 03 05 8747
Project Title. **Application of Parameter Extraction at Extreme Angles of Attack**

Company: DEI-TECH, INCORPORATED
703 MIDDLE GROUND BOULEVARD
NEWPORT NEWS, VA 23606

Principal Investigator TAYLOR, ROBERT T

Contract Number NAS1-17933 Amount: $29,992 NASA Center LARC

Abstract· Recent advances in the understanding of flight at post stall conditions have shown a potential maneuvering benefit in allowing quicker more agile turning with an attendant time on target advantage Furthermore, stall and spin recovery has been shown to be made more effective using a company patented, modified horizontal control surface. This project (Phase I) is aimed at developing methods for the extraction of aerodynamic derivatives from flight data at high angles of attack, and includes comparison of the derivatives so determined with wind tunnel derivatives In addition, the work includes an analysis of instrument errors and the propagation of these errors through the derivative extraction process. A Phase II effort would develop high angle of attack maneuvers aimed at the detection of cross derivatives and at acceleration related derivatives These tests will enable an assessment of the need for new ground based facilities and tests as well as manned flight testing requirements for high angle of attack flight Finally, hysteresis effects will be explored at high angles of attack and methods will be proposed for their inclusion in the equations of motion.

Proposal Number: 03.08 9191
Project Title: **Optimal Guidance with Obstacle Avoidance for NOE Flight**

Company: THEORY AND APPLICATIONS UNLIMITED CORPORATION
10 JACKSON STREET
SUITE 101
LOS GATOS, CA 95030

Principal Investigator: DENTON, RICHARD V

Contract Number: NAS2-12092 Amount: $50,000 NASA Center: ARC

Abstract: Nap-of-the-Earth flight is flight as close to the earth's surface as obstacles, terrain and vegetation will permit, so that maximum advantage of masking from threats is obtained. This effort addresses an automated guidance procedure for NOE flight that also accounts for obstacles Such automated guidance is imperative for crew station workload reduction in support of the Advanced Rotorcraft Technology Integration (ARTI) and Superaugmented Rotorcraft Technology (SART) programs. It is based on innovative dynamic programming optimization techniques that currently show promise for terrain following/terrain avoidance guidance as well. Objectives are the establishment of NOE obstacle avoidance functional requirements, the formulation of this optimal control problem, and the feasibility demonstration of a solution approach including computer simulation. The functional requirements include obstacle parameterization and use of suitable digital terrain elevation data bases The effort addresses definition of several possible performance measures that can be optimized in real-time, resulting in a flight path that, for example, maximizes terrain masking while avoiding obstacles over each route segment. Feasibility of this automatic guidance approach, including preliminary computer sizing requirements, will be established.

Proposal Number: 03 09 2281
Project Title: **Decision-Making Modeling for Theory of Human Error**

Company: SYSTEMS TECHNOLOGY, INC.
13766 S. HAWTHORNE BOULEVARD
HAWTHORNE, CA 90250

Principal Investigator. ALLEN, R. WADE

Contract Number: NAS2-12094 Amount: $50,000 NASA Center. ARC

Abstract: The project covers the development of an analytical model and theory of human error for aeronautical systems comprising on-board and off-platform humans, aircraft, and traffic control/communication/navigation/ flight control system elements. The theory is intended to characterize supervisory, monitoring, decision-making, information processing, and continuous and discrete control activities of the human(s) Emphasis in the error aspects of the system is placed on grievous (exceeding of safe operating tolerances) errors The model is a multi-stage decision process, with discrete and continuous elements, which maximizes subjective utility As such, the model encompasses a broad range of human function, and is intended to be useful in analyzing the overall performance and reliability of the pilot-aircraft system Such an analysis tool should be invaluable in research directed towards reducing human error in aviation operations.

Proposal Number: 03.09 5845
Project Title: **Polar Graphics for Rapid Assessment of Multivariate Information**

Company: ARD CORPORATION
5457 TWIN KNOLLS ROAD
COLUMBIA, MD 21045

Principal Investigator. MUNSON, ROBERT C

Contract Number: NAS2-12095 Amount: $49,966 NASA Center: ARC

Abstract: Polar graphic displays present quantitative information about a system's parameters at the nodes of a geometric figure. By taking advantage of human pattern recognition capabilities, this display concept may enhance operators' ability to rapidly assess system status. The present research addresses basic and applied issues in human visual processing and decision-making with polar graphics, in an effort to optimize the user-compatibility of these displays. Speed to assess system status will be measured for displays that represent a variety of generic model systems. The objectives are (1) to discover basic properties of human decision-making with displays of multivariate data, (2) to explore the advantages of polar graphics with respect to human pattern recognition, (3) to delineate display guidelines that will allow polar graphics to be designed so that information can be extracted most readily, and (4) to identify NASA operational systems in which polar graphics would be useful. To the extent that the user-compatibility of polar graphics can be quantified and enhanced, this display concept will prove feasible for implementation in fielded systems.

TOPIC 04. MATERIALS AND STRUCTURES

Proposal Number: 04.01 1504
Project Title: **High Temperature Aluminum Bronze Matrix Composites**

Company: DWA COMPOSITE SPECIALTIES, INC.
21119 SUPERIOR STREET
CHATSWORTH, CA 91311-4393

Principal Investigator: SUPAN, EDWARD C

Contract Number: NAS3-23897 Amount: $48,480 NASA Center: LERC

Abstract: A unique aluminum bronze matrix composite has been developed that offers attractive properties for elevated-temperature use. This Phase I program will fabricate extruded aluminum-bronze matrix composites and demonstrate the usefulness of these materials at temperatures up to 1500°F for power and propulsion systems. Discontinuous reinforcements for aluminum bronze are TiC and fused Al_2O_3 particulates and chopped Saffil fibers These composites offer densities approaching titanium alloys, low cost, stiffness exceeding steel, and outstanding oxidation resistance. These materials have the potential for replacing titanium and steel alloys for many applications. Evaluation of these composites will focus on mechanical-property testing at room and elevated temperatures and characterization of microstructure, all of which will be summarized in a final report with recommended tasks for a Phase II program.

Proposal Number. 04.03 5400
Project Title: **Woven Reinforcement Constructions for Composites**

Company: MATERIALS SCIENCES CORPORATION
GWYNEED PLAZA II
BETHLEHEM PIKE
SPRING HOUSE, PA 19477

Principal Investigator: DOW, NORRIS F.

Contract Number. NAS1-17934 Amount: $48,685 NASA Center. LARC

Abstract: A research program is designed to determine whether economically attractive weave constructions for the reinforcement of composites have the potential for inhibiting intralaminar transverse failure modes. Both transverse tension and transverse shear failure modes will be investigated Systematic correlations will be attempted with the density of interweaving (numbers of over-and-unders per unit area) of the reinforcement and the stress for initial failure. Results will be interpreted by relation to comparable unidirectionally reinforced laminates.

Proposal Number: 04.03 5911
Project Title: **4D Impact Resistant and Damage Tolerant Composites**

Company: FIBER MATERIALS, INC.
BIDDEFORD INDUSTRIAL PARK
BIDDEFORD, ME 04005

Principal Investigator: HERRICK, JOHN W

Contract Number: NAS1-17935 Amount: $49,986 NASA Center: LARC

Abstract: This is Phase I of a program to develop and evaluate novel 4D composites containing non-orthogonal fiber orientation. A 4D composite will be designed and fabricated with in-plane fiber angles of $0°/\pm 60°$ plus a low concentration of through-the-thickness fibers. This construction should yield a composite with good tensile, compressive and shear properties in the plane of the panel combined with greatly improved impact resistance and damage tolerance 4D composite panels, along with comparative 2D laminates, will be impacted to create controlled damage, and the energy required to initiate damage will be determined and the residual compressive properties measured The results of this Phase I program should demonstrate that a new and novel 4D composite will solve the current damage tolerance problem with advanced composites. A Phase II program would emphasize the fabrication and testing of prototype aircraft panels.

Proposal Number. 04.05 5911
Project Title **Silicon Carbide Matrix Thermal Protection Materials**

Company: FIBER MATERIALS, INCORPORATED
BIDDEFORD INDUSTRIAL PARK
BIDDEFORD, ME 04005

Principal Investigator COX, M. K.

Contract Number NAS2-12104 Amount. $49,826 NASA Center: ARC

Abstract. A durable, lightweight, reusable material is required for thermal protection of atmospheric systems and exo-atmospheric vehicles. This project is directed towards 3-dimensionally (Cartesian) woven constructions of Nextel 312 and Nicalon fibers impregnated with a polycarbosilane resin. Following impregnation, these constructions will be pyrolyzed to yield a SiC matrix to provide high temperature resistance and oxidation resistance. Evaluation of these materials will be conducted through thermal and mechanical testing and scanning electron microscopy of the SiC matrix/fiber interface

Proposal Number 04.07 5785A
Project Title: **Characterization and Development of Hot Pressed Gr/Al for Low CTE Fittings**

Company: MATERIAL CONCEPTS, INC
666 NORTH HAGUE AVENUE
COLUMBUS, OH 43204

Principal Investigator: BURKE, PATRICK D.

Contract Number: NAS9-17243 Amount: $47,958 NASA Center JSC

Abstract. Satellites and space structures utilizing graphite/metal matrix composites will require high modulus, low density thermally stable joints One candidate material is chopped (discontinuous) Gr/Al This program will investigate the fabrication characteristics and measure the thermal and mechanical properties of chopped Gr/Al Consolidation and forming methods will be evaluated

Proposal Number. 04 07 7227
Project Title: **Precision Wires from Ion-Plated Aluminum/Graphite Composite Tape**

Company: CORDEC CORPORATION
7371-C LOCKPORT PLACE
P.O BOX 188
LORTON, VA 22079-0188

Principal Investigator WEIMER, RAYMOND J

Contract Number: NAS9-17284 Amount. $48,926 NASA Center: JSC

Abstract Recent developments in the manufacture of metal matrix composite precursors by physical vapor deposition techniques have created an opportunity to fabricate high-quality, fine-gage composite wires having precise dimensions and fiber volume fractions. Specially designed dies will be used to draw ion-plated graphite/aluminum and graphite/magnesium composite tapes into 1.8-mm diameter composite wires and the materials will be characterized in terms of mechanical properties, densities, and microstructures The feasibility of producing low-density, high-modulus, high-strength wires having precise dimension and a zero coefficient of thermal expansion (CTE) will be demonstrated for arbitrary lengths Design guidelines will be established for a pilot-scale process in which a parametric optimization can be carried out (Phase II).

Proposal Number: 04.09 5050
Project Title. **Structural Modules with Self-Integrity Monitoring**

Company· ANCO ENGINEERS, INC.
9937 JEFFERSON BOULEVARD
CULVER CITY, CA 90232-3591

Principal Investigator: IBANEZ, PAUL and WALTON, WILLIAM

Contract Number: NAS7-937 Amount $49,922 NASA Center. JPL

Abstract Continual monitoring of structural integrity and detection of damage and its subsequent compensation, repair, and control are important considerations for large, complex space structures. Phase I is to research a system which will reduce this task to a module-by-module self-integrity monitoring system. A complex space structure will be divided into several sections, or modules. Interface forces and moments (reactions) between modules will be measured, as will selected dynamic responses of a module itself. A model of a module, validated by initial tests, will be used to assess the continuing consistency of these reactions and dynamic responses for the module. Significant discrepancies will indicate structural damage and suggest its nature

Proposal Number 04.10 0332
Project Title: **Ultrasonic Correlator for Nondestructive Characterization of Materials**

Company INDUSTRIAL QUALITY, INC
P O. BOX 2397
GAITHERSBURG, MD 20879-0397

Principal Investigator. BERGER, HAROLD

Contract Number: NAS1-17937 Amount: $49,980 NASA Center LARC

Abstract. A new cross-correlation method developed for medical diagnosis and a new flat response acoustic emission transducer are brought together with the promise of an improved, nondestructive, ultrasonic method to characterize materials. The impulse response can yield valuable information about materials such as damage, porosity, microstructure, composition, fatigue, etc The cross-correlation method, now used to characterize audio systems and to study lung disease to frequencies of 20 kHz, will be

extended to the megahertz range. The flat response receiving transducer will be coupled with a similar ultrasonic transmitter; the transmitter amplitude requirements will be modest The resultant nondestructive characterization instrument will provide capability to measure the impulse response of a materials system and yield information about the test object in terms of frequency, phase and group delay response and dispersion, these measurements will reveal important information about the state of the material Such information is vital in determining whether or not materials should be used or remain in service. The measurement promises to be particularly useful as a comparative technique to detect early indications of degradation due to fatigue, impact damage, etc., it will be useful for materials characterization in the plant and in the field and for continued research on materials The new test instrument will be applicable to measurements for many materials including metals, composites, polymers and ceramics.

Proposal Number 04 12 4495
Project Title: **Protecting Steel Structures with Polymers That Expand When Cured**

Company: DR. MURRAY S., COHEN & ASSOCIATES
12 SYMOR DRIVE
CONVENT STATION, NJ 07961

Principal Investigator: COHEN, MURRAY S

Contract Number: NAS10-11141 Amount: $49,922 NASA Center: KSC

Abstract: A newly developed polymer system is described that has the unique property of expanding when converted from the liquid (uncured) to the solid (cured) state Coatings on steel made from this class of materials should be desirable because the polymer to metal bond is intimate and would resist attack by salt spray and other corrosive agents. Described is a program to formulate coatings, apply them to steel specimens, and evaluate them side by side with state-of-the-art coatings.

Proposal Number: 04.13 1504
Project Title: **Low CTE Metal Matrix Composite Fittings**

Company DWA COMPOSITE SPECIALTIES, INC.
21119 SUPERIOR STREET
CHATSWORTH, CA 91311-4393

Principal Investigator. SUPAN, EDWARD C

Contract Number: NAS8-35264 Amount: $47,837 NASA Center MSFC

Abstract. This Phase I program is designed to demonstrate the feasibility of producing lightweight, low CTE metal-matrix composite fittings of graphite-fiber/aluminum and to show by mechanical and physical-property tests that the material is useful for application to Space structural hardware. The program will focus on recently developed DWG (continuous graphite-fiber/aluminum) and DWAL-G (chopped graphite-fiber/ aluminum) materials using Thornel Pitch 55, Pitch 75, and Pitch 100 fiber Simple shapes that can be visualized as representative of real fittings or joints will be produced to demonstrate feasibility Specimens for property test will be taken from both the demonstration items and from preform material Structural evaluation and property-test analysis, along with recommendations for Phase II program tasks, will be included in the final report

Proposal Number: 04.14 9030
Project Title: **Novel Oxygen Atom Source for Material Degradation Studies**

Company: PHYSICAL SCIENCES INC.
P.O BOX 3100
RESEARCH PARK ANDOVER, MA 01810

Principal Investigator CALEDONIA, GEORGE E.

Contract Number NAS7-938 Amount $49,971 NASA Center: JPL

Abstract· A pulsed device will be studied which can produce large fluxes of oxygen atoms in the 1 to 5 eV energy range. The high end of this energy range corresponds to velocities appropriate to low earth Space Shuttle orbits As presently configured the device would provide $\sim 10^{18}$ oxygen atoms per pulse and would be scalable to higher levels and repetitive pulsing. An experimental proof of concept will be provided in Phase I. Presence of a high flux of oxygen atoms will be demonstrated and the O-atom velocity will be measured In Phase II a repetitively pulsed test facility will be fabricated to be used to study the effects of energetic atomic oxygen on materials appropriate for low earth orbit applications

TOPIC 05. TELEOPERATORS AND ROBOTICS

Proposal Number 05.01 5915
Project Title: **A Remote Teleoperations Manual Feedback Device**

Company. MODUS INCORPORATED
515 N MELTON DRIVE
JONESBORO, AR 72401

Principal Investigator: JONES, KEITH A

Contract Number NAS7-939 Amount. $49,625 NASA Center: JPL

Abstract. Over the past two decades there have been numerous improvements in microprocessor control technology, resulting in their use as remote sensor and servocontrol drivers in a variety of aeronautic and industrial robotic applications This technology has been adapted to several innovative devices and technological approaches to biodynamic data collection The current project seeks to determine if these devices can be modified for the purpose of providing near-instantaneous manual force feedback for improved telepresence in remote operation of end extenders or manual manipulators This gain in level of subjective telepresence is to be achieved by real-time translation of force against manual flexion points on both human operator and their analogous mechanical structure, with alternating direction of force mediation (i.e., both man-machine and machine-man), accommodated by an intelligent subminiature supervisory control microprocessor with complex array handling capability at the point of man-machine interface.

Proposal Number 05 02 6585
Project Title: **Self-Aligning Electrical Connector**

Company ARBUS, INC
P.O. BOX 80388
LAS VEGAS, NV 89103

Principal Investigator· STOKES, DANNY B

Contract Number NAS8-35265 Amount: $34,826 NASA Center: MSFC

Abstract. The primary purpose of this project is to reduce the requirements for initial alignment accuracy when bringing a pair of connectors together prior to mating them. This will be accomplished by investigating the use of a tapered or conical design to include a

preliminary latching feature to capture and to cause alignment of a pair of complementary connectors. The investigation will take into consideration the need for reliability, high circuit density, low contact resistance, etc

Proposal Number: 05.04 4561
Project Title: **Dead Reckoning Optoelectronic Intelligent Docking System (DROID)**

Company: ENERGY OPTICS, INC.
224 NORTH CAMPO STREET
LAS CRUCES, NM 88001

Principal Investigator: WARD, STEVEN M.

Contract Number: NAS9-17283 Amount: $50,000 NASA Center JSC

Abstract: This project is designed to study a new concept for the automation of STS operations employing a synergistic combination of existing optoelectronic subsystems integrated by microprocessor intelligence. The DROID is a robot pilot which utilizes a laser rangefinder, a laser interferometer, a laser diode array, a quadrant receiver and an optical contrast video tracker to produce precise information on target position, closing velocity and spacecraft guidance commands. A command and control unit manipulates the optoelectronic subsystems and maneuvers the spacecraft through target acquisition, terminal rendezvous and docking with either cooperative or uncooperative targets. The system also provides a full duplex, laser telemetry link for communication with cooperative spacecraft. The primary effort is to design the DROID system to meet NASA objectives and to study the feasibility of the approach in light of practical constraints The significance of the project is the development of a new capability in automated docking at a substantial savings in R&D expense, since the concept relies on well proven technologies. It is anticipated that the approach is feasible and that a design will be generated that will allow engineering development in Phase II

Proposal Number 05.04 8600A
Project Title **Maneuver Automation Sensor**

Company: APPLIED RESEARCH, INC.
5025 BRADFORD BOULEVARD
P.O. BOX 11220
HUNTSVILLE, AL 35805

Principal Investigator MORRIS, JOHN W.

Contract Number: NAS9-17294 Amount: $49,828 NASA Center JSC

Abstract: With the advent of the Space Shuttle and the associated enhanced accessibility of outer space, more automation of routine spaceflight operations is desirable. This is especially so for relative spacecraft maneuver operations requiring a high degree of reliability and crew time. This project concerns an analysis program to investigate the feasibility and practicality of the essentials of a unique sensor system complex for automation of rendezvous, docking, stationkeeping and orientation of one spacecraft relative to another. Computer simulation and analyses will be performed to determine the key system requirements In addition to assessing the technical feasibility of the concept, a preliminary system design will be provided as well as system mass, power consumption and size estimates.

Proposal Number 05.06 4161
Project Title: **Advanced Torque Converters for Robotics and Space Applications**

Company: TALANDIC RESEARCH CORPORATION
2793 EAST FOOTHILL BOULEVARD
PASADENA, CA 91107

Principal Investigator. TRACY, J.

Contract Number: NAS1-17938 Amount. $50,000 NASA Center LARC

Abstract: This project concerns the development of a class of versatile tools for applications in space, based on a new concept of mechanical power transmission The transmission is capable of optimally matching a power source operating at a fixed angular speed to loads operating over a wide range of speeds Continuous (infinite gear ratios) matching is achieved by a novel direct-drive method using no fluids or frictional clutches for energy coupling. In addition, there are several other advantages which can be exploited for development of mechanical tools The research and development described here is needed to make hardware improvements in the miniaturized transmission devices and integrate them into compact space tools for applications in robotics or space construction A number of prototype tools incorporating this power transmission concept are envisioned

TOPIC 06. COMPUTER SCIENCES AND APPLICATIONS

Proposal Number. 06 01 3030K
Project Title: **Optimal Systolic Architecture for the Navier-Stokes Equations**

Company: TECHNOLOGY DEVELOPMENT OF CALIFORNIA, INC
2431 MISSION COLLEGE BOULEVARD
SANTA CLARA, CA 95054

Principal Investigator. FOK, SIMON K

Contract Number NAS2-12082 Amount $50,000 NASA Center ARC

Abstract Optimal systolic architectures are designed for the numerical solutions of partial differential equations arising from applying finite differencing techniques to the Navier-Stokes equations. Since the crux of finite differenced partial differential equation (PDE) algorithms involves solutions of linear equation systems, this research is a logical extension to the recently completed works on optimal systolic architectures for linear algebra systems funded by the 1983 NASA SBIR program The key steps in this optimal design process are. (1) synthesis of a taxonomy of systolic modules involved in the finite difference solution of the Navier-Stokes equations, (2) development of systolic architectures for various PDE algorithms for the Navier-Stokes equations, and (3) PDE systolic architectures synthesis.

Proposal Number 06 02 5100
Project Title: **Improved Visual Display of Three-Dimensional Information**

Company. APPLIED SCIENCE LABORATORIES, INC
335 BEAR HILL ROAD
WALTHAM, MA 02154

Principal Investigator. AISENBERG, SOL

Contract Number. NAS2-12083 Amount: $49,496 NASA Center. ARC

Abstract: A practical and simplified method will be studied and developed for the video display of three-dimensional (3-D) information with the following design goals: no attachments to be worn by viewer, 3-D video display in full color, low cost system, largely compatible with standard video technology, no moving parts, and no dependence upon special physiological factors that may not be shared by all viewers The approach involves an innovative combination of video technology, lens design, and optical alignment techniques Computerized ray tracing will be used for the special lens design A prototype for use with video camera display will be built to verify the expected performance. These results will be used to arrange licenses with user companies for the

commercialization after completion of Phase II. In Phase II, the design will be simplified for cost reduction and easy maintenance. Provisions will be added for viewing computer generated graphics.

Proposal Number: 06.02-9500
Project Title **Automated Object Scan System for 3D CRT**

Company: AERODYNE RESEARCH, INC.
45 MANNING ROAD
BILLERICA, MA 01821

Principal Investigator: GAYNOR, EDWIN S

Contract Number NAS2-12084 Amount $49,926 NASA Center ARC

Abstract: This is a project to establish the feasibility of a technique for forming holograms for three dimensional images of computer-generated objects in real-time point by point. This proprietary technique is a method for quickly moving points of light through a three-dimensional object volume. This new method, along with the young technology of real-time thermo-plastic recording materials, will overcome the traditional problem of low dynamic range associated with attempts of this sort since 1967 Successful completion of Phase I will result in demonstration holograms of 3D scenes written in real-time.

Proposal Number: 06 03 1234
Project Title: **A Floating-Point Computer Module for Array Processing on a FLEX/32 Multicomputer**

Company: FLEXIBLE COMPUTER CORPORATION
1801 ROYAL LANE
SUITE 810
DALLAS, TX 75229

Principal Investigator: MATELAN, NICHOLAS

Contract Number: NAS1-17939 Amount: $50,000 NASA Center LARC

Abstract: The FLEX/32 MultiComputing Environment is a general-purpose, digital multi-processor system that allows virtually any number of high performance, heterogeneous, 32-bit Computer Modules to compute together on one or more tasks This project addresses the feasibility of adding a new Computer Module to the FLEX/32 standard set: the Pipelined Floating Point Computer Module (FPCM) This module would operate in the four to six megaflops (million floating point operations per second) range It would be fully integrable into any FLEX/32 configuration, be it all FPCMs or mixed as needed with already existing Computer Module types. FPCM software would execute under UNIX System V, used by other FLEX/32 modules A FLEX/32 cabinet could contain up to twenty FPCM processors, giving single cabinet power in the 80 to 120 megaflops range. Since there is no inherent architectural limitation to the number of cabinets that can be directly coupled together, there is no theoretical limit to the size and processing power that such a machine can attain A five cabinet FLEX/32 could offer performance in the 500 megaflops range, for example, depending on use of suitable algorithms. The availability of an FPCM would turn the commercially available FLEX/32 MultiComputer into a lower cost array-processing super-computer replacement

Proposal Number. 06 04 1625
Project Title· **Enhancement of Simulation/Animation Graphics Systems**

Company: LINCOM CORPORATION
18100 UPPER BAY ROAD
SUITE 100
HOUSTON, TX 77058

Principal Investigator VOSS, JOHN MARK

Contract Number: NAS9-17277 Amount $50,000 NASA Center: JSC

Abstract: High resolution simulation/animation graphics systems must incorporate real-time hidden surface and external lighting algorithms for display realism. Existing graphics systems which provide such display algorithms are costly and not adaptable to a multi-user environment. The computational tasks required are extremely complex and need hardware processors that must be developed for that specific purpose This effort seeks to develop a graphics system which will support simulation/animation applications by providing the modeling and shading capabilities of raster scan technology with the display resolution and speed of vector displays The system will provide data base resolution not available in any graphics systems other than specialized multi-million dollar complexes. For the Phase I effort, the technical questions that will be addressed to determine the feasibility of the enhanced graphics hardware system include use of floating point and array processors; raster versus vector displays for high resolution scene definition, general purpose graphics processors; and graphic silicon architectures. After a definition of the system requirements for the graphics system, a joint venture will be sought with a selected manufacturer to design and build a prototype graphics system utilizing Phase II funding.

Proposal Number: 06 05 8677
Project Title: **Improvements in Control Center Man-Machine Allocation and Effectiveness**

Company: TECHNICAL & ADMINISTRATIVE SERVICES CORPORATION
600 MARYLAND AVENUE, S W
SUITE 301 WEST
WASHINGTON, DC 20024

Principal Investigator: VON EHRENFRIED, MANFRED

Contract Number· NAS5-28632 Amount: $49,270 NASA Center GSFC

Abstract: The research will investigate critical yet fundamental control center functions at the man-machine interface These interfaces are examined at a selected site with respect to the allocations of tasks to man versus computer using a Man Machine Interface Test Bed Facility. The research is pertinent to both new controls using advanced technology and methodologies as well as to modifications to existing control centers in order to improve system efficiency and operator effectiveness The research explores advances in man machine dialog languages and the concept of rapid prototyping for specific applications of the test bed facility. The research also explores some advanced technology, i.e , artificial intelligence with the concept of automating or mimicking some operator logic processes in control center environments. The continuity thread throughout the research is the desire to arrive at the correct balance between the allocation of tasks to the man versus the computer hardware and software The correct place for this to occur in the systems engineering process is in the "Allocated Baseline." The anticipated research benefits are directly applicable to NASA, DOD, and industrial/international organizations building or modifying control centers for use in the 1990's

Proposal Number 06.06 6700
Project Title: **Software Life Cycle Engineering Support System**

Company. OPTIMIZATION TECHNOLOGY, INC
P.O BOX 949
AUBURN, AL 36830

Principal Investigator MCENTIRE, PAUL L.

Contract Number: NAS1-19936 Amount: $50,000 NASA Center: LARC

Abstract: In recent years, the issues of software quality and productivity have received increasing attention as areas in which there are pervasive problems. Increased use of automated software development tools is by far the most promising approach to lowering the cost of software operations and maintenance. This effort will concentrate principally upon the design of an integrated software development and support system and its associated methodology The two areas of primary concentration for the baseline system are requirements and specification support, and testing support. The effort shall determine the feasibility of incorporation of an existing requirements tool into the system, and describe the tools to be developed for the complete system These additional tools will be designed to assist managers in assessing the progress of software development and to track and control changes to the software requirements, specifications, design, and code

TOPIC 07. INFORMATION SYSTEMS AND DATA HANDLING

Proposal Number. 07.04 1112
Project Title: **Focal-Plane Processing of Visual Information**

Company. Q-DOT, INC
1069 ELKTON DRIVE
COLORADO SPRINGS, CO 80907

Principal Investigator: ROBERTS, PETER C T

Contract Number. NAS1-17940 Amount. $49,993 NASA Center LARC

Abstract. Limitations to the effectiveness of present pattern recognition systems when applied to robot or computer vision systems exist because of present TV camera hardware. This project involves an innovative solid-state smart sensor development which will finally permit real time pattern recognition at equivalent throughputs exceeding 1 GOPS to 1000 GOPS. A complete subsystem study for Phase I leading to Phase II hardware build is outlined.

Proposal Number: 07 06 1000
Project Title: **Low-Power Spectrum Analysis and Real-Time Data Compression System**

Company: DEFENSE SYSTEMS, INC
7903 WESTPARK DRIVE
MCLEAN, VA 22102

Principal Investigator: STARKEY, DONALD L.

Contract Number. NAS5-28624 Amount $49,809 NASA Center. GSFC

Abstract: The objective of this Phase I project is to construct and deliver a "brassboard" Fourier Transform spectrum analysis processor for magnetic field instruments having a bandwidth of 0-10 Hz It will be designed to operate at a power consumption of less than 1 W and incorporates extensive post-processing data compression capabilities This CMOS based processor consists of a lowpass filter followed by an A/D converter and a Discrete Fourier Transform (DFT) processor, all under the control of a software-driven microprocessor which also performs post-processing data compression

operations The DFT processor produces the same result as an FFT processor but does not require the large FFT input memory, since all operations on a data sample are performed 'on-the-fly" prior to input of the next A/D data sample. All major processing parameters including frequency band placement, resolution, and the length of the time averaging window are reprogrammable in flight, as are all post-processing parameters and algorithms. In the course of this project, an innovative post-processing algorithm matched to the statistics of the magnetic field data will be developed Post processing capabilities will include Hanning weighting in the frequency domain, a two-pass noise-mean calculation, estimation of variance, adaptive thresholding and the determination of the peak frequency, amplitude and cluster width of spectral line clusters

---

Proposal Number: 07 06 6207
Project Title: Determination of Cloud Properties from Satellites

Company: ATMOSPHERIC AND ENVIRONMENTAL RESEARCH, INC
840 MEMORIAL DRIVE
CAMBRIDGE, MA 02139

Principal Investigator: ISAACS, R G and HOFFMAN, R. N.

Contract Number: NAS5-28622 Amount: $49,707 NASA Center: GSFC

Abstract: This study will determine cloud properties from LANDSAT 4 Thematic Mapper (TM) data by combining a spatial coherence approach with a variety of cloud parameter retrieval methods. The TM has seven spectral bands which, in principle, allow cloud amount, height, phase, and the optical depth or cloud particle size may also be retrievable. The spatial coherence approach uses a histogram filling and identification technique to identify homogeneous areas in the scene, thereby allowing efficient compositing for cloud parameter retrievals. A variety of cloud parameter retrieval methods will be utilized including bispectral threshold and statistical methods. As particular algorithms are developed, they will be evaluated with a variety of ground truth data. Sensitivity calculations will be performed to optimize these methods.

Proposal Number: 07 06 6211
Project Title: West Coast Storm Forecasting with Satellite Data

Company: REMOTE SENSING SYSTEMS
475 GATE FIVE ROAD
SUITE 211
SAUSALITO, CA 94965

Principal Investigator: WENTZ, FRANK J.

Contract Number: NAS5-28634 Amount: $50,000 NASA Center: GSFC

Abstract: A new generation of satellite microwave radiometers, the SSMI, may have the potential to significantly improve the forecasting of North Pacific storms coming into the West Coast This project is a demonstration that SSMI-derived images of wind speed, water vapor, and rain rates can assist the forecaster in characterizing and predicting the development of mid-latitude cyclones. In preparation for the 1986 SSMI, wind/vapor/rain (WVR) images of past storms will be produced from the radiance measurements of the SEASAT and NIMBUS-7 microwave radiometers. These images will be generated by means of a non-linear algorithm that directly relates microwave radiances to wind, vapor, and rain. New forecasting techniques will be developed that use the WVR images in conjunction with other meteorological data sets. The final objective is to test the WVR image forecasting techniques in a real-time environment and compare the results with the official National Weather Service forecasts

---

Proposal Number· 07.06 9709
Project Title: **A Low Power Fourier Transform Processor**

Company: AMS CORPORATION
4706 PAPERMILL ROAD
KNOXVILLE, TN 37919

Principal Investigator. KERLIN, T W

Contract Number· NAS5-28635 Amount $49,916 NASA Center GSFC

Abstract: This project involves a new approach for a low power Fourier Transform processor. An algorithm which requires no multiplications in the Fourier transformation has been developed. It is to be implemented and tested in this program The algorithm is well suited for real-time spectral analysis at frequencies of interest in the 0 to 10 Hz range required for processing magnemometer data The work also addresses sideband leakage and aliasing in conjunction with the Fourier transformation effort in order to provide highest overall numerical efficiency

Proposal Number 07.08 5300
Project Title **Expert System for Extraction of Data System Requirements**

Company: COMPUTER TECHNOLOGY ASSOCIATES
5680 SOUTH SYRACUSE CIRCLE
SUITE 506
ENGLEWOOD, CO 80111

Principal Investigator HOBBS, ROBERT W

Contract Number: NAS7-940 Amount. $49,919 NASA Center JPL

Abstract The objective of this research is to study the feasibility of applying artificial intelligence technology to the derivation of spacecraft data system requirements from user scenarios During Phase I the research will be directed toward the development of a formal notation for the expression of scenarios which allows the user the necessary flexibility in describing his use of the system. This notation will also provide an engineering framework from which system requirements can be automatically extracted. The expert system which supports this notation is expected to provide assistance to the prospective computer system user in entering his scenarios, and to the systems engineer in establishing an operations concept and extracting requirements. The research is expected to lead to a design concept and a prototype expert system which would be further developed in Phase II

Proposal Number 07.09 7511
Project Title **Robust Natural Language Processor for Transactional Dialogues**

Company. NATURAL LANGUAGE PRODUCTS
180 PECORA WAY
PORTOLA VALLEY, CA 94025

Principal Investigator: GINSPARG, JERROLD

Contract Number: NAS2-12087 Amount· $49,970 NASA Center. ARC

Abstract. Today's natural language technology is inadequate for applications involving untrained public users For example, no existing system is powerful enough to sell travel services without human assistance. Involved is a design for a general deductive system and underlying representation language integrated with the syntactic processing methods developed earlier The deductive system will monitor the dialogue between the machine and the user, deciding the meaning of the user's statements, why they were said and how to respond. The representation language expresses both the meaning of the user's

statements and the rules for reasoning about them. The innovation lies in using rule-based deduction in the context of a representation language epistemologically adequate for Natural Language applications. It is expected that the research will remove the remaining "technically risky" roadblocks to a natural language system robust enough to be used by the public without prior training.

TOPIC 08. INSTRUMENTATION AND SENSORS

Proposal Number: 08.01 6882
Project Title: **Concentric Groove Grating**

Company: HYPERFINE INC.
1930 CENTRAL AVENUE
SUITE B
BOULDER, CO 80301

Principal Investigator: BACH, BERNHARD W.

Contract Number: NAS5-28636 Amount: $49,468 NASA Center: GSFC

Abstract: This project involves new designs of in-plane and off-plane varied line-space gratings for upcoming astronomical satellites. These new grating types have been theoretically calculated but have never been manufactured until recently A radial fan grating has been ruled and is presently being tested This effort will rule a variable concentric groove grating to verify its anticipated optical performance

Proposal Number 08 03 4520
Project Title: **A Particulate Monitor for Comet and Planetary Atmospheres**

Company: RUPPRECHT & PATASHNICK COMPANY, INC.
17 MAPLE ROAD, DRAWER H
VOORHEESVILLE, NY 12186

Principal Investigator: RUPPRECHT, GEORG

Contract Number: NAS7-941 Amount: $49,878 NASA Center JPL

Abstract: Future missions to comets and planetary atmospheres require particulate monitoring instrumentation to fulfill a number of scientific and engineering measurement needs. There is only one instrument capable of spacecraft operation which can provide a direct measurement of particulate masses with a loading range of six orders of magnitude. This instrument is the Tapered Element Oscillating Microbalance (TEOM) A TEOM with a collection substrate can measure sub-nanogram particles in a comet rendezvous mission, and a TEOM with a filter cartridge can monitor particulates in a planetary atmosphere The instrumentation provides real-time measurements, and can be temperature cycled to provide a measure of volatile and non-volatile components of the particulates Phase I of this project is intended to establish the limits of mass resolution capability of the TEOM under relevant space and planetary atmosphere conditions. The goal of Phase II is the production of prototypes which can serve the particulate measurement tasks of the various missions

Proposal Number. 08.05 1590
Project Title: **Simultaneous Orbit Determination with Physical Connectedness**

Company: APPLIED TECHNOLOGY ASSOCIATES, INC.
444 CASTRO STREET
SUITE 308
MOUNTAIN VIEW, CA 94041

Principal Investigator. WRIGHT, JAMES R

Contract Number: NAS5-28637 Amount: $47,757 NASA Center: GSFC

Abstract· The innovation, called simultaneous orbit determination, refers to the sequential simultaneous estimation of the orbits of two spacecraft (Space Shuttle and TDRSS) when tracking measurements depend simultaneously on both orbits. Successful simultaneous orbit determination depends on physical connectedness This refers to the use of physically connected modeling of random acceleration errors for the process noise of the sequential orbit estimator; and it refers to the use of physical properties associated with random phenomena of the system used to generate the tracking data Objectives of Phase I are: (1) to collect appropriate live Doppler-sum tracking and support data; (2) construct an experiment design report to be used in Phase II to develop a live-data engineering test-bed. The objective for Phase II is to demonstrate significant orbit determination accuracy improvement for the Space Shuttle orbit using Doppler-sum tracking data and the innovations.

Proposal Number: 08 05 3220
Project Title. **Integrated Receiver Concept Using Programmable Charge Coupled Devices**

Company: STANFORD TELECOMMUNICATIONS, INC.
6888 ELM STREET
MCLEAN, VA 22101

Principal Investigator WEINBERG, AARON

Contract Number. NAS5-28638 Amount: $49,573 NASA Center GSFC

Abstract. To support the increasing accuracy, speed and efficiency requirements of the orbit determination process for future low earth orbiting spacecraft missions, a growing need for improved signal processing techniques is becoming apparent. A principal need is the significant reduction in Pseudo-noise (PN) code acquisition times, relative to the times achievable via conventional techniques This is simultaneously coupled with additional needs for cost effective, microprocessor based, and flexible signal processing techniques that permit improvements in, and the integration of, other key receiver functions that support orbit determination The goal of this research is to develop a conceptual design of a new, integrated receiver that uses programmable Charge Coupled Device (CCD)/PN matched filters (PNMF) for unusually rapid PN acquisition time The design should reflect key system parameters and explicitly show how the CCD/PNMF may serve as the basis for the other processing functions of significance. A performance assessment, via analysis and simulation, is to be conducted to demonstrate the technical feasibility of integrating such receiver functions, the potentially dramatic performance enhancements achievable via CCD/PNMF processing, and other signal processing benefits not readily achievable via conventional techniques

Proposal Number: 08 06 1920
Project Title. **A Pulsed CO_2 Laser for Space Application in Remote Atmospheric Sensing**

Company. PULSE SYSTEMS, INC.
139 LONGVIEW DRIVE
LOS ALAMOS, NM 87544

Principal Investigator: MCLELLAN, EDWARD J

Contract Number: NAS5-28639 Amount: $50,000 NASA Center: GSFC

Abstract. The development of a space qualifiable pulsed CO_2 laser system for remote sensing of the atmosphere is a difficult problem made more difficult because of present pulsed CO_2 (TEA) laser characteristics such as high operating voltage, low efficiency, and relatively short life expectancy under sealed conditions. This project examines the feasibility of applying a unique low-voltage, compact, efficient, long-life pulsed CO_2 laser system for application in a spacecraft environment. The laser will be based upon

the innovative technology used in present lasers which emit more than 3 J per pulse with a discharge voltage of ±1 4 kV as opposed to about 40 kV for equivalent TEA lasers. The principals will build upon new technology to study the development of a sealed laser system capable of emitting several joules with voltages less than ±2000 V in a light and compact configuration with lifetime and efficiency which exceeds those of existing TEA lasers The results of this study will be used to establish the optimum design of a prototype low-voltage, pulsed CO_2 laser for spacecraft application which could revolutionize the remote sensing of the atmosphere

Proposal Number: 08.07 5800B
Project Title: **An Analog/Digital Electro-Optical System for Real-Time X-Ray Imaging**

Company: BRIMROSE CORPORATION OF AMERICA
7527 BELAIR ROAD
BALTIMORE, MD 21236

Principal Investigator: ROSEMEIER, RONALD G.

Contract Number. NAS5-28640 Amount $49,480 NASA Center: GSFC

Abstract. The research in Phase I is a two-fold effort First, to optimize existing first and second generation x-ray image intensifiers, a comprehensive research program will be established to evaluate all critical parameters Second, to create a real-time analog/digital x-ray image detector, a state-of-the-art solid state TV camera will be coupled to first and second generation x-ray image intensifiers. The newly developed camera will be able to provide an analog format for display on a closed circuit TV monitor, as well as a digital format for computer image processing

Proposal Number: 08 07 8629
Project Title. **Adiabatic Demagnetization Refrigerator for Use in Zero Gravity**

Company· ALABAMA CRYOGENIC ENGINEERING
P O. BOX 2451
HUNTSVILLE, AL 35804

Principal Investigator HENDRICKS, JOHN B

Contract Number· NAS5-28641 Amount: $49,878 NASA Center: GSFC

Abstract. This project covers the development of an adiabatic demagnetization refrigerator for use in zero gravity and employs an innovative precooler and thermal switch. In addition, the project involves the design of a superconducting magnet system energized by a superconducting flux pump The system requires a 2K heat sink for operation.

Proposal Number· 08 08 0537
Project Title: **An All Solid State Tunable Laser for Remote Sensing Applications**

Company LASERGENICS CORPORATION
P.O. BOX 33010
LOS GATOS, CA 95031-3010

Principal Investigator. SCHLECHT, RICHARD

Contract Number. NAS1-17941 Amount: $49,161 NASA Center: LARC

Abstract: The need for continuously tunable laser sources for several space applications is well recognized. However, to date no such source exists that can be expected to be space qualified in the near future This project involves investigation of the potential of an all solid state tunable laser system which will emit in the 650 nm to 900 nm band and which has the potential for also emitting continuously between 488 nm and 290 nm by

second harmonic generation and sum frequency mixing in nonlinear crystals. Such a device would cover a large region of the spectrum which is of interest for remote sensing from satellites A solution to meeting these requirements is to utilize the well-developed technology of the frequency-doubled Nd:YAG laser to pump the tunable vibronic laser system of Ti:sapphire. This device with the addition of semiconductor laser pumping of the Nd:YAG pump laser would have absolutely no gas or liquid components and could easily be cooled by conduction cooling.

Proposal Number: 08.08 9030
Project Title: **Laser Spectrometer and Wavemeter**

Company: PHYSICAL SCIENCES INC.
P.O. BOX 3100
RESEARCH PARK
ANDOVER, MA 01810

Principal Investigator: NEBOLSINE, PETER E.

Contract Number: NAS1-17942 Amount: $49,986 NASA Center. LARC

Abstract. The goal is to design an optimal spectrometer/wavemeter instrument that will facilitate laser remote sensing measurements (lidar) that require careful laser tuning The output of a laser spectrometer/wavemeter (LS/W) will not only serve as a laser diagnostic but also make it possible to servo control the laser wavelength and line shape Numerous interferometers for LS/W systems have been suggested and built—and even commercialized in some cases The merits and disadvantages of all designs will be considered relative to lidar needs and a particular LS/W system will then be selected for prototype construction in Phase II. Emphasis will be placed on light weight, compactness, reliability, reduced costs, ease of alignment, and mechanical/thermal stability Success in this project will greatly improve the reliability of pulsed tunable lasers, because the means for automatically controlling these lasers will be at hand. In turn, the possibilities for atmospheric lidar studies, particularly those involving differential absorption, will be greatly enhanced.

Proposal Number: 08 09 6500
Project Title: **Optimal Silicon Carbide Production**

Company: AERODYNE RESEARCH, INC.
45 MANNING ROAD
BILLERICA, MA 01821

Principal Investigator: WORMHOUDT, JODA C

Contract Number. NAS3-24531 Amount: $49,897 NASA Center LERC

Abstract. It is desirable to enhance the ability to make high purity silicon carbide crystals to be used in monitoring instruments and sensors for use in harsh environments A significant advancement in SiC production has been made at NASA-Lewis The objective of this project is to optimize the NASA-Lewis process for making semiconductor-quality silicon carbide crystals by better understanding both the chemical and physical processes involved

Proposal Number. 08 11 2227
Project Title **Widely Tunable Gas Laser for Remote Sensing of the Stratosphere**

Company: ROTHE TECHNICAL RESEARCH
407 VILLAGE CENTER DRIVE
ENCINITAS, CA 92024

Principal Investigator ROTHE, DIETMAR E

Contract Number. NAS7-935 Amount: $49,826 NASA Center: JPL

Abstract: Remote sensing and range-resolved measurements of atmospheric gases, aerosols, biologic species, physical parameters of atmosphere and oceans, and geologic minerals with coherent light pulses is an emerging technology which is only constrained by the availability of suitable narrowband tunable laser sources This project addresses the development of an advanced, compact multigas laser for airborne and Shuttle-based lidar systems Newly developed excimer laser and pulse power technology permits the design of a laser with extended tunability in the IR and UV parts of the spectrum and with greatly increased efficiency The laser will be line-tunable over more than 200 spectral lines in the near and far IR, continuously tunable over the 9 and 10 bands of CO_2, and will have some tunability around selected excimer bands in the UV. Narrowband pulse energies will be between 100 mJ and 1 J at pulse frequencies up to 50 Hz. This performance is considerably better than that of present lidar systems In addition to the improved tunability and optical power level, the laser will be designed for extended life and reliability Phase I will be a design optimization study for the advanced laser; Phase II, the construction and testing of a prototype.

Proposal Number: 08.12 7847
Project Title: **Analysis of Micrometer and Submicrometer Atmospheric Aerosols**

Company ST&E TECHNICAL SERVICES, INC.
20 BELINDA COURT
SAN RAMON, CA 94583

Principal Investigator. KLAINER, STANLEY M

Contract Number. NAS1-17943 Amount: $48,293 NASA Center: LARC

Abstract. The use of microRaman spectrometric techniques should allow the complete molecular analysis of a collected aerosol as small as 0.1 micrometer in diameter This will provide a technique for analyzing the small particles which are key to understanding atmospheric chemistry. The ultimate goal of the present program is a practical spectrometer design which can be implemented (Phase II) using available hardware and existing technology. The initial part of this research focuses on the characteristics of light scattering spectra from samples that are smaller than the wavelength of the exciting light as well as the problems of handling, locating and placing these small aerosols, which are neither visible or observable from their reflected light, in the microRaman spectrometer Other considerations in the spectroscopy of small particles are thermal and photochemical degradation Once these have been addressed, then instrumentation designs must be considered The emphasis will be placed on the following areas: generating sufficient Raman photons, while maintaining sample integrity; collecting these with exceptionally high efficiency, and then using them properly Based on the information gleaned and the projected spectrometer design, analytical information on particle size vs the amount of single species needed for detection and/or quantification will be developed

Proposal Number 08.13 4561
Project Title: **Miniature Infrared Data Acquisition and Telemetry (MIRDAT) System**

Company. ENERGY OPTICS, INC.
224 NORTH CAMPO STREET
LAS CRUCES, NM 88001

Principal Investigator: WARD, STEVEN M

Contract Number: NAS1-17944 Amount $50,000 NASA Center: LARC

Abstract: This project is designed to study a new concept for the miniaturization of data acquisition and telemetry units for application in wind tunnel instrumentation. The

proposed MIRDAT system includes telemetry transmitter units (TTUs) which collect sixteen channels of analog data, three channels of pulsed digital data and four binary status bits The TTU transmits data by means of free-space, pulsed IR communication to a telemetry receiver unit at ranges exceeding 200 feet. Key components include a single chip microcomputer, a multiplexed A/D converter and a pulsed IR transmitter It is anticipated that the TTU (less battery and connector) can be fabricated on a one square inch circuit board without developing new integrated circuits. The primary effort is to design and construct MIRDAT TTU prototypes that meet NASA objectives and to study the feasibility of the approach in light of practical constraints It is anticipated that the approach is not only feasible but will provide many advantages over existing techniques and that this project will result in a family of low cost, miniature telemetry transmitters for final development and limited manufacturing in Phase II.

Proposal Number: 08 13 8500
Project Title: **Modular Digital Holographic Fringe Data Processing System**

Company: KMS FUSION, INC
3621 SOUTH STATE ROAD
P.O. BOX 1567
ANN ARBOR, MI 48106

Principal Investigator DOWNWARD, JAMES G

Contract Number NAS1-17945 Amount. $49,990 NASA Center. LARC

Abstract. The goal of this project is to develop a general purpose, modular, holographic fringe analysis system which will be able to use expert knowledge to control the processing of fringe patterns into useful engineering data The Phase I objective is to develop the architectural design for this system. System modularity and a well defined architecture will allow functions to be added without affecting other system components Fringe analysis will be controlled by an analysis shell which directs the processing flow through the various stages based on application-specific control scripts. To allow adaptive control of fringe processing by either the analysis script or "expert" decision making subsystems, the architecture will permit knowledge about the current state of the analysis to be shared between the analysis shell, processing modules, and decision subsystems

Proposal Number: 08.15 1315
Project Title: **Measurement of Chlorophyll, Related Pigments and Productivity in the Sea**

Company. BIOSPHERICAL INSTRUMENTS, INC.
4901 MORENA BOULEVARD
SUITE 1003
SAN DIEGO, CA 92117

Principal Investigator: BOOTH, CHARLES R

Contract Number NAS7-942 Amount. $50,000 NASA Center. JPL

Abstract. This work will examine the feasibility of commercially producing a second generation fluorometer that will significantly enhance the research and sampling capabilities of marine and freshwater biologists and fisheries scientists who routinely monitor the crop size, taxonomic composition, and production of phytoplankton. Several basic approaches to fluorometry will be investigated: multispectral fluorometry, multiple excitation flash fluorometry, and solar excited fluorometry. Although there is adequate evidence that all three types of fluorometers offer important advantages over present instruments, the laboratory experiments and data review will offer a definitive analysis of the potential of these methodologies This analysis will provide the basis for the design, construction and field testing of a new oceanographic instrument for the measurement of the distribution and characterization of phytoplankton during Phase II

Proposal Number. 08 15 1512
Project Title: **Measurement of the Liquid Water and Ice Water Contents of Snow**

Company. OPHIR CORPORATION
7333 WEST JEFFERSON AVENUE
SUITE 210
LAKEWOOD, CO 80235

Principal Investigator. NELSON, LOREN D and CERNI, TODD A

Contract Number NAS7-943 Amount $47,495 NASA Center. JPL

Abstract· An innovative new technique is proposed for measurement of the liquid water and ice water contents, in g/cm^3, of snow or ice The technique consists of measuring the capacitive component of the electrical impedance of a snow sample at frequencies of 1 and 50 KHz The dielectric constants of liquid water and ice are substantially different at these frequencies and this difference can be exploited to yield an accurate measurement of the amount of liquid water and ice present in a sample A direct temperature measurement of the sample will be included with the instrument so that the temperature dependence of the dielectric constants could be properly accounted for The sensor would be small, rugged, reliable, relatively inexpensive, and low in power requirements. It could be easily transported to remote snowfield or sea ice sites and could be adapted for unattended use at remote sites.

TOPIC 09. SPACECRAFT SYSTEMS AND SUBSYSTEMS

Proposal Number. 09 01 6364
Project Title· **Control of Large Space Structures Using the Stable Factorization Approach**

Company SCIENTIFIC SYSTEMS, INC
54 RINDGE AVENUE EXTENSION
CAMBRIDGE, MA 02140

Principal Investigator. RAZAVI, H. C

Contract Number NAS1-17946 Amount: $49,999 NASA Center. LARC

Abstract The problem of control design for large space structures (LSS) is very demanding for several reasons: (1) the true description of the flexible modes of LSS is infinite dimensional, (2) structural damping is low, (3) tracking and pointing accuracy requirements are very high, and (4) component failures are to be tolerated by the control system The use of control synthesis methods developed previously (both classical and modern) has not been very successful due to the above difficulties Phase I research will investigate a new promising technique which can successfully address all the above problems. The control synthesis approach is based on the factorization of the system transfer function and produces a family of stable controllers which can all stabilize the system The Phase I effort will be devoted to further developments of the theory and numerical algorithms

Proposal Number. 09 02 1753A
Project Title **Thermal Transport System Using Conformal Heat Exchanger**

Company APPLIED TECHNOLOGY ASSOCIATES
P O. BOX 19434
ORLANDO, FL 32814

Principal Investigator: CLARK, WILLIAM

Contract Number NAS8-35266 Amount. $49,800 NASA Center: MSFC

Abstract Future NASA spacecraft may require means to transport thermal energy between structural modules connected in orbit. These modules may be allowed to rotate or

gimbal, and the thermal transport system would have to accomodate such motion. A thermal transport system addressing this need would feature a-fluid to fluid contact heat exchanger having pressure activated compliant skins for low thermal contact resistance and a compact dual fluid swivel This system is capable of full rotation and gimbal motion. It can be mated and demated several times without the use of tools and without decoupling fluid lines The objectives of the effort are to demonstrate the system hardware and identify areas for improvement. Toward these ends, the work in Phase I will consist of an analysis to predict performance, appropriate detail design, fabrication and test of the proposed hardware Initial analysis indicates heat transfer rates of 480 BTU/HR-°F (250 Watts/°C) per square foot of heat exchanger frontal area is expected at low fluid flow rates

Proposal Number 09 04 9450
Project Title: **Electrochromic Panels for Control of Radiant Energy Transfer**

Company EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062

Principal Investigator. RAUH, R DAVID

Contract Number: NAS8-35267 Amount: $49,595 NASA Center: MSFC

Abstract. Since heat transfer in space is largely radiative, the emissivity of the surfaces linking the payload to the space environment are key to the problem of temperature stabilization and control in orbiting spacecraft This project considers the design and fabrication of surfaces which would have variable thermal infrared emissivity. Control is achieved by passage of a small dc electrical current through the panel and is based on the concept of "electrochromism" in thin films of some metal oxides, such as WO_3 and IrO_2 When crystalline films of these materials are reduced electrochemically by incorporation of hydrogen or alkali metals, they undergo an increase in reflectivity proportional to the charge passed. It is intended for Phase I to prepare thin films of WO_3 with high crystalline perfection, and to measure spectroscopically the infrared reflectance modulation out to 50 microns for H_xWO_3 as a function of x The resulting emissivities will be used in simple models of heat transfer in satellites to predict the extent of thermal control that could be achieved during orbit. A small self-contained variable emissivity element will be constructed during Phase I and will serve as a basis for Phase II research and development Phase II and subsequent commercial development would address the detailed construction of larger area panels, optimization of reflective electrochromic materials, and long-term degradation mechanisms of integrated structures

Proposal Number. 09.05 1504
Project Title: **Electronic Component Temperature Control Using Metal-Matrix Composites**

Company: DWA COMPOSITE SPECIALTIES, INC.
21119 SUPERIOR STREET
CHATSWORTH, CA 91311-4393

Principal Investigator SUPAN, EDWARD C

Contract Number: NAS3-24245 Amount: $49,818 NASA Center· LERC

Abstract· This Phase I program is intended to demonstrate the feasibility of producing a lightweight metal-matrix composite (MMC) heat-removal bar having the thermal conductivity of copper and to show, by mechanical and physical-property tests, that this MMC is a useful material for heat transfer in space and avionics applications. The program will focus on newly developed "DWG" material (continuous graphite-fiber/ aluminum) using Pitch 100 fiber that has a thermal conductivity of 300 BTU/hr/ft^2/°F/ft

Methodology for joining a "DWG" bar or plate to a high-intensity electronic component heat source, and techniques for fabricating plate and air-cooled heat sinks will be included in a final report, along with recommended tasks for a Phase II program.

Proposal Number. 09 06 5785
Project Title: **Metallized Kevlar Space Tether System**

Company. MATERIAL CONCEPTS, INC.
666 NORTH HAGUE AVENUE
COLUMBUS, OH 43204-1492

Principal Investigator ORBAN, RALPH F

Contract Number: NAS8-35268 Amount. $45,746 NASA Center: MSFC

Abstract A new conductive material, metallized Kevlar, will be examined for use as a tether material in space applications This proprietary metallization process will be examined in regard not only to rendering the Kevlar conductive, but also in regard to protection of the Kevlar from attack by atomic oxygen. Furthermore, a polymer coating will be applied to act as insulation to the tether and further enhance protection against atomic oxygen attack. Finally, a pilot production line will be designed and built to produce quantities of the selected candidate material.

Proposal Number: 09.08 6551
Project Title **High Performance Ambient Temperature Heat Pipes**

Company: THERMACORE, INC
780 EDEN ROAD
LANCASTER, PA 17601

Principal Investigator SHAUBACH, ROBERT M.

Contract Number: NAS8-35269 Amount: $49,997 NASA Center MSFC

Abstract. Thermal management is emerging as a key and sometimes enabling technology in future space missions Heat pipes are a key element in thermal management technology. Growth versions of the space station will require heat pipe heat acquisition capability of 10 W/cm^2 and heat transport capability of 5000 watts over 50 feet. These requirements have not been met in ambient temperature aluminum/ammonia heat pipes Phase I is a program to develop innovative sintered aluminum wick structure/heat pipe designs which will meet or exceed NASA's requirements The basic technology for making sintered aluminum wicks has been developed. What needs to be done is to adapt that technology to high performance wick designs which can be fabricated in 50 foot lengths.

Proposal Number: 09.09 0546
Project Title· **Metal Hydrides for Integration of Spacecraft Hydrogen Resources**

Company: HYDROGEN CONSULTANTS, INC.
P O BOX 10454
DENVER, CO 80210

Principal Investigator. EGAN, G J

Contract Number: NAS8-35270 Amount· $50,000 NASA Center. MSFC

Abstract: The technical objective of the Phase I effort is to determine the feasibility of using metal hydride subsystems to integrate common spacecraft resources. This will be accomplished by developing a realistic set of design data characterizing the potential use of metal hydride systems in space This data will be generated by an approach

which will identify and catalogue the thermal systems and equipment designs which present opportunities for providing heat collection and heat rejection for candidate hydride cycles The results will then be merged with hydride system design data and evaluated in sufficient detail to allow determination of technical feasibility and overall desirability of using hydride systems to integrate the major spacecraft resource, hydrogen

---

Proposal Number. 09 10 1447
Project Title: **Polarization Stability of a Pyroelectric Conversion Material**

Company CHRONOS RESEARCH LABORATORIES, INC
3025 VIA DE CABALLO
OLIVENHAIN, CA 92024

Principal Investigator OLSEN, RANDALL B.

Contract Number: NAS7-936 Amount. $49,953 NASA Center JPL

Abstract· Pyroelectric conversion represents an unusual opportunity for waste heat utilization in space. It can provide both Carnot limited conversion (to electricity) and thermal rejection. Furthermore, the pyroelectric approach can provide both the electrical generator and the radiator at very low specific mass and relatively low cost. The objective of the Phase I effort is to determine the long term stability of the polarization of a certain pyroelectric polymer which has recently been shown to have substantial conversion capabilities The pyroelectric conversion characteristics of the material will be followed for extended time periods as it is subjected to the thermal and electrical cycling conditions which will exist in energy converters

---

Proposal Number 09 11 9785
Project Title. **Active Refrigeration and Heat Pump Thermal Control of Spacecraft**

Company: ENERGY RESEARCH AND GENERATION, INC
952 57TH STREET
OAKLAND, CA 94608

Principal Investigator: BENSON, GLENDON M.

Contract Number NAS8-35271 Amount. $49,992 NASA Center. MSFC

Abstract. This project assesses the relative benefits and penalties associated with the use of dispersed and centralized refrigeration/heat pumps for thermal control of spacecraft The performance and limitations of free-piston Stirling cycle heat pumps (either linear electric motor or free-piston Stirling engine driven) for spacecraft waste heat management will be determined, and the characteristics of an electric motor driven Stirling heat pump will be demonstrated through laboratory testing of a breadboard model configured for pumping waste heat to an elevated rejection temperature

---

Proposal Number. 09 12 3800B
Project Title. **A Reliable, Long-Lifetime Closed-Cycle Cryocooler for Space**

Company. CREARE R&D INC
P O BOX 71
HANOVER, NH 03755

Principal Investigator SIXSMITH, H.

Contract Number. NAS5-28642 Amount· $47,147 NASA Center: GSFC

Abstract There is a strong need for simple, reliable closed-cycle cryocoolers capable of providing approximately 5 watts of refrigeration at temperatures near 65-75 K The most prominent example of current approaches is the Linear Stirling Cycle under

sponsorship of NASA Recent technological developments in the miniaturization of gas bearings and turbines indicate that a reverse-Brayton cycle using turbomachines may be an attractive alternative to the Linear Stirling cryocooler This Phase I program evaluates the feasibility of developing a 5 watt, 70 K cryocooler based on rotating turbomachines in a reverse-Brayton cycle. The objective of Phase I is to establish the sizes and types of hardware required to meet the 5 W load at 70 K. The effort will establish whether current technology can meet this application and what developments must take place to demonstrate a working prototype.

Proposal Number 09.13 5000
Project Title. **A Single Channel Handheld Optical Radar**

Company: ODETICS, INC.
1380 S ANAHEIM BOULEVARD
ANAHEIM, CA 92805

Principal Investigator: DRAP, ROBERT

Contract Number NAS9-17289 Amount: $50,000 NASA Center JSC

Abstract. The study covers a single channel handheld optical radar which is smaller than comparable laser rangefinders and yet has better performance than the larger rangefinders. This handheld optical radar would feature absolute range resolution under two inches, range rate indication, a sunlight readable display, reduced weight and low power. The Phase I study will help define the Phase II prototype development and test in a four-step program. (1) survey and determine NASA operating requirements and safety standards for a laser rangefinder system; (2) define the relationships between optical parameters, maximum range, range resolution, size, power and weight; (3) define the subsystem block diagram by investigating lens configurations laser devices, receiver characteristics and processing algorithms, and (4) conduct a packaging study of the subsystems with special emphasis on hybrid device requirements

Proposal Number. 09 14 4942
Project Title: **Pumped, Two-Phase, Non-Azeotropic Spacecraft Cooling Systems**

Company. FREDERICK A. COSTELLO, INC.
12864 TEWKSBURY DRIVE
HERNDON, VA 22071

Principal Investigator. COSTELLO, FREDERICK A

Contract Number: NAS5-28643 Amount $48,926 NASA Center GSFC

Abstract This effort will design and demonstrate by a computer simulation a typical spacecraft temperature-control system that uses a non-azeotropic, two-phase fluid as the working medium The innovation lies in the use of the non-azeotropic fluid Existing research and existing designs are based on having conventional, single-component or azeotropic fluids as the working medium. Non-azeotropic fluids, a class of mixtures of fluids, boil not at a fixed temperature but over a small range in temperature (at a fixed pressure). Therefore, the amount of fluid that has been evaporated (i.e., the thermodynamic quality) can be readily determined by sensing the easily measured temperaure Therefore, also, the quality of the fluid leaving an evaporator can be controlled to, for example, 80% The following advantages result simpler and more reliable control systems, faster control system response, higher average evaporator and condenser heat-transfer coefficients, smaller evaporators and condensers, reduced fluid flow rates, lighter temperature control systems, and less power consumption for temperature control Systems with conventional fluids have no practical means for measuring quality. The sensor is heavy and costly and the response time is long. Instead, either the

fluid is super-heated and poor heat-transfer coefficients are accepted or the plate temperature is measured and the control system response time is slow.

Proposal Number. 09.15 1230
Project Title **Self-Maintaining Thermal Surfaces**

Company: THERMACORE, INC.
780 EDEN ROAD
LANCASTER, PA 17601

Principal Investigator ERNST, DONALD M

Contract Number: NAS8-35272 Amount $49,994 NASA Center MSFC

Abstract· This project is concerned with an engineering assessment of the potential of intrinsic surfaces as maintenance-free radiating surfaces for long-lived spacecraft. An intrinsic surface is one whose radiating characteristics derive from its geometry rather than from the thermal properties of the surface materials themselves An intrinsic surface, by its nature, is virtually unaffected by factors that change its surface emissivity, such as evaporation and deposits

Proposal Number. 09 16 1227
Project Title· **Modular Cold Plates for High Heat Fluxes**

Company· THERMACORE, INC
780 EDEN ROAD
LANCASTER, PA 17601

Principal Investigator: ERNST, DONALD M

Contract Number. NAS9-17280 Amount. $49,998 NASA Center: JSC

Abstract Full, effective use of the thermal bus on the Space Station will require universal thermal/mechanical mounting plates for power dissipating experiments and permanent equipment This project involves Phase I of a program to develop a high performance modular thermal mounting position for Space Station use

Proposal Number 09.19 8629
Project Title **A Helium-3/Helium-4 Dilution Cryocooler for Operation in Zero Gravity**

Company· ALABAMA CRYOGENIC ENGINEERING
P.O BOX 2451
HUNTSVILLE, AL 35804

Principal Investigator: HENDRICKS, JOHN B.

Contract Number. NAS8-35273 Amount. $49,987 NASA Center MSFC

Abstract: This project concerns the development of a cryocooler to operate at 0.1 K in zero gravity. The cryocooler will use the principle of dilution of Helium-3 solution by pure superfluid Helium-4 for the cooling effect A conventional dilution refrigerator requires gravity for operation, so an innovative technique is required for the zero gravity system. The system, which requires a 2 K heat sink, and can be built with a cooling capacity approaching one milliwatt at 0 1 K

TOPIC 10. SPACE POWER

Proposal Number: 10.01 7270
Project Title: **Novel Electrodes for Hydrogen – Bromine Battery**

Company: GINER, INC.
14 SPRING STREET
WALTHAM, MA 02154

Principal Investigator: JALAN, VINOD

Contract Number: NAS3-24394 Amount: $49,979 NASA Center: LERC

Abstract: Innovative approaches to solve the problems encountered at both the anode and cathode of the hydrogen-bromine battery system are addressed. Advanced inert catalysts will be prepared as the positive electrode material and tested for their resistance against bromine intercalaton and subsequent degradation. Similarly, novel electro-catalysts will be used for the negative electrode to improve the resistance against bromide poisoning.

Proposal Number: 10.02 5110
Project Title: **Silicone and Silicone-Imide Copolymers for Solar Cell Encapsulation**

Company. GUMBS ASSOCIATES, INC.
26 AVENUE B
NEWARK, NJ 07114

Principal Investigator. GUMBS, RONALD

Contract Number NAS7-930 Amount $49,400 NASA Center JPL

Abstract A series of elastomeric silicones and silicone-imides will be synthesized and screened for application as solar cell encapsulants in photovoltaic arrays to be deployed in space. Key physical properties such as the tensile modulus, optical absorbance over 300 nm-1100 nm, long-term stability in vacuum UV, refractive index, and thermal properties as well as charging and flammability characteristics will be evaluated in a preliminary fashion in order to select one or more promising candidates during Phase I A limited number of cells will be encapsulated during this period in order to demonstrate feasibility Scale-up of synthesis, development of optimum processing techniques, and accelerated and life-testing activities will be deferred until Phase II The ultimate goal is to develop tailored encapsulation packages for both the current generation and lightweight, thin film solar cells which may be used in the future. This development will significantly reduce the weight of solar arrays, and will eventually find many commercial as well as military applications

Proposal Number. 10.03 6000
Project Title: **High Efficiency Radiation-Resistant Indium Phosphide Solar Cells**

Company: SPIRE CORPORATION
PATRIOTS PARK
BEDFORD, MA 01730

Principal Investigator. SPITZER, M B.

Contract Number: NAS3-24395 Amount. $49,501 NASA Center. LERC

Abstract. This research addresses the feasibility of fabricating radiation-resistant high efficiency space solar cells from indium phosphide Research in Phase I is directed at the evaluation of present-day processes for (1) cell fabrication and includes (1) cell modeling to determine optimal cell design, (2) process research to evaluate fabrication techniques such as ion implantation, and (3) prototype cell fabrication to evaluate the cell fabrication techniques under investigation The cell structure to be investigated is

the conventional p/n junction. The ultimate objective of Phase I is the identification of a feasible solar cell fabrication process for this structure Phase II will comprise in-depth research of aspects of cell fabrication as well as investigations of radiation sensitivity of the devices.

Proposal Number: 10:04 2221A
Project Title: **Measurement of Reversing Flow Pressure Drops in Stirling Engine Heat Exchangers**

Company: SUNPOWER, INC.
6 BYARD STREET
ATHENS, OH 45701

Principal Investigator: WOOD, GARY

Contract Number: NAS3-24396 Amount· $50,000 NASA Center· LERC

Abstract: One of the important factors affecting Stirling engine efficiency and performance is the pumping loss through the heat exchanger loop. The flow through these heat exchangers is oscillatory, a condition for which sufficient test data does not exist It has been realized from engine test results that the pressure drop through this loop must be greater than that predicted using steady unidirectional flow data Phase I of this project is to design a test rig which can be used to accurately measure this oscillatory flow pressure drop through heat exchangers and regenerators over a wide range of operating frequencies and mean pressures. Fabrication of the hardware would be performed under Phase II Also under Phase II, testing of many configurations of heat exchangers and regenerators would be performed for several working fluids This would result in valuable information for the design and optimization of Stirling engines, in both the NASA Automotive Stirling Program and the NASA Space Power Program

Proposal Number. 10.04 7039
Project Title: **A Deployable 1 MW Solar Concentrator with Receiver and Heat Storage**

Company: ENERGY SCIENCE LABORATORIES, INC
11404 SORRENTO VALLEY ROAD
SAN DIEGO, CA 92121

Principal Investigator. CARROLL, JOSEPH A

Contract Number NAS3-24397 Amount $49,881 NASA Center. LERC

Abstract· U S. research on dynamic space power conversion technology since the 1960s has focused mainly on nuclear reactors, heat pipes, and heat engines. Little work has been done on STS-compatible solar concentrators This study refines our design of an umbrella-like concentrator which should: (1) weigh significantly less than 400 kg, (2) stow in the space reserved for the 2nd shuttle RMS arm, and (3) deliver 1 MW to a receiver not much larger than one square meter. The baseline receiver & storage designs involve heat transport by heat pipes or by MHD-pumped lithium, and sensible heat storage in liquid lithium. Efforts here are on container materials selection using existing data bases. Hot-side thermal storage provides 3 major benefits in a dynamic power system: (1) engine & radiator can be downsized 40%, (2) thermal transients in engine & radiator are minimized, and (3) storage batteries are not needed for darkside power. The study also addresses the compatibility and output of this system with Stirling, Brayton, Rankine and sodium/BASE thermoelectric engines, and considers other non-heat-engine applications for the concentrator

Proposal Number 10.07 5030
Project Title: **An Expert System for Space Power Design**

Company. CREATIVE ENTERPRISES
10323 RUE FINISTERRE
SAN DIEGO, CA 92131

Principal Investigator COOPER, RALPH S.

Contract Number. NAS3-23900 Amount: $49,293 NASA Center: LERC

Abstract· This project will apply an emerging artificial intelligence technique, "expert systems," to the task of configuring, designing and evaluating space power systems This method emulates the processes employed by an expert professional in the field but can be used by nonexpert engineers as well. The knowledge base developed for the program can be much larger and more accurate than that of any single expert and readily accessed. Phase I evaluates the feasibility of applying this method by creating and exercising NOVICE, a primitive expert system that contains the essential elements. In addition, it investigates novel techniques for improving performance by an interactive computer/ expert mode and for introducing "innovation generators" that stimulate the human to create innovative designs. Phase II would cover the development of a true expert system with a complete data base that would be useful for conceptual design of space power systems The design approach, the data base and the novel techniques also would be useful in themselves.

Proposal Number. 10.08 1140
Project Title: **Thermally Stable Electrolytes for Rechargeable Lithium Batteries**

Company: COVALENT ASSOCIATES, INC.
52 DRAGON COURT
WOBURN, MA 01801

Principal Investigator: KOCH, VICTOR R.

Contract Number. NAS7-944 Amount: $74,690 NASA Center JPL

Abstract: The key problem inhibiting the development of high energy rechargeable Li batteries is the poor cycleability of the Li electrode Although major advances in this technology have been made over the last five years, significant improvements in controlling Li-electrolyte reactivity are still required Solvents such as 2-methyltetrahydrofuran, 2-methylfuran, and 3-methylsulfolane are known to be stable toward Li. However, all of these solvents must employ $LiAsF_6$ as a supporting electrolyte to achieve Li electrode cycling efficiencies in excess of 98%. This salt is thermally unstable in prototype batteries, which greatly limits the applicability of rechargeable Li technology. This problem will be addressed by synthesizing and purifying several new Li salts for evaluation in several organic solvents. These new electrolytes will undergo a variety of physical, chemical, and electrochemical tests so as to assess the feasibility of their use in rechargeable Li batteries.

TOPIC 11. SPACE PROPULSION

Proposal Number: 11 03 1856A
Project Title: **Temperature Sensitive, Variable Area Flow Regulator for Joule-Thomson Nozzles**

Company: GENERAL PNEUMATICS CORPORATION
7662 EAST GRAY ROAD, #107
SCOTTSDALE, AZ 85260

Principal Investigator: WALKER, GRAHAM

Contract Number: NAS10-11144 Amount. $50,000 NASA Center: KSC

Abstract: Cryocoolers and gas liquefiers utilize isenthalpic expansion of cooled gas in Joule-Thomson nozzles To effectively optimize usage of the compressed gas, a variable gas mass flow rate is necessary. A high flow rate is required initially with a progressive reduction as the design condition is attained and intermittent flow thereafter depending on the load demand. This project incorporates innovative approaches to achieve this desirable load demand characteristic in Joule-Thomson nozzles and also to virtually eliminate a common problem of Joule-Thomson nozzles: orifice blockage by condensed contaminants in the working fluid These two objectives are accomplished by the effective combination of materials having different coefficients of thermal expansion and by design for expansion in a tapered annulus equipped with labyrinth flow spoilers (also serving as catchment reservoirs for condensed contaminants). The effort is specifically directed to gas liquefiers used to condense the vapor boil-off from hydrogen and oxygen fuels stored on spacecraft in insulated dewar vessels at cryogenic temperature.

Proposal Number: 11.06 0511
Project Title: **Internal Fluid Mechanics of Liquid Propellant Rocket Thrust Chambers**

Company: SCIENTIFIC RESEARCH ASSOCIATES, INC
P.O BOX 498
GLASTONBURY, CT 06033

Principal Investigator GIBELING, HOWARD J.

Contract Number. NAS8-35274 Amount. $49,960 NASA Center: MSFC

Abstract: This project addresses a computer code capable of accurately simulating the internal fluid mechanics of liquid propellant rocket thrust chambers using a combined Eulerian-Lagrangian description. Such a code will be extremely useful in conducting a parametric study of the effect of design parameters on engine performance and in studying the performance of thrust chambers with variable thrust While the long term goal of the effort is the development of a code to simulate the multi-component, multi-phase, reacting flow in realistic thrust chambers, the objective of the Phase I effort is to establish the feasibility of the approach by simulating the flow field in a simplified model thrust chamber involving single-component, two-phase, non-reacting flow of evaporating "propellant." This objective will be achieved by suitably modifying an existing multidimensional, time-dependent Navier-Stokes code to include the Lagrangian description of the droplet dynamics.

Proposal Number: 11 07 6000
Project Title **Dry Film Lubrication for Cryogenic Turbopump Bearings Using Cubic Boron Nitride**

Company: SPIRE CORPORATION
PATRIOTS PARK
BEDFORD, MA 01730

Principal Investigator: SIOSHANSI, PIRAN

Contract Number NAS8-35275 Amount $49,980 NASA Center MSFC

Abstract: High speed cryogenic turbomachinery requires reliable dry film lubricants in the main shaft to support rolling element bearings The lubricant presently used has a very short lifetime, causing unacceptable wear on the bearings once the dry films are depleted Research is required to develop highly reliable dry films lubricants which can dramatically improve the lubricant life in liquid oxygen and liquid hydrogen turbopumps. A low friction, high hardness lubricating film of cubic boron nitride

fabricated by ion beam deposition is likely to be suitable. It is anticipated that the cubic boron nitride will have friction properties similar to diamond-like carbon films and will extend the functional life of the cryogenic turbopumps

TOPIC 12. HUMAN HABITABILITY AND BIOLOGY IN SPACE

Proposal Number: 12.01 2484
Project Title: **Water Quality Monitoring (Organic Content) Application and Sensors Integration**

Company ASTRO RESOURCES INTERNATIONAL CORPORATION
100 PARK AVENUE
LEAGUE CITY, TX 77573

Principal Investigator: EJZAK, EDWARD M

Contract Number: NAS9-17282 Amount $50,000 NASA Center. JSC

Abstract: Today, water quality monitoring, specifically total organic carbon (TOC), usually requires certain consumable reagents (such as acids, persulfates) and expendable gases (such as oxygen and carbon dioxide) to perform the analysis. TOC is basically a parameter used in industry and by other federal agencies (specifically the EPA) to measure organic content on a non-selective basis The primary purpose of this investigation is to identify other end detection and/or primary oxidation methods for quantitative organic content monitoring Starting with current commercial UV/ Persulfate Oxidation – sparge – CO_2 gas detection system, other types of CO_2 detectors for both liquid and gas phases will be examined. Second, the oxidation system will be modified to enable the use of alternate "delta" detection devices for measurement of carbon or other analagous parameter (which directly represents organic content) in either the ionic or gaseous form The secondary purpose is to study the integration of all water quality monitoring sensors (from various vendors) required for long term space flight into a single unit This will eliminate sample handling systems replication and transport time while minimizing volume and mass requirements Integration may tend to improve total system reliability and accuracy as some sensors may operate synergistically or eliminate the need for redundant manual analysis

Proposal Number: 12.01 4100
Project Title **A Novel Membrane-Based Water Reclamation Post-Treatment Unit**

Company BEND RESEARCH, INC
64550 RESEARCH ROAD
BEND, OR 97701-8599

Principal Investigator RAY, RODERICK J.

Contract Number. NAS9-17286 Amount: $49,469 NASA Center. JSC

Abstract. For future long-term space missions spacecraft water recycle systems are now under development One water recycle system studied by NASA includes a reverse-osmosis (RO) subsystem that will produce reusable water from wash waters The concentrate from the RO subsystem will be combined with urine and distilled to recover more water This project will investigate the use of an additional RO component as the initial step of the post-treatment required to remove the contaminants that are left in the phase-change subsystem distillate. This RO unit will use the same, novel, fouling-resistant composite hollow-fiber membrane modules being developed for NASA for the recycle of spacecraft wash waters, as well as for other applications for which fouling resistance is important If RO is used as the initial step in the treatment of the distillate, then the load on the remaining conventional distillate treatment steps will be reduced, allowing a much longer life for the expendable components. Furthermore, this membrane unit will act as a barrier to protect the rest of the post-treatment train

should the phase-change subsystem fail The Phase I program will determine the feasibility of using these RO membrane modules for post-treatment applications by testing them on synthetic and actual distillates The Phase II effort would begin to develop flight hardware.

Proposal Number: 12.01 8371
Project Title. **Anti-Bacterial Agent for Water Post-Treatment Sorbent Beds**

Company: SPRINGBORN LABORATORIES, INC.
10 SPRINGBORN CENTER
ENFIELD, CT 06082

Principal Investigator: BAUM, BERNARD

Contract Number: NAS9-17285 Amount: $49,945 NASA Center: JSC

Abstract: Potentially toxic microorganisms can grow in activated carbon and ion exchange beds used for post-treatment in spacecraft water recovery systems Ordinary biocides dissolve in water and, if used, would leach from the beds. This project involves bound biocides that would not leach into water or affect the purification properties of post-treatment systems. Two approaches will be taken using biocidal agents that are made non-leachable by chemical or free radical attachment to the post-treatment bed: (1) quaternary ammonium monomer biocides attached to carbon or ion exchange resin surface via chemical reaction or by free radical grafting using cerium, ozone, peroxide, or UV activation and (2) in situ bonding of zinc peroxide with carbon black and/or ion exchange resin formed by reaction of zinc acetate with hydrogen peroxide in situ. For bed treatments, test methods for observing growth of bacteria on an anion exchange or activated carbon bed will include either ASTM G21(22) and/or the development of a more rapid test method using circulating river water Modified activated carbon and ion exchange beds will be examined for possible loss of purification properties, and the effluent will be analyzed by mass spectrometry for presence of toxic products.

Proposal Number: 12.02 5090A
Project Title: **Space Adaptation**

Company: ESSEX CORPORATION
1040 WOODCOCK ROAD
SUITE 227
ORLANDO, FL 32803

Principal Investigator: KENNEDY, ROBERT S

Contract Number: NAS9-17278 Amount $50,000 NASA Center: JSC

Abstract: This project study sets out to address a biomedical problem (the space adaptation syndrome) by combining technologies available in perceptual psychology and human factors engineering Although motion sickness-like symptoms have occurred in about half of the space travellers in NASA's Shuttle and Skylab programs, all or nearly all have adapted while aloft This project will undertake a literature review as well as conduct an experiment on the adaptation process The primary purpose will be to determine whether lawful relationships govern transfer of learned behaviors from one set of stimulus conditions to another The secondary objective will be to determine the extent to which certain individuals possess greater facility at adapting to altered perceptual stimuli than others A traditional perceptual-motor rearrangement study (using prismatic displacement) will be transferred to a traditional human factors problem (tracking performance with a set of incompatible control display relationships)

Proposal Number: 12 02 8606
Project Title. **Tissue Fixation Apparatus for Flight Experimentation**

Company: PHYTORESOURCE RESEARCH, INC
707 TEXAS AVENUE
SUITE 207-D
COLLEGE STATION, TX 77840

Principal Investigator SCHELD, H W

Contract Number NAS9-17291 Amount: $50,000 NASA Center. JSC

Abstract· The complex biological research aimed at probing biological response on shuttle/spacelab or space station will involve the in-flight treatment of cells, tissues or small organisms in preparation for microscopic analysis. There is a need for equipment capable of performing the broad range of tissue treatment functions required by modern cell analysis techniques. This research effort develops an item of modular flight research hardware which will meet the requirements of a broad range of plant and animal cell experiments in the environment-controlled growth and chemical treatment of cultured cells, tissues or organisms A set of design criteria will be established Available equipment will be evaluated for use unmodified, and then, in derivative form, utilizing functional bread-board models to test and demonstrate approaches. Concepts will be developed in bread-board form which can perform the needed manipulative and support functions for the foreseeable range of flight experiments The selected concepts will be fabricated to the necessary levels of fidelity to flight configuration and tested against a set of experimental situations anticipated for flights. Results of development tests will be incorporated into a set of development hardware upon which design/fabrication of the final hardware will be based.

Proposal Number. 12.04 8606
Project Title: **In-Flight Acquisition of Engineering Data for Plant Growth Systems Design**

Company PHYTORESOURCE RESEARCH, INC
707 TEXAS AVENUE
SUITE 207-D
COLLEGE STATION, TX 77840

Principal Investigator: SCHELD, H. W.

Contract Number NAS9-17292 Amount $50,000 NASA Center: JSC

Abstract· The use of higher plants in support of space habitability is a logical and reasonable goal in planning for long term space activity However, the concepts and data for accomplishment of this goal are not currently available. The basis for this project is the recognition that effective design of zero g-rated systems for plant culture will depend upon availability of a baseline of biophysical data generated under zero gravity conditions This project will undertake the development of a system for routine exposure of plants or plant models aimed at generation of the necessary engineering data A protocol for repetitive test cycles keyed to successive Shuttle flights and a standard test chamber for containment of test fixtures will be developed A routine program of tests will be planned for a period of several years with a gradual incorporation of data into predictive models of plant growth and productivity in micro-g. The accumulating results of these studies will be utilized in optimization of increasingly large and complex space-rated plant culture systems.

Proposal Number 12 05 0298
Project Title· **Cellulose Conversion for CELSS**

Company. CELLULOSE CONVERSION ENTERPRISES
P.O. BOX 9315
BERKELEY, CA 94709

Principal Investigator. MALACHOWSKI, M J

Contract Number. NAS2-12096 Amount· $47,683 NASA Center. ARC

Abstract· Astronauts in space live in an enclosed ecological life support system where the non-digestible fraction of comestible biomass accumulates. For short duration missions, an astronaut's metabolic needs are met from on-board stores-and-their wastes disposed However, the waste fraction represents a significant amount of bulk, as well as mass and stored energy, and, therefore, for long term missions, required recycling Progress in biotechnology has reached a point where it is possible to obtain enzymes capable of hydrolyzing the carbohydrates in biomass to their component basic sugars In general, biological methods, enzymatic conversion makes possible the production of sugars, basic chemicals, and foods from the large amounts of lignocellulosic materials now treated as waste Of special interest is the conversion of cellulose to its monosaccharide glucose, blood sugar The purpose of this project is to provide information on a simple small scale enzymator/hydrolyzor (EH) unit capable of reducing the astronaut's non- digestible vegetative waste fraction. The EH unit can be incorporated into NASA's Controlled Ecological Life Support System (CELSS) and will be part of our Waste Management Module (WMM) of the Space Farm, a system symbiotic and complementary to an astronaut's needs Possible products of a WMM are glucose or other sugars, alcohols, aldehydes, organic acids, methane, vitamins, salts, sludge, and water The EH system will be designed to facilitate research for the determination of pertinent conversion parameters, to test computer simulation (modeling), and to serve as a test bed for instrumentation

Proposal Number 12 05 3309
Project Title **An Animal Development Habitat for Space Biology**

Company: STAR ENTERPRISES
3595 N HINKLE ROAD
BLOOMINGTON, IN 47401

Principal Investigator. ALBERTS, JEFFREY R

Contract Number. NAS2-12113 Amount: $50,370 NASA Center ARC

Abstract· Current life-support systems for experimental animals cannot be used for developmental studies of animals in space An innovative approach to the design of an animal development habitat, compatible with the middeck lockers of the Space Shuttle, is based on studies of naturally-occurring maternal burrows of rodents, surface/volume ratios of different habitat configurations, and analysis of physiological and behavioral requirements The design will also incorporate current and projected science requirements, as indicated by compilation of several science reviews, as well as interviews of investigators Phase I work will culminate with the production of a full-size model of an animal development habitat The habitat will embody new principles of life-support for animals in space, particularly those relevant to welfare of the animals and the conduct of a broad program of developmental studies in space biology

Proposal Number 12 06 4787
Project Title: **Radon Property Detection System for Global Biologic Studies**

Company GULL ENGINEERING, INC.
78 MITCHELL ROAD
OAK RIDGE, TN 37830

Principal Investigator: WALFORD, GRAHAM V.

Contract Number NAS2-12097 Amount $50,000 NASA Center. ARC

Abstract: The data obtained from measurement of radon progeny at remote locations and varying altitudes yields valuable information on geologic phenomena and conditions, and on global bio-geochemical transport mechanisms The surface generation of radon, and its short half-life permits evaluation of air mass movement This is of particular value if measured on a near real-time basis. A real time air sampler and measurement system for radon daughter products has the potential of being the most sensitive monitor possible for the above measurements Theoretical and experimental design studies are required in Phase I to identify the optimum air sampling geometry, and the best combination of detector and shield configuration Conceptual work will also be performed on the mechanical sample transport and the control and data acquisition electronics Particular emphasis will be placed on the ruggedization of the system to provide a complete and self-contained monitor package capable of operating in harsh conditions while performing sensitive spectroscopic measurements. In Phase II, the monitor system will be fabricated and flight tested to verify its measurements performance and sensitivity, and its value in global studies.

Proposal Number. 12.06 9500
Project Title: **An Open Path Diode Laser Flux Meter for Trace Gases of Biogenic Origin**

Company: AERODYNE RESEARCH, INC
45 MANNING ROAD
BILLERICA, MA 01821

Principal Investigator: STANTON, ALAN C

Contract Number: NAS2-12117 Amount. $49,858 NASA Center ARC

Abstract: The purpose of this project is to design and develop an instrument to measure fluxes of trace gases in order to determine their sources and sinks in the biosphere The method is based on the well established eddy correlation technique and would use a tunable diode laser source combined with a unique open path multiple pass absorption cell for trace species detection at sub-ppb levels This instrument will have the fast time response (0 1 s) and short measurement path (1 m) required for the eddy correlation method In the Phase I study, the open path absorption cell will be designed, assembled, and tested in order to validate the measurement concept and define sensitivity limits These tests will be conducted in combination with a laboratory tunable diode laser system and will include open path measurements of trace gases such as nitrous oxide. Optimum detection wavelengths for several gases will be determined in the Phase I program, including nitrous oxide, methane, carbon monoxide, ammonia, carbonyl sulfide, and carbon disulfide. The results of the Phase I effort are expected to resolve critical design issues and permit the development of an instrument for field use in Phase II

TOPIC 13. QUALITY ASSURANCE, SAFETY, AND CHECK-OUT FOR GROUND AND SPACE OPERATIONS

Proposal Number: 13.02 2863
Project Title **Computer Software for Signal Processing for Multiple, Mixed NDE Transducers**

Company: APTECH IMAGING, INC
795 SAN ANTONIO ROAD
PALO ALTO, CA 94303

Principal Investigator: FOUSE, SCOTT D

Contract Number: NAS10-11145 Amount $49,636 NASA Center: KSC

Abstract: There is a need for rapid, accurate, cost-effective non-destructive evaluation (NDE) of reusable flight hardware components and systems after each use to determine whether or not they have reached the end of their useful (safe, reliable) life Flaws and defects

which influence this useful life include cracks, delaminations, voids, density variations and entrapped moisture A variety of NDE techniques are required to detect these defects, including, but not limited, to radiography, acoustic emissions, eddy currents and interferometry This project will develop a computer software package which receives the signals from several NDE transducers of different type and then integrates these signals to maximize the information for a given defect. The ability to combine different types of NDE information will significantly improve the ability to determine the significance of the defect.

Proposal Number: 13.03 5911
Project Title: **Hydrogen, Oxygen Monitoring Device**

Company: CAPE COD RESEARCH, INC
P O. BOX 600
BUZZARDS BAY, MA 02532

Principal Investigator: WALSH, MYLES

Contract Number. NAS10-11146 Amount $49,999 NASA Center. KSC

Abstract: This project concerns a real time hydrogen, oxygen monitoring device that, if successful, could help assess the status of a rocket launch environment The device is simple, operable with minimal attention and relatively inexpensive so that a number of devices could be strategically located. The research explores the feasibility of electrochemically sensing hydrogen and oxygen with a novel miniature electrode If this approach is successful, it will lead to the development of a rugged, fast, inexpensive and accurate device for monitoring these gases in the field. The Phase I demonstration involves the construction and testing of the proposed structure. Special attention is paid to the reliability, response time, selectivity, accuracy, precision and detectivity of the device

Proposal Number· 13 05 1424
Project Title. **Forecasting Sea Breeze Thunderstorms Using a Mesoscale Numerical Model**

Company. R*SCAN CORPORATION
511 ELEVENTH AVENUE SOUTH
MINNEAPOLIS, MN 55415

Principal Investigator. LYONS, WALTER A.

Contract Number. NAS10-11142 Amount: $48,149 NASA Center KSC

Abstract: The Prognostic Three Dimensional Mesoscale (P3DM) model, originally developed by N0AA as a Florida sea breeze model, has undergone over a decade of continuous development Initial studies suggested that there was a strong correlation between regions of predicted mesoscale surface convergence and the initial formation of sea breeze triggered thunderstorms under synoptically undisturbed conditions. These conditions may account for 30-40% of the thunderstorms experienced in the vicinity of KSC With new supercomputer capabilities, the P3DM can be exercised at relatively low cost. A new lightning position and tracking system covering all Florida provides an available source of data to monitor areas of convective initiation Case studies are used to evaluate the possible use of the P3DM to provide several hours advanced indication of the location of formation and initial character of sea breeze thunderstorms This work could form the basis of a future real-time system to support various KSC operations

Proposal Number 13 08 8581
Project Title: **Nonadiabatic Compartment Venting Heating**

Company: REMTECH, INC
2603 ARTIE STREET
SUITE 21
HUNTSVILLE, AL 35805

Principal Investigator: ENGEL, CARL D.

Contract Number: NAS8-35277 Amount $50,000 NASA Center MSFC

Abstract. Launch vehicles have many compartments which are vented to the local external environment. Local high pressure areas can cause high enthalpy flows into compartments at one location which are vented at other locations during ascent During reentry, high enthalpy gases are entrained and expelled from vented compartments during the tumbling motion of the vehicle The internal components must be protected from the high enthalpy gas For example, poor protection could produce parachute overheating, yielding vehicle loss or damage on impact Current techniques use adiabatic venting codes and a decoupled heating analysis The high area and large mass of surrounding structure invalidates this approach and produces over conservative heating predictions. This results in unnecessary and costly internal thermal protection materials to be applied and TPS closeout requirements The computer tool needed to appropriately address these questions does not exist and should consist of a nonadiabatic venting code coupled with a set of free and forced convection internal heating options and transient conduction routines

Proposal Number: 13.08 8581C
Project Title: **Space Flight Gas Temperature Probe**

Company: REMTECH INC
2603 ARTIE STREET
SUITE 21
HUNTSVILLE, AL 35805

Principal Investigator BENDER, R L

Contract Number. NAS8-35276 Amount $50,000 NASA Center MSFC

Abstract: The current Space Shuttle gas temperature probe designs have not provided adequate data for evaluation of the base heating process during the ascent flight stages in which heating is most severe These designs have inadequate thermal responsiveness as well as insufficient accountability for gage thermal inputs from the radiation, convection and conduction environments An analytical approach is presented with the objective of defining an optimal probe configuration based on parametric calculations of the probe responses which are most likely to meet the design requirements. Existing thermal probe models will be modified to allow the required calculations Using the available Space Shuttle base heating flight data, calculations of the thermal response and accuracy of a given probe design will be made and compared to similar calculations with different probe configurations. Previous work with gas probes utilized on Space Shuttle model tests have indicated that a multiple sensor (2 or more) probe has distinct accuracy advantages over single sensor designs The parametric evaluations will concentrate on a multi-probe design Second phase efforts would include finalization of construction drawings, construction of a test probe, conducting laboratory tests, and construction and utilization of one or more flight probes

Proposal Number: 13 10 0900A
Project Title: **Innovative Rotary Power System Recharger Subsystem**

Company. SPARTA TECHNOLOGY, INC
258 EAST ALTAMONTE DRIVE
HIGHWAY 436
ALTAMONTE SPRINGS, FL 32701

Principal Investigator OWENS, LESTER J.

Contract Number: NAS10-11143 Amount: $48,668 NASA Center: KSC

Abstract. Hydraulic power systems presently in use can be very light and reliable (as shown by aircraft use), can be extremely rugged and dependable as shown by earth moving equipment and machine tools; and can operate in very hostile environments, as demonstrated by Space Shuttle systems. When electrical power is not available or conditions preclude internal combustion engines, sparks and heat sources, hydraulic systems are very attractive if stored energy (accumulators) can supply sufficient power for the needed task. A practical accumulator recharging system could have many uses This project develops a concept for recharging hydraulic accumulators through the point of analytical proof of principle. Analyses of test data will permit full assurance of identifying any impact to the environment or to safety caused by the recharger The Phase I effort parametrically analyzes accumulator size/weight verse recharge cycle, cycle frequency/quantity verse efficiency and pressure ranges verse system weight/efficiency A preliminary design of a demonstration rotary hydraulic power pack containing an automatically controlled recharge system and analytical data to support the prediction of the probability of successful hardware is developed.

Proposal Number. 13 12 7886
Project Title: **High Speed Pneumatic Valve**

Company ATHENA LABS, INC.
2121 NELA AVENUE
ORLANDO, FL 32809

Principal Investigator READEY, HARVEY

Contract Number: NAS9-17279 Amount $35,620 NASA Center: JSC

Abstract: A need exists for a rapid action valve with a minimum pressure capability of 20,000 psi and with a minimum flow passage area of 0 05 square inch for use in high pressure oxygen test systems. The approach in this project provides unique design features that reduce necessary actuation power to existing state-of-the-art rapid action electrical solenoids These solenoids are capable of stroking the valve gate system in 3 milliseconds The key feature of this valve that allows attaining the required operating time is an internally bearing supported gate The project objectives will be to verify the valve design techniques that reduces the actuation power to the range of the simple high speed solenoid Theoretical work will optimize valve component sizing including actuator power requirements Laboratory simulations will be conducted to verify the predicted response time performance of critical features under actual load conditions Based on Phase I research, a preliminary prototype valve design will be established for Phase II fabrication and test.

TOPIC 14. SATELLITE COMMUNICATIONS

Proposal Number: 14.01 6642
Project Title: **Advanced Low-Cost Universal 20 GHz Monolithic Receiver Front-End**

Company: MICROWAVE MONOLITHICS, INCORPORATED
465 E. EASY STREET
SIMI VALLEY, CA 93065

Principal Investigator PETERSEN, WENDELL C.

Contract Number. NAS3-24246 Amount $50,000 NASA Center LERC

Abstract: This project will study the design of a monolithic microwave integrated circuit (MMIC) implementation of a versatile, low cost, multi-band 20 GHz receiver front-end. The technical highlight of the receiver front-end MMIC chip set is an innovative local oscillator (LO) approach for universal applicability including the 30/20 GHz communications systems and the 22-23 GHz bands. Phase I concentrates on the detailed design and analysis of the critical low noise amplifier (LNA) and LO chips to show concept feasibility. Included in the Phase I study are accurate estimates of chip performance and overall performance of the receiver front end Design of the remaining non-critical components, including the mixer and IF amplifier, will be completed in Phase II; a mask tool set will also be generated at that time and used to fabricate the chip set The design frequency band is tentatively set at 17 7-20.2 GHz This will permit adaptation to neighboring frequencies with minor mask modifications

Proposal Number 14.02 2913
Project Title: **Multi-User Programmable Modem**

Company: TELECOMM SCIENCE ASSOCIATES, INC
2560 FIRST AVENUE
SUITE 105
SAN DIEGO, CA 92103

Principal Investigator: EISENBERG, B. R.

Contract Number NAS3-24247 Amount: $49,769 NASA Center LERC

Abstract Individual satellite users are restricted in connectivity because the satellites are not capable of processing all available user modulation waveforms. Greatly increased satellite availability and user connectivity would be possible if all new satellites were capable of processing the wide variety of commonly used modulation waveforms This Phase I effort researches preliminary designs leading toward a Phase II preliminary development of a multi-user, programmable modem This device, intended for satellite, Space Station and ground sites, will provide for modulation, acquisition, tracking and demodulation of a wide variety of commonly used modulation waveforms including BPSK, QPSK, OQPSK and MSK; as well as analog AM and FM voice The modem will feature. (1) real-time operator-selectable or ground up-link commandable modem configuration changes, (2) automatic demodulator signal recognition; and (3) simultaneous demodulation of several waveforms The Phase I effort encompasses· (1) identification of common and unique algorithm among the modulation waveforms; (2) algorithm partitioning into efficient processing functions; (3) identification of processing speed requirements and channel data rates for various technologies suitable for implementation; and (4) associated analytical support and computer simulations for performance verification.

Proposal Number: 14.02 6642
Project Title: **Advanced GaAs Monolithic 20 GHz RF Switch Matrix for Spacecraft Applications**

Company: MICROWAVE MONOLITHICS INCORPORATED
465 E. EASY STREET
SIMI VALLEY, CA 93065

Principal Investigator: CH'EN, DANIEL R.

Contract Number: NAS3-24248 Amount: $50,000 NASA Center. LERC

Abstract: A novel, advanced, monolithic GaAs RF switch matrix for satellite communications applications using a design concept originally developed for a monolithic GaAs IF switch matrix will be studied for application to RF switching applications Preliminary estimated RF switch matrix parameters indicate that attractive performance for large arrays appears feasible at 20 GHz, encouraging further verification followed by implementation. In this approach, passive FET switches are used for signal steering, while FET buffer amplifiers provide an overall insertion loss of 0 dB, allowing two dimensional cascading to form very large arrays (perhaps up to 100 × 100), also with 0 dB insertion loss. A proprietary packaging concept will also be investigated during phase I to facilitate the modular construction of large crosspoint matrices and the interface of the monolithic IF switch matrix to other systems components Phase II will concentrate on demonstration of the monolithic RF switch matrix concept by fabrication of a 3 × 3 matrix and design of a 10 × 10 (or TBD size) switch matrix. The ultimate goals of this program will be a space qualifiable RF switch matrix technology for advanced satellite communications systems, significantly enhancing communications capabilities while simultaneously reducing satellite complexity

Proposal Number: 14.03 3220
Project Title **Multi-Access Technique Evaluation Simulator**

Company: STANFORD TELECOMMUNICATIONS, INC.
6888 ELM STREET
MCLEAN, VA 22101

Principal Investigator. ZAKRZEWSKI, EDWIN J

Contract Number NAS9-17281 Amount: $49,990 NASA Center JSC

Abstract This project concerns a technique which combines the inherent time benefits of an analytic modeling approach for investigating communication channels with the flexibility of a Monte Carlo direct simulation approach into a single integrated software package The resultant mathematical modeling tool is fully generalized and will allow an analyst to evaluate anticipated performance levels of candidate multiple access communication systems The goal of this research is to demonstrate that this hybrid analysis technique provides a flexible, accurate and reliable tool without requiring large computer resources This goal will be achieved through flexible options for selecting the software analysis technique and innovative approaches to chaining data flow through the communication link components The unique aspect of this research is the combining of these often competitive approaches into one fully flexible software tool as one investigates the communication channel of interest. The Phase II proposed effort is concerned with extending the Phase I prototype to provide a dynamic environment for the transmission signal. The dynamic model will allow one to evaluate details of the multi-access scheme between the Space Station and free flyers which account for orbit dynamics, multi-path, RFI, etc

Proposal Number. 14 04 9000
Project Title **Intersatellite Optical Communications High Power Laser Transmitter**

Company. GENERAL OPTRONICS CORPORATION
2 OLSEN AVENUE
EDISON, NJ 08820

Principal Investigator. WANG, C S.

Contract Number. NAS5-28644 Amount: $50,000 NASA Center: GSFC

Abstract: The primary objective of this program is to develop a phase-locked laser diode array that can deliver output power greater than 200 mW The diode should have long life and be capable of modulated bandwidths greater than 500 MHZ The output beam should be

able to be collimated to within one milliradian so that it is suitable for long distance space communication The Phase I effort investigates two different structures of laser diode arrays One is the planer large optical cavity laser array and the other is a laser array based on a high power CNS-DCC-LOC single mode laser Laser arrays with stripes numbering between three to ten are investigated for both cases. It is believed both structures will yield devices that meet the stated requirements

Proposal Number: 14 06 0200
Project Title: **Low Overhead Error Protection for LPC+ Digitized Speech**

Company TIME & SPACE PROCESSING, INC
3410 CENTRAL EXPRESSWAY
SANTA CLARA, CA 95051

Principal Investigator: RADIN, LON

Contract Number: NAS7-929 Amount: $49,680 NASA Center JPL

Abstract. A new family of low overhead error redistributing (LOER) coding techniques will be explored. Codes in this family introduce a small bit error rate but concentrate the transmission bit errors on some of the bits while shielding certain other bits This LOER coding technique is combined with a data quality indicator (DQI) signal from the modem to yield an algorithm for transmission of linear predictive coding (LPC) speech over fading mobile satellite channels. This algorithm uses LOER coding to minimize the effect of bit errors and the DQI signal to trigger inter-frame smoothing of LPC model parameters The LOER coding scheme is implemented in a real time voice digitizer. The DQI signal is implemented in a mobile satellite modem These devices are interfaced and the overall effect of the error protection algorithms is measured in actual listening tests.

Proposal Number. 14.07 3319
Project Title: **Low Power Digital Controller for Laser Communication**

Company· THE NAVTROL COMPANY
9204 MARKVILLE DRIVE
DALLAS, TX 75243

Principal Investigator BROWN, RICHARD J.

Contract Number: NAS5-28645 Amount· $50,000 NASA Center GSFC

Abstract The objective of this research is the development of a low power digital controller (LPDC) for providing the overall control electronics functions for a highly accurate and stable laser pointing and tracking system to be applied to laser intersatellite communication systems. Reductions in system power, size and weight are to be achieved without sacrifice of performance by application of the latest technology in CMOS VLSI, computer architecture, and advanced control system theory. The computational load for a control system processor to meet laser pointing and tracking requirements is considerable, and without severe design compromises, cannot be handled in conventional microprocessors. With the LPDC processor it can However, more than the design of a low power small processor is involved. The same technology will be applied to reduce size, weight and power of the interface electronics, as well. In addition, advanced system techniques will be applied to cut power used in motors and sensors. Anticipated Phase I results are the conceptual design of such a system and a feasibility assessment including costs. Phase II efforts will lead to a complete control system designed for space applications.

TOPIC 15. MATERIALS PROCESSING, MICRO-GRAVITY AND COMMERCIAL APPLICATIONS IN SPACE

Proposal Number: 15 01 7307
Project Title: **A Color Schlieren System for Large Scale Low-Gravity MPS Fluids Experiments**

Company: SYSTEM SPECIALISTS
11200 CALLE AURORA
TUCSON, AZ 85748

Principal Investigator: POTEET, WADE M.

Contract Number: NAS8-35278 Amount: $37,104 NASA Center: MSFC

Abstract: A number of low gravity materials processing experiments such as crystal growth studies require a specialized optical system capable of flow visualization. Several such systems have been built for use in space and ballistic aircraft flights, including schlieren systems. However, no color schlieren system has been developed for these applications. A color schlieren system produces data more amenable to detailed analysis than a standard schlieren system, and since white light sources are more energy-efficient than lasers, it should be possible with this system to study larger samples under the limited power conditions of flight than has been possible with earlier systems. This project therefore develops and builds a small prototype color schlieren system and tests it on the NASA KC-135 low gravity simulation aircraft. Its suitability for microgravity materials processing applications such as crystal growth and biological experiments requiring simple flow visualization are evaluated, laying the ground work for development of a large scale system.

Proposal Number. 15.03 7039
Project Title: **Ultrafine Particle Production in Micro-Gravity**

Company: ENERGY SCIENCE LABORATORIES, INC.
11404 SORRENTO VALLEY ROAD
SUITE 113
SAN DIEGO, CA 92121

Principal Investigator: WEBB, GEORGE W

Contract Number: NAS8-35279 Amount. $49,623 NASA Center· MSFC

Abstract. Ultrafine particles or powder can be prepared by evaporating material into an inert gas atmosphere The vapor is cooled by the inert gas and becomes supersaturated, leading to particle condensation. However, convection of the inert gas is a severe problem, causing the particles to coalesce into a fewer number of larger particles Analysis suggests that particle production by this technique in micro-gravity has unique advantages This effort will (1) investigate appropriate heating methods, (2) analytically model the particle condensation process, and (3) develop particle collection methods.

Proposal Number: 15.04 7840
Project Title: **Lunar Oxygen Production from Ilmenite**

Company CARBOTEK, INC
2916 WEST T.C JESTER
HOUSTON, TX 77018

Principal Investigator: GIBSON, MICHAEL A.

Contract Number: NAS9-17287 Amount: $50,000 NASA Center. JSC

Abstract. Development of a lunar oxygen production system by direct hydrogen reduction of ilmenite and vapor-phase electrolysis of resultant water vapor is the objective of this project; a by-product, $FeTiO_2$, suitable for shielding material is produced as well Two processes—continuous fluid-bed reduction and semi-continuous fixed-bed reduction—are to be investigated initially The fluid-bed reactor with heat exchange offers good gas-solids heat integration, but suffers from equilibrium conversion limitations The fixed-bed reactor overcomes the equilibrium conversion limitation when equipped for heat removal and water condensing, but this sacrifices the heat integration Therefore, it is important to compare both techniques. Phase I results should enable design of continuous prototype experiments in Phase II to demonstrate process feasibility Phase II would include design of Phase III Shuttle bay tests of critical components to confirm performance for lunar gravity, vacuum and heat transfer conditions.

Proposal Number. 15 04 7840A
Project Title: **Aspen Simulations—Lunar Oxygen Production Facility**

Company: CARBOTEK, INC
2916 WEST T C. JESTER
HOUSTON, TX 77018

Principal Investigator. GIBSON, MICHAEL A.

Contract Number: NAS9-17288 Amount: $50,000 NASA Center. JSC

Abstract: Lunar oxygen production by direct hydrogen reduction of ilmenite and vapor-phase electrolysis of resultant water vapor appears the most promising method. The preliminary ASPEN simulation model to be developed will be based on the assumption of mining ilmenite or removing it from a mare pit using a bucket-wheel excavator feeding a shiftable conveyor system; beneficiation of the ilmenite ore by sieving, electrostatic sizing, magnetic separation, and electrostatic separation, processing of the concentrated ilmenite ore by continuous fluid-bed reduction to produce water vapor which is electrolyzed to product oxygen and recycled hydrogen; and liquefaction and storage of product oxygen for future transport to user facilities The Phase I effort involves· (1) the development of the preliminary flowsheet for the overall mining, beneficiation, processing, and recovery scheme, (2) the development of the ASPEN model based on the preliminary flowsheet, (3) preliminary costing and economic evaluation of the overall scheme, and (4) recommendations for further upgrading of the model by improving design, physical property and costing data. Phase I results would be extended in greater detail in Phase II to optimize the choices of conceptual equipment and their combination to confirm the feasibility of an effective overall process Promising Phase II results would justify major engineering/cost estimating and lunar production planning in a following Phase III program

Proposal Number 15.05 7606
Project Title: **The Large Format Camera: Novel Analyses of Sensor Applications**

Company· AUTOMETRIC, INC
5205 LEESBURG PIKE
SUITE 1308/SKYLINE 1
FALLS CHURCH, VA 22041

Principal Investigator: LUCAS, CARROLL

Contract Number NAS8-35280 Amount $49,357 NASA Center. MSFC

Abstract: NASA plans to place the Large Format Camera in the Space Shuttle for earth sensing missions in 1984 It is believed that the LFC not only has direct utility in cartography, but can be used in a true multispectral sense to answer unique civil requirements Further, because of its geometric fidelity, LFC imagery could be used as a map base for

other multisensor, nonimaging products. This project will (a) investigate the utility of several film reproduction techniques including reproductions from the individual emulsion layers of the color and color IR films, (b) investigate the feasibility of combining the LFC cartographic and multi-spectral hardcopy products with other sensor products, and (c) analyze the multispectral aspects of film products by digitizing, computerizing, displaying, superimposing and enhancing the digital products to support known or anticipated civil requirements.

APPENDIX

SPECIAL CONSIDERATIONS

Final Reports—The results of the Phase I effort will be reported to NASA approximately 30 days after the completion of the work Only a single page summary of each report may be published by NASA in order to accord the small business firm its rights to the data

Data Rights—Rights to data used in, or first produced under, any Phase I or Phase II contract will be specified in appropriate clauses in such contracts, consistent with the following

(1) Some data of a general nature are to be furnished to NASA without restriction (i.e , with unlimited rights) and may be published by NASA These data will normally be limited to the project summary accompanying any periodic progress reports and the final report required to be submitted (see Section 6 2), but in any event, the requirement for them will be specifically set forth in any contract resulting from this solicitation

(2) In keeping with NASA's policy, data which constitute trade secrets or other information that is commercial or financial and confidential or privileged and developed at private expense will not normally be acquired, but, if acquired, will be with "limited rights" or "restricted rights " Such rights do not include the right to use the data for manufacturing or reprocurement purposes

(3) Other than as required by (1) above, rights in data first produced in the performance of a Phase I or Phase II contract will be acquired under use and disclosure limitations for a period adequate to provide incentive for commercialization This may include additional rights for the Government to use the data for governmental purposes, including manufacture and reprocurement, to the extent necessary to meet mission needs

Patents—The contractor will normally have first option to retain title to inventions made in the performance of any Phase I or Phase II contract in accordance with P L 96-517 (35 U S C 200 et seq) This option is subject to the reservations and limitations, including a non-exclusive royalty-free, irrevocable license in the Government and certain march-in rights to assure commercialization, as required by P L 95-517 and implementing regulations thereunder

Whenever an invention is made and reported under any NASA contract, it is NASA policy to withhold other information which may disclose the invention (provided that NASA is notified of the information and the invention to which it relates) for a reasonable time to allow the contractor to obtain patent protection as authorized by Section 205 of P L 96-517 (25 U S C 205)

Program Information—Questions regarding the NASA program may be addressed to

SBIR Manager
Code RS
National Aeronautics and Space Administration
Washington, DC 20546

Individuals or organizations desiring to receive future issues of the NASA SBIR Program Solicitation must write to the address given above If you have written to this office in the past or have submitted a proposal for the SBIR program, you will receive the next NASA solicitation

For specific information about the SBIR programs of other federal agencies, contact each agency individually General information can be obtained from the Small Business Administration

INDEX OF COMPANIES AND PROPOSAL NUMBERS

NASA SBIR 84-1

Atmospheric and Environmental Research, Inc
840 Memorial Drive
Cambridge, MA 02139
Proposal Number 07 06 6207

Autometric, Inc.
5205 Leesburg Pike
Suite 1308/Skyline 1
Falls Church, VA 22041
Proposal Number. 15 05 7606

Bend Research, Inc.
64550 Research Road
Bend, OR 97701-8599
Proposal Number: 12 01 4100

Biospherical Instruments, Inc.
4901 Morena Boulevard
Suite 1003
San Diego, CA 92117
Proposal Number: 08 15 1315

Brimrose Corporation of America
7527 Belair Road
Baltimore, MD 21236
Proposal Number. 08 07 5800B

Cape Cod Research, Inc
P O. Box 600
Buzzards Bay, MA 02532
Proposal Number. 13 03 5911

CARBOTEK, Inc
2916 West T.C Jester
Houston, TX 77018
Proposal Number. 15 04 7840
Proposal Number: 15 04 7840A

Cellulose Conversion Enterprises
P O Box 9315
Berkeley, CA 94709
Proposal Number: 12 05 0298

Chronos Research Laboratories, Inc
3025 Via de Caballo
Olivenhain, CA 92024
Proposal Number. 09.10 1447

Computer Technology Associates
5680 South Syracuse Circle
Suite 506
Englewood, CO 80111
Proposal Number. 07 08 5300

CORDEC Corporation
7371 C Lockport Place
P O Box 188
Lorton, VA 22079-0188
Proposal Number 04.07 7227

Covalent Associates, Inc
52 Dragon Court
Woburn, MA 01801
Proposal Number. 10.08 1140

Creare R&D Inc
P.O. Box 71
Hanover, NH 03755
Proposal Number: 09 12 3800B

Creative Enterprises
10323 Rue Finisterre
San Diego, CA 92131
Proposal Number 10 07 5030

DCW Industries, Inc.
5354 Palm Drive
La Canada, CA 91011
Proposal Number 02.01 3844

Defense Systems, Inc.
7903 Westpark Drive
McLean, VA 22102
Proposal Number. 07 06 1000

DEI-Tech, Incorporated
703 Middle Ground Boulevard
Newport News, VA 23606
Proposal Number: 03 05 8747

Dr Murray S Cohen & Associates
12 Symor Drive
Convent Station, NJ 07961
Proposal Number. 04 12 4495

DWA Composite Specialties, Inc
21119 Superior Street
Chatsworth, CA 91311-4393
Proposal Number 04 01 1504
Proposal Number 04 13 1504
Proposal Number 09.05 1504

EIC Laboratories, Inc
111 Downey Street
Norwood, MA 02062
Proposal Number 09.04 9450

Energy Optics, Inc.
224 North Campo Street
Las Cruces, NM 88001
Proposal Number. 05 04 4561
Proposal Number: 08 13 4561

Energy Research and Generation, Inc
952 57th Street
Oakland, CA 94608
Proposal Number 09 11 9785

Energy Science Laboratories, Inc
11404 Sorrento Valley Road
San Diego, CA 92121
Proposal Number: 10.04 7039
Proposal Number 15.03 7039

ESCON
Engineering and Science Consultants
101 Henry Lee Lane
Grafton, VA 23692
Proposal Number: 02 02 8218
Proposal Number. 02 02 8218A

Essex Corporation
1040 Woodcock Road
Suite 227
Orlando, FL 32803
Proposal Number· 12.02 5090A

Exfluor Research Corporation
P O Box 7807
Austin, TX 78713
Proposal Number 01 05 3812

Fiber Materials, Inc.
Biddeford Industrial Park
Biddeford, ME 04005
Proposal Number 04 03 5911
Proposal Number: 04.05 5911

Flexible Computer Corporation
1801 Royal Lane
Suite 810
Dallas, TX 75229
Proposal Number. 06.03 1234

Flow Industries, Inc
21414 68th Avenue South
Kent, WA 98032
Proposal Number 01.01 8500
Proposal Number 02 02 8500A

Flow Industries, Inc.
Automation & Controls Division
1835 Terminal Drive
Suite 100
Richland, WA 99352
Proposal Number. 02 08 8676

Frederick A Costello, Inc.
12864 Tewksbury Drive
Herndon, VA 22071
Proposal Number. 09 14 4942

General Optronics Corporation
2 Olsen Avenue
Edison, NJ 08820
Proposal Number: 14.04 9000

General Pneumatics Corporation
7662 East Gray Road, #107
Scottsdale, AZ 85260
Proposal Number: 11 03 1856A

Giner, Inc.
14 Spring Street
Waltham, MA 02154
Proposal Number. 10.01 7270

Gull Engineering, Inc
78 Mitchell Road
Oak Ridge, TN 37830
Proposal Number 12.06 4787

Gumbs Associates, Inc.
26 Avenue B
Newark, NJ 07114
Proposal Number 10 02 5110

Howlett and Associates, Inc.
800 J Cedar Valley
Radford, VA 24141
Proposal Number. 01 06 0252

Hydrogen Consultants, Inc
P O Box 10454
Denver, CO 80210
Proposal Number 09 09 0546

Hyperfine Inc.
1930 Central Avenue
Suite B
Boulder, CO 80301
Proposal Number: 08 01 6882

Industrial Quality, Inc
P O. Box 2397
Gaithersburg, MD 20879-0397
Proposal Number: 04.10 0332

James G. Boyko
20 West Winkley Street
Amesbury, MA 01913
Proposal Number. 01 05 1753

KMS Fusion, Inc
3621 South State Road
P O Box 1567
Ann Arbor, MI 48106
Proposal Number: 08.13 8500

LaserGenics Corporation
P.O Box 33010
Los Gatos, CA 95031- 3010
Proposal Number 08 08 0537

LinCom Corporation
18100 Upper Bay Road
Suite 100
Houston, TX 77058
Proposal Number· 06.04 1625

Madison Magnetics Inc
216 Walnut Street
Madison, WI 53705
Proposal Number: 02 03 5903

Material Concepts, Inc.
666 North Hague Avenue
Columbus, 0H 43204-1492
Proposal Number 04.07 5785A
Proposal Number 09.06 5785

Materials Sciences Corporation
Gwyneed Plaza II
Bethlehem Pike
Spring House, PA 19477
Proposal Number 04 03 5400

Microwave Monolithics Incorporated
465 E. Easy Street
Simi Valley, CA 93065
Proposal Number 14 01 6642
Proposal Number. 14 02 6642

Modus Incorporated
515 N. Melton Drive
Jonesboro, AR 72401
Proposal Number. 05.01 5915

Natural Language Products
180 Pecora Way
Portola Valley, CA 94025
Proposal Number 07 09 7511

Nielsen Engineering & Research, Inc.
510 Clyde Avenue
Mountain View, CA 94043
Proposal Number 02.01 9457B

Odetics, Inc
1380 S. Anaheim Boulevard
Anaheim, CA 92805
Proposal Number. 09.13 5000

OPHIR Corporation
7333 West Jefferson Avenue
Suite 210
Lakewood, CO 80235
Proposal Number 08 15 1512

Optimization Technology, Inc
P O Box 949
Auburn, AL 36830
Proposal Number 06 06 6700

Physical Sciences Inc.
P O Box 3100
Research Park
Andover, MA 01810
Proposal Number: 04 14 9030
Proposal Number. 08 08 9030

PhytoResource Research, Inc
707 Texas Avenue
Suite 207-D
College Station, TX 77840
Proposal Number 12 02 8606
Proposal Number 12.04 8606

Pulse Systems, Inc
139 Longview Drive
Los Alamos, NM 87544
Proposal Number 08.06 1920

Q-DOT, Inc
1069 Elkton Drive
Colorado Springs, CO 80907
Proposal Number. 07.04 1112

R*SCAN Corporation
511 Eleventh Avenue South
Minneapolis, MN 55415
Proposal Number 13 05 1424

RAI Associates
432 Stonehenge
Arlington, TX 76014
Proposal Number. 01.05 8279A

Raman Aeronautics, Inc.
734 Melville Avenue
Palo Alto, CA 94301
Proposal Number: 02.06 4037

Remote Sensing Systems
475 Gate Five Road
Suite 211
Sausalito, CA 94965
Proposal Number: 07.06 8911

REMTECH Inc.
2603 Artie Street
Suite 21
Huntsville, AL 35805
Proposal Number· 13.08 8581
Proposal Number: 13.08 8581C

Ribbon Technology Corporation
P.O. Box 30758
825 Taylor Station Road
Gahanna, OH 43230
ProposalNumber: 01.03 5444

Rothe Technical Research
407 Village Center Drive
Encinitas, CA 92024
Proposal Number. 08 11 2227

Rupprecht & Patashnick Company, Inc.
17 Maple Road, Drawer H
Voorheesville, NY 12186
Proposal Number. 08.03 4520

Scientific Research Associates, Inc.
P.O. Box 498
Glastonbury, CT 06033
Proposal Number: 01.01 0511A
Proposal Number: 11 06 0511

Scientific Systems, Inc.
54 Rindge Avenue Extension
Cambridge, MA 02140
Proposal Number: 09.01 6364

Sparta Technology, Inc.
258 East Altamonte Drive
Highway 436
Altamonte Springs, FL 32701
Proposal Number: 13.10 0900A

Spectron Development Labs
3303 Harbor Boulevard
Suite G-3
Costa Mesa, CA 92626
Proposal Number: 02.06 8477
Proposal Number. 03.02 8477

Spire Corporation
Patriots Park
Bedford, MA 01730
Proposal Number 10 03 6000
Proposal Number 11 07 6000

Springborn Laboratories, Inc
10 Springborn Center
Enfield, CT 06082
Proposal Number. 12 01 8371

ST&E Technical Services, Inc.
20 Belinda Court
San Ramon, CA 94583
Proposal Number 08 12 7847

Stanford Telecommunications, Inc.
6888 Elm Street
McLean, VA 22101
Proposal Number 08 05 3220
Proposal Number: 14.03 3220

Star Enterprises
3595 N. Hinkle Road
Bloomington, IN 47401
Proposal Number: 12.05 3309

Sunpower, Inc
6 Byard Street
Athens, OH 45701
Proposal Number: 10 04 2221A

System Specialists
11200 Calle Aurora
Tucson, AZ 85748
Proposal Number: 15.01 7307

Systems Technology, Inc.
13766 S Hawthorne Boulevard
Hawthorne, CA 90250
Proposal Number 03 09 2281

Talandic Research Corporation
2793 East Foothill Boulevard
Pasadena, CA 91107
Proposal Number: 05 06 4161

Technical & Administrative Services
Corporation
600 Maryland Avenue, S.W.
Suite 301 West
Washington, DC 20024
Proposal Number. 06.05 8677

Technology Development of California, Inc.
2431 Mission College Boulevard
Santa Clara, CA 95054
Proposal Number: 06.01 3030K

Telecomm Science Associates, Inc.
2560 First Avenue
Suite 105
San Diego, CA 92103
Proposal Number: 14.02 2913

The Navtrol Company
9204 Markville Drive
Dallas, TX 75243
Proposal Number: 14.07 3319

Theory and Applications Unlimited Corporation
10 Jackson Street
Suite 101
Los Gatos, CA 95030
Proposal Number: 03.08 9191

Thermacore, Inc.
780 Eden Road
Lancaster, PA 17601
Proposal Number: 09.08 6551
Proposal Number: 09.15 1230
Proposal Number: 09 16 1227

Time & Space Processing, Inc
3410 Central Expressway
Santa Clara, CA 95051
Proposal Number. 14.06 0200

Vigyan Research Associates, Inc
28 Research Drive
Hampton, VA 23666
Proposal Number: 02.02 0794

VRA, Inc
P.O Box 50
Blacksburg, VA 24060
Proposal Number: 02.01 0769
Proposal Number. 02.04 0769

INDEX OF PRINCIPAL INVESTIGATORS AND PROPOSAL NUMBERS

NASA SBIR 84-1 AWARDS

Kennedy, Robert S.
12.02 5090A

Kerlin, T. W.
07 06 9709

Klainer, Stanley M.
08.12 7847

Klopfer, Goetz H
02.01 9457B

Koch, Victor R
10.08 1140

Levy, Ralph
01.01 0511A

Lewis, Clark H
02 01 0769
02.04 0769

Lucas, Carroll
15.05 7606

Lyons, Walter A
13.05 1424

Malachowski, M. J.
12.05 0298

Matelan, Nicholas
06.03 1234

McEntire, Paul L.
06.06 6700

McLellan, Edward J.
08.06 1920

Morris, John W.
05.04 8600A

Munson, Robert C.
03.09 5845

Nebolsine, Peter E.
08.08 9030

Nelson, Loren D.
08.15 1512

Olsen, Randall B.
09 10 1447

Orban, Ralph F.
09 06 5785

Owens, Lester J.
13.10 0900A

Petersen, Wendell C.
14 01 6642

Pfenninger, Werner
02.02 8218

Poteet, Wade M.
15.01 7307

Radın, Lon
14.06 0200

Raman, K. R.
02.06 4037

Rauh, R. David
09.04 9450

Ray, Roderick J.
12 01 4100

Razavı, H. C.
09 01 6364

Readey, Harvey
13.12 7886

Reich, Frederich R.
02.08 8676

Roberts, Peter C.T.
07.04 1112

Rosemeier, Ronald G.
08.07 5800B

Rothe, Dietmar E.
08 11 2227

Rupprecht, Georg
08 03 4520

Scheld, H. W.
12.02 8606
12.04 8606

Schlecht, Richard
08.08 0537

Shaubach, Robert M.
09.08 6551

Sıoshansi, Pıran
11.07 6000

Sixsmith, H.
09 12 3800B

Spitzer, M. B.
10 03 6000

Stanton, Alan C.
12.06 9500

Starkey, Donald L.
07.06 1000

Stokes, Danny B.
05.02 6585

Supan, Edward C.
04.01 1504
04.13 1504
09 05 1504

Taylor, Robert T.
03.05 8747

Tracy, J.
05.06 4161

Trolinger, James D.
02.06 8477

van Dam, Cornelis P.
02.02 0794

Viken, Jeffrey K
02.02 8218A

von Ehrenfried, Manfred
06.05 8677

Voss, John Mark
06.04 1625

Walford, Graham V.
12.06 4787

Walker, Graham
11.03 1856A

Walsh, Myles
13.03 5911

Walton, William
04.09 5050

Wang, C. S.
14 04 9000

Ward, Steven M.
05.04 4561
08.13 4561

Webb, George W.
15.03 7039

Weimer, Raymond J.
04 07 7227

Weinberg, Aaron
08.05 3220

Wentz, Frank J.
07.06 8911

Wılcox, Davıd C.
02 01 3844

Wood, Gary
10.04 2221A

Wormhoudt, Joda C.
08.09 6500

Wright, James R.
08.05 1590

Zakrzewskı, Edwın J.
14.03 3220

INDEX OF PROPOSAL AND CONTRACT NUMBERS

NASA SBIR 84-I AWARDS

Proposal Number	*Contract Number*	*NASA Center*	*Proposal Number*	*Contract Number*	*NASA Center*
01.01 0511A	NAS3-24532	LERC	06 02 5100	NAS2-12083	ARC
01.01 8500	NAS3-24533	LERC	06.02 9500	NAS2-12084	ARC
01.02 7070	NAS3-24534	LERC	06.03 1234	NAS1-17939	LARC
01.03 5052	NAS3-24535	LERC	06.04 1625	NAS9-17277	JSC
01.03 5444	NAS1-17978	LARC	06 05 8677	NAS5-28632	GSFC
01.05 1753	NAS3-24536	LERC	06.06 6700	NAS1-19936	LARC
01.05 3812	NAS3-23896	LERC	07.04 1112	NAS1-17940	LARC
01.05 8279A	NAS3-24537	LERC	07 06 1000	NAS5-28624	GSFC
01.06 0252	NAS3-23899	LERC	07.06 6207	NAS5-28635	GSFC
02.01 0769	NAS2-12102	ARC	07.06 8911	NAS5-28634	GSFC
02.01 3844	NAS2-12103	ARC	07.06 9709	NAS5-28633	GSFC
02.01 9457B	NAS2-12088	ARC	07.08 5300	NAS7-940	JPL
02.02 0794	NAS1-17926	LARC	07.09 7511	NAS2-12087	ARC
02.02 8218A	NAS1-17949	LARC	08.01 6882	NAS5-28636	GSFC
02.02 8218	NAS1-17950	LARC	08.03 4520	NAS7-941	JPL
02.02 8500A	NAS1-17930	LARC	08.05 1590	NAS5-28637	GSFC
02 03 5903	NAS1-17931	LARC	08 05 3220	NAS5-28638	GSFC
02.04 0769	NAS9-17290	JSC	08.06 1920	NAS5-28639	GSFC
02.06 4037	NAS2-12121	ARC	08.07 5800B	NAS5-28640	GSFC
02.06 8477	NAS2-12120	ARC	08.07 8629	NAS5-28641	GSFC
02.08 8676	NAS1-17951	LARC	08.08 0537	NAS1-17941	LARC
03.02 8477	NAS1-17932	LARC	08.08 9030	NAS1-17942	LARC
03.03 8293	NAS2-12124	ARC	08 09 6500	NAS3-24531	LERC
03.05 8747	NAS1-17933	LARC	08.11 2227	NAS7-935	JPL
03.08 9191	NAS2-12092	ARC	08.12 7847	NAS1-17943	LARC
03 09 2281	NAS2-12094	ARC	08 13 4561	NAS1-17944	LARC
03 09 5845	NAS2-12095	ARC	08.13 8500	NAS1-17945	LARC
04.01 1504	NAS3-23897	LERC	08.15 1315	NAS7-942	JPL
04.03 5400	NAS1-17934	LARC	08.15 1512	NAS7-943	JPL
04.03 5911	NAS1-17935	LARC	09.01 6364	NAS1-17946	LARC
04.05 5911	NAS2-12104	ARC	09 02 1753A	NAS8-35266	MSFC
04.07 5785A	NAS9-17293	JSC	09 04 9450	NAS8-35267	MSFC
04 07 7227	NAS9-17284	JSC	09 05 1504	NAS3-24245	LERC
04.09 5050	NAS7-937	JPL	09.06 5785	NAS8-35268	MSFC
04 10 0332	NAS1-17937	LARC	09.08 6551	NAS8-35269	MSFC
04.12 4495	NAS10-11141	KSC	09.09 0546	NAS8-35270	MSFC
04.13 1504	NAS8-35264	MSFC	09.10 1447	NAS7-936	JPL
04.14 9030	NAS7-938	JPL	09.11 9785	NAS8-35271	MSFC
05.01 5915	NAS7-939	JPL	09 12 3800B	NAS5-28642	GSFC
05.02 6585	NAS8-35265	MSFC	09 13 5000	NAS9-17289	JSC
05 04 4561	NAS9-17283	JSC	09 14 4942	NAS5-28643	GSFC
05 04 8600A	NAS9-17294	JSC	09.15 1230	NAS8-35272	MSFC
05.06 4161	NAS1-17938	LARC	09 16 1227	NAS9-17280	JSC
06 01 3030K	NAS2-12082	ARC	09.19 8629	NAS8-35273	MSFC

10 01 7270	NAS3-24394	LERC
10 02 5110	NAS7-930	JPL
10.03 6000	NAS3-24395	LERC
10.04 2221A	NAS3-24396	LERC
10 04 7039	NAS3-24397	LERC
10.07 5030	NAS3-23900	LERC
10.08 1140	NAS7-944	JPL
11.03 1856A	NAS10-11144	KSC
11.06 0511	NAS8-35274	MSFC
11.07 6000	NAS8-35275	MSFC
12.01 2484	NAS9-17282	JSC
12 01 4100	NAS9-17286	JSC
12.01 8371	NAS9-17285	JSC
12.02 5090A	NAS9-17278	JSC
12 02 8606	NAS9-17291	JSC
12 04 8606	NAS9-17292	JSC
12 05 0298	NAS2-12096	ARC
12.05 3309	NAS2-12113	ARC
12 06 4787	NAS2-12097	ARC
12.06 9500	NAS2-12117	ARC
13 02 2863	NAS10-11145	KSC
13.03 5911	NAS10-11146	KSC
13 05 1424	NAS10-11142	KSC
13.08 8581	NAS8-35277	MSFC
13.08 8581C	NAS8-35276	MSFC
13.10 0900A	NAS10-11143	KSC
13.12 7886	NAS9-17279	JSC
14.01 6642	NAS3-24246	LERC
14.02 2913	NAS3-24247	LERC
14.02 6642	NAS3-24248	LERC
14.03 3220	NAS9-17281	JSC
14.04 9000	NAS5-28644	GSFC
14.06 0200	NAS7-929	JPL
14 07 3319	NAS5-28645	GSFC
15.01 7307	NAS8-35278	MSFC
15 03 7039	NAS8-35279	MSFC
15 04 7840	NAS9-17287	JSC
15 04 7840A	NAS9-17288	JSC
15.05 7606	NAS8-35280	MSFC

INDEX OF AWARDS FOR EACH NASA CENTER

NASA SBIR 84-I

Ames Research Center

Goddard Space Flight Center

Jet Propulsion Laboratory

Johnson Space Center

Kennedy Space Center

Langley Research Center

Lewis Research Center

Marshall Space Flight Center

PAGE INTENTIONALLY BLANK

INDEX OF AWARDS FOR EACH STATE

NASA SBIR 84-I

Virginia:	01 06 0252	02.01 0769	Washington:	01.01 8500	02.02 8500A
	02.02 0794	02.02 8218		02.08 8676	
	02.02 8218A	02.04 0769			
	03.05 8747	04.07 7227	Wisconsin:	02.03 5903	
	07.06 1000	08.05 3220			
	09.14 4942	14.03 3220			
	15.05-7606				

*U.S. GOVERNMENT PRINTING OFFICE: 1985-461-599 30015

National Aeronautics and
Space Administration

Washington, D C
20546