SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BAØ1 Number: Revision:
   Title: Aircraft Structural Weight Sensitivity Calculation Capability

2. Purpose, Objective or Background of Work to be Performed:

   The purpose of this task is to develop an integrated system of computer codes to calculate the sensitivity of optimized structural weight to aircraft configuration shape changes. The system will include capabilities for performing parametric model geometry changes, aeroelastic loads calculations and structural member sizing.

3. Description of the Work to be Performed:

Tasks:

1. Aircraft Structural Weight Sensitivity Analysis System

   The contractor shall develop an integrated system using previously completed work on the High Speed Research (HSR) Equivalent Laminated Plate (ELAPS) based structural analysis system as the basic framework.. The ELAPS based system is being developed under the HSR Aeroelastic Concept Engineering (ACE) activity. This task is designed to continue that development. The new system must have the generality for application to the wide variety of aircraft studied by the Systems Analysis Branch (SAB). These aircraft include subsonic transports, military aircraft and unique configurations designed to exploit a particular technology. Also, the new system must incorporate analysis codes that are currently used and/or planned for use in SAB, as stated below. In this work the contractor shall perform the following subtasks.

   a. Develop a software design for the integrated system that includes the ELAPS based system and new capabilities described in subtasks b-h.

   b. Implement the most up to date version of the ELAPS equivalent plate structural analysis code.

   c. Develop and implement a rapid turn around flutter analysis and sensitivity analysis capability.

   d. Develop/implement a structural member sizing procedure. This procedure must be capable of sizing both honeycomb core and stiffened (integral, zee, or corrugated) panel constructions for wing cover skins with metallic or composite materials. The initial part of this subtask is to evaluate the ST-SIZE code, used by the NASA Hypersonic Vehicles Office (HVO) and Vehicle Analysis Branch (VAB), for this purpose.

   e. Develop a capability for making parametric model changes.

   f. Demonstrate use of the new integrated system on the airframe configuration being studied in the HSR/Aeroelastic Concept Engineering (ACE) project.

   g. Analyze and implement parallel computing techniques which offer the opportunity to improve system computational speed.

   h. Analyze possibility for system speed and accuracy improvements through application of the DOT optimization method.

1. Task Order Number and Title	Number:	Revision:
Title: Aircraft Structural Weight Sensitivity Calculation Capability		

3. Tasks, Deliverables and or Products, and performance measurements (continued):

Deliverables:

Subtask a [6/1/97]
The contractor shall deliver the software design description in the form of a memorandum. This description will include implementation details and schedule for subtasks b-e described above.

Subtask b-e [9/1/97]
The contractor shall deliver computer program source code for the new integrated sensitivity analysis system in electronic format.

Subtask f [10/15/97]
The contractor shall deliver the complete software system, including all source code and scripts
The contractor shall perform a structural sensitivity analysis on the HSR ACE configuration. This study will look at the effects of changing the wing spar depth on the weight of the sized structure. The study will parallel the ongoing ACE effort.

Subtask g-h [4/30/98]
The contractor shall deliver a report on the advantages/disadvantages of the parallel computing and DOT optimization techniques.

The contractor shall deliver detailed documentation of the sensitivity analysis system which includes a complete definition of user input and procedures. The documentation will also include sensitivity results from Subtask f. The documentation will take the form of a contractor report. [documentation delivery date 4/30/98]

Minimum Acceptable Performance Standards:

1. Timely delivery of deliverables and completion of subtasks
2. Documentation will describe the function operation and input/output requirements of each element of the software system.
3. The new system will be operational on System Analysis Branch computers using existing command language inputs (i.e. UNIX scripts). The system shall demonstrate operational robustness ~~(how do you define robustness. This will cause problems during the award fee evaluation process. Hypothetically, if you determine that the system is not robust)~~ on the HSR ACE supersonic transport structural weight sensitivity problem. Operational robustness shall be defined as the ability to generate a converged structural weight for the baseline configuration plus two thickness perturbations in 15 working days. Completely the designs in less time will exceed minimum performance standards.
4. Monthly progress reports describing activities, results and problems encountered.
5. Issues and concerns which jeopardize successful completion are communicated within 48 hours of discovery. Plans to solve problem provide with a list of concerns will exceed minimum performance.

SAERS (NAS1-96013) Task Order Page 3

1. Task Order Number and Title Title: Aircraft Structural Weight Sensitivity Calculation Capability	Number:	Revision:

4. Government Furnished Items:

The government shall furnish a copy of the most up to date version of the ELAPS, and linear aerodynamics analysis computer programs.

The government will furnish access to the ST-SIZE, and DOT.

The government shall furnish access to computer workstations, CPU time, FORTRAN and C compiler and report writing software required to complete this task.

5. Other information needed for performance of task.

None

6. Security clearance required for performance of work:

Unclassified. The Contractor must sign an agreement to abide by the terms of the Limited Exclusive Rights in Data (LERD) applicable to the HSR program.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Peter G. Coen
M/S: 248 Phone: 804-864-45991

SEARS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BAØ2 Title: Aircraft Safety	Number:	Revision:

2. Purpose, Objective or Background of Work to be Performed:

Safety is a pillar of NASA's mission to serve the American public. To that extent and pursuant to the findings of Vice President Gore's commission on safety, it is critical that NASA Langley, in its role as systems analysis center of excellence, incorporate system level safety measurement methodologies into its independent technology assessment capability.

3. Description of the Work to be Performed

This task is to survey and assess currently and near-term methodologies that address the benefits of advanced technologies and/or operating procedures on aircraft accident and/or fatality rates. Integrate the best methodology into a flexible modeling capability in order to gain first-order safety assessments of aircraft system and air traffic management system design trades.

Two related activities are within the scope of this task:

1. Survey academic, industry, transportation and design organizations for relevant safety related modeling methodologies. This includes currently operational methodologies and methods in development. At this phase the definition of safety and how it relates to the aircraft system is open-ended. Analyze survey results and make recommendations about the methodologies as to their:

   a. applicability to relevant operational characteristics of the aircraft system in the flight management system;
   b. level of data detail required to execute methodology; and
   c. output performance measures.

2. Adapt or modify the single best of surveyed methodologies for NASA use to assess the introduction of technology and operational procedures for new aircraft systems. This will include:

   a. integration of the safety assessment methodology subset for common input assumptions;
   b. explicit mapping of NASA design methodology outputs to the integrated safety assessment tool; and
   c. demonstrating the results of aircraft system design trades and operational procedure changes on various system level measures of safety.

1. Task Order Number and Title	Number:	Revision:
Title: Aircraft Safety		

3. Tasks, Deliverables and/or Products, and performance measurements (continued):

Activity (1):

Due: June 1, 1997
- Study Plan for survey
- Draft outline for final presentation

Due: September 30, 1997
- Written report of findings
- Oral presentation to SAB

Metrics: Minimum: Written report of findings
Oral presentation to Systems Analysis Branch
Maximum: Minimum plus outline for implementation of recommendations

Activity (2):

Due: April 1, 1998
- Excel spreadsheet model readily transferable across MAC and PC platforms
- Deterministic and stochastic input capability
- Data flow diagram, variable hierarchy tree, etc. to describe model functionality
- User's manual for model consisting of:
  - variable identification
  - examples for specific macro functions
  - examples for scenario input modifications

Due : April 30, 1998
- Demonstration to SAB

Metrics: Minimum: Incorporation of safety methodology into aircraft systems analysis capability
Exceeds: Validation of methodology with historical data for two (2) vehicles

SEARS (NAS1-96013) Task Order Page 3

1. Task Order Number and Title Title: Aircraft Safety	Number:	Revision:

4. Government Furnished Items:

5. Other information needed for performance of task. *N/A*

6. Security clearance required for performance of work: *N/A*

7. Period of Performance	
Planned start date: 05/1/97	Expected completion date: 04/30/98

8. NASA Technical Monitor: Vicki K. Crisp .M/S: 248 Phone: 757-864-4483

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BA03 Number: Revision:
   Title: Flight Optimization System (FLOPS) Development

2. Purpose, Objective or Background of Work to be Performed:
   The purpose of this task is to update and maintain the primary tools used by the Systems Analysis Branch, namely, the Flight Optimization System (FLOPS) and associated tools/methods.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall be responsible for modifying the FLOPS source codes and updating the associated documentation in conjunction with the following subtasks:

a. Perform modifications to the FLOPS code to provide integration capability with the High Speed Research Program's Aeroelastic Concept Engineering DOSS system.

b. Incorporate NASA provided weight estimation equations for General Aviation aircraft weight prediction.

c. Reduce current optimization time requirements by 5 percent.

d. Incorporate takeoff and climb path variables currently used in the computation of noise effects into the optimization routines to allow optimization using these variables.

e. Serve as focal point for the FLOPS user community to: (1) forward requests for enhancements and/or bug fixes to SAB personnel and (2) create FLOPS distribution media.

f. Perform two error checkings on NASA provided FLOPS-RAPID interface when delivered.

g. Develop and demonstrate XFLOPS implementation of NASA provided prototype expert system logic for FLOPS interface.

h. Correct errors in FLOPS methodology/source codes, up to 250, when found and incorporate option to use NASA-provided equations up to 20, as needed, into FLOPS source codes.

SAERS (NAS1-96013) Task Order Page 2

1. Task Order Number and Title Title: Flight Optimization System (FLOPS) Development:	Number:	Revision:

3. Deliverables, schedules, and performance measurements (continued):

(a) The contractor shall deliver updated source codes and documentation upon completion of each subtask identified above. The contractor shall be responsible for maintaining configuration control of FLOPS and associated codes and documentation during the period of performance. The contractor shall ensure that the previous working version of FLOPS and associated codes and documentation is available for SAB use during the period of performance.

(b) The contractor shall provide a monthly status report showing what technical accomplishments have been achieved, tasks to be performed, and the current status of the FLOPS codes and documentation.

Milestones/Schedule:

June 97:	subtask d completed
July 97	subtask b completed
Oct. 97:	subtask a completed
Nov. 97:	subtask c completed
Dec. 97:	subtask f completed
March 98:	subtask g completed
April 98:	subtask e completed
April 98:	subtask h completed

Performance Measurements:

1. Timely delivery of all deliverables and completion of all subtasks pursuant to the above schedule shall be considered the minimum acceptable performance. One week early exceeds. One month early significantly exceeds.

2. Accurate and complete documentation, including definitions of all new variables and one paragraph describing the purpose of the variable, relative to new program capabilities and full-time availability of functional FLOPS code and documentation during period of performance shall be considered exceeding the minimum acceptable performance.

3. Reduction in the time required for FLOPS optimization by 10 percent or more, accuracy improvement in one or more FLOPS analysis modules, and 48 hour or less response time for FLOPS user community requests shall be considered significantly exceeding minimum acceptable performance.

4. Government Furnished Items:

The Government shall supply the necessary computer equipment for completion of this effort at the NASA Langley Research Center. NASA will provide a description of the DOSS system for part 3.a. NASA will provide weight equations for part 3.b, expert system logic for part 3.g, and updated equations/problem reports for part 3.h.

SAERS (NAS1-96013) Task Order Page 3

1. Task Order Number and Title Title: Flight Optimization System (FLOPS) Development:	Number:	Revision:

5. Other information needed for performance of task. *NA*

6. Security clearance required for performance of work: *NA*

7. Period of Performance	
Planned start date: 05/1/97	Expected completion date: 04/30/98

8. NASA Technical Monitor: James W. Fenbert .M/S: 248 Phone: 757-864-5973

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BAØ4 Number: Revision:
   Title: Linear Theory Aerodynamic Methods Validation and Calibration

2. Purpose, Objective or Background of Work to be Performed:

Systems studies in support of supersonic transport technology development rely primarily on aerodynamic analysis based on linearized aerodynamic theory. These methods provide accurate aerodynamic performance estimates with turn around time appropriate for systems studies. It is vital that these methods be validated with the latest available experimental data and higher order computational methods.

3. Description of the Work to be Performed:

Tasks:

1. Calibration of the AERO3S and WDES linear theory aerodynamic computer programs.
   The contractor shall calibrate the results of these two computer programs with experimental data available from the High-Speed Research (HSR) program wind tunnel test database. The contractor shall review and update the empirical force and moment corrections contained in these computer programs.

2. Validation of the WDES linear theory design method.
   The contractor will use computational fluid dynamic (CFD) analysis to evaluate the camber surface design techniques embodied in the WDES computer program. The purpose of the evaluation is to validate the aerodynamics performance levels obtained from wing camber and twist distributions developed using the WDES method. The contractor shall develop a method to correct the camber and twist distributions produced by the WDES method for real flow effects identified by the CFD analysis.

3. Calibration of the AWAVE and CDF zero-lift drag analysis computer programs.
   Using the wind tunnel database described above, the contractor shall calibrate the AWAVE wave drag prediction program and the CDF skin friction drag prediction program against the experimental zero-lift drag data. The contractor shall use this calibration data to develop empirical correction data for wave and skin friction drag The contractor shall develop computer program that will apply this correction to the output of the AWAVE and CDF programs

Deliverables:

1. Calibration of AERO3S and WDES computer programs [6/1/97]
   a. Computer source code for the updated programs in electronic form.
   b. Detailed documentation of the calibration data and empirical corrections in the form of an HSR contractor report.

1. Task Order Number and Title	Number:	Revision:
Title: Linear Theory Aerodynamic Methods Validation and Calibration		

3. Tasks, Deliverables and or Products, and performance measurements (continued):

Deliverables:(continued)

2. Validation of the WDES linear theory design method. [11/30/97]
   a. Detailed documentation of the process used to validate the WDES camber surface design method and the shape correction methodology.

3. Calibration of the AWAVE and CDF zero-lift drag analysis computer programs. [4/30/98]
   a. Computer source code for the AWAVE/CDF correction program in electronic form.
   b. Detailed documentation of the calibration studies, empirical correction factors and computer program in the form of an HSR contractor report.

Minimum Acceptable Performance Standards:

1. Calibration of AERO3S and WDES computer programs
   Analytical and experimental lift drag and pitching moment data shall be compared for a range of Mach numbers appropriate for each of the computer programs. At each Mach, the available range of angle of attack and control surface (wing flaps and stabilizer/elevator) deflections shall be examined.
   Detailed analysis of the proposed empirical correction factors for the force and moment data shall be supplied. The empirical correction factors shall be applicable to the appropriate range of Mach numbers and control deflections.

2. Validation of the WDES linear theory design method.
   CFD analysis and comparisons with WDES shall be performed for one wing alone geometry and at least two wing body geometries with different wing planforms.
   The shape correction methodology shall be applicable to planform geometries appropriate for HSCT vehicles. The correction methodology shall produce output data compatible with the existing Systems Analysis Branch methodologies.

3. Calibration of the AWAVE and CDF zero-lift drag analysis computer programs.
   Analytical and experimental data shall be compared for a range of mach numbers appropriate for each of the computer programs. The correction program shall be error free and produce output data compatible with the existing Systems Analysis Branch methodologies.

4. Monthly progress reports describing activities, results and problems encoutered.

5. Issues and concerns which jeopardize successful completion are communicated within 48 hours of discovery.

Significantly Exceeds Minimum Acceptable Performance Standards:
Calibrated computer programs, empirical correction factors and shape correction methodology integrated into an aerodynamic analysis program with graphical user interface.

1. Task Order Number and Title	Number:	Revision:
Title: Linear Theory Aerodynamic Methods Validation and Calibration		

4. Government Furnished Items:

The government shall furnish geometry models and wind tunnel data from the HSR database.

The government shall furnish access to computer workstations, CPU time, FORTRAN compiler, report writing software and the linear theory computer programs AERO3S, WDES, AWAVE and CDF.

5. Other information needed for performance of task.

None

6. Security clearance required for performance of work:

Unclassified. The contractor must sign an agreement to abide by the terms of the Limited Exclusive Rights in Data (LERD) applicable to the HSR program.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Peter G. Coen
M/S: 248 Phone: 804-864-45991

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BA05 Number: Revision:
   Title: Innovative Concepts for Improved HSCT Takeoff and Landing Noise

2. Purpose, Objective or Background of Work to be Performed:

   One of the major design drivers of the High-Speed Civil Transport (HSCT) aircraft being studied in the High Speed Research (HSR) Program is minimization of takeoff and landing noise. Wind tunnel experiments recently performed indicate that canard and three surface configurations have potential advantages in low speed performance. An aerodynamic design study is required to determine the combination of wing and control surface planform that produce the best combination of low speed and cruise performance for these type of configurations.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Tasks:

1. Canard and Three Surface HSCT Aerodynamic Design
   The Contractor shall perform an advanced aerodynamic design study of canard and three surface HSCT configurations. The configurations shall be derived from the current HSR Technology Concept Airplane (TCA). Wing and control surface planforms and positions shall be parametrically varied to determine the best combination of low speed and high speed aerodynamic performance.

Deliverables:

1. Geometry descriptions for the canard and three surface configuration designs in written and electronic format [8/31/97]
2. Detailed documentation describing the aerodynamic design process, the configuration alternatives considered and the resulting aerodynamics performance levels compared to the HSR TCA. The documentation shall be in the form of an HSR contractor report. [10/31/97]

Minimum Acceptable Performance Standards:

1. The aerodynamic design process shall address as a minimum: control surface sizing for pitch trim and stability; configuration layout and balance; wing twist and camber design at supersonic speeds and aerodynamic performance at low speed and supersonic cruise flight conditions.
2. The parametric design study shall consider as a minimum three alternative planforms for both the canard and three surface. Also, at least three wing planform variations shall be considered.
3. The geometry data supplied to the government must be compatible with existing Systems Analysis Branch configuration analysis tools.
4. Monthly progress reports.
5. Issues and concerns which jeopardize successful completion are communicated within 48 hours of discovery.

Significantly Exceeds Minimum Acceptable Performance Standards:

1. Application of optimization methodology to identify a wing planform that produces the best aerodynamic performance for each design alternative.

BA05

SAERS (NAS1-96013) Task Order Page 2

1. Task Order Number and Title	Number:	Revision:
Title: Innovative Concepts for Improved HSCT Takeoff and Landing Noise		

4. Government Furnished Items:

The government shall furnish a complete description of the HSR TCA including geometry, aerodynamic performance, weights, performance, and mission ground rules.

The government shall furnish access to computer workstations, CPU time, report writing software and the linear theory aerodynamics analysis computer programs AERO3S, WDES, AWAVE and CDF.

The government shall furnish access to geometry modeling software.

5. Other information needed for performance of task.

None

6. Security clearance required for performance of work:

Unclassified. The contractor must sign an agreement to abide by the terms of the Limited Exclusive Rights in Data (LERD) applicable to the HSR program.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: October 31, 1997

8. NASA Technical Monitor: Peter G. Coen
.M/S: 248 Phone: 757-864-45991

BA05

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BA06 Number: Revision:
Title: Conceptual Design Study of Large, Blended-Wing-Body Type Transport Aircraft

2. Purpose, Objective or Background of Work to be Performed:
Conduct conceptual design studies of large transport aircraft that incorporate extensive blending of the fuselage and wing such that the fuselage is non-circular and carries significant load.

3. Description of the Work to be Performed:

Tasks:

A. The contractor shall conduct a conceptual design study of blended-wing-body-type transport configurations for payloads of 400, 800, and 1200 passengers. An 80-meter constraint on both wing span and length shall be maintained for the study if possible, and a maximum range of 7,500 nmi at full payload shall be held constant for all configurations. The contractor shall develop conventional transport concepts of comparable technology for comparison with the blended-wing-body-type configurations.

B. The contractor shall evaluate structural design options for the pressurized, non-circular, centerbody of a blended-wing-body configuration. These concepts shall be compared to a circular fuselage section of equal volume.

Deliverables:

1. Final Technical Report - Contractor shall deliver a final technical report for each task.

2. Monthly Progress Report.

Schedule:

Task A completed and Task A Final Report delivered - November 14, 1997.
Task B completed and Task B Final Report delivered - April 30, 1998.

SAERS (NAS1-96013) Task Order Page 2

1. Task Order Number and Title	Number:	Revision:
Title: Conceptual Design Study of Large, Blended-Wing-Body Type Transport Aircraft		

3. Deliverables, schedules, and performance measurements (continued):

Performance Measurements:

1. Contractor shall provide comparison of performance between blended-wing-body configurations and the conventional transport configurations. At a minimum, this comparison should include weights, fuel burn and relevant dimensions. Additional comparison of factors will exceed the minimun measurement.

2. Contractor shall evaluate sufficient structural concepts for the pressurized centerbody of a blended-wing-body configuration to determine the concept for minimum weight. The minimum weight concept should also be compared to a circular fuselage section of equal volume to determine the weight benefit or weight penalty between the two types of passenger configurations.

4. Government Furnished Items:

The government shall furnish the computer hardware and make available linear methods if desired by the contractor.

5. Other information needed for performance of task.

None

6. Security clearance required for performance of work:

Unclassified

7. Period of Performance	
Task A:	
Planned start date: 05/1/97	Expected completion date: 11/14/97
Task B:	
Planned start date: 11/14/97	Expected completion date: 04/30/98

8. NASA Technical Monitor: James R. Elliott, Jr.
M/S: 248 Phone:757-864-7123

BA06

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title BAØ7 Number: Revision:
   Title: Systems Analysis and Trade Studies for Advanced Military Aircraft

2. Purpose, Objective or Background of Work to be Performed:
   The NASA Advanced Aircraft Program performs systems analysis and research and development work related to advancing vehicle concepts and the technology needed to ensure the survivability of future advanced aircraft. Vehicle concepts are considered in the context of requirements established by integrated research teams composed of Industry, Government and end-user technical focal points. Trade studies have and will be conducted to define the appropriate vehicle performance parameters and investigate the impact of these parameters on the vehicle characteristics. Key technical issues will be identified and addressed through analysis and/or ground and flight testing.

   The Advanced Aircraft Branch conducts systems analysis and trade studies to determine / define the requirements and performance characteristics of advanced military aircraft. Mission effectiveness, operational considerations and cost models are an integral part of these studies as appropriate. Vehicle concepts will be studied to determine estimates of performance, weight, survivability, cost, etc.

   The Contractor will participate as part of a team composed of the Contractor, Government technical focal points, and possibly the end-user community.

   This team shall investigate operational environments and scenarios to quantify operations figure-of-merit (FOM) elements. Appropriate vehicle performance parameters (range, payload (weight and volume), aero performance, propulsion concepts, observables, etc.) will be systematically investigated to determine the impact of these parameters on the vehicle characteristics. The Contractor shall develop sets of evaluation metrics, including but not limited to, development risk and cost, procurement cost, life cycle cost, reliability, mission capability, etc., to be used as criteria for assessing or narrowing the number of concepts for further evaluation.

   As the number of concepts to be considered is reduced, the Contractor may be asked to conduct studies to a greater level of detail for the most promising concepts. More detailed configuration definition will be conducted to more precisely determine the vehicle performance characteristics, cost, etc. Detailed analyses shall be conducted to validate candidate systems concepts and/or their subsystems. Consideration will be paid to the realistic details that must be part of the design (materials, structural integrity, aero compatibility, signature control, etc.). A major part of this phase of the effort will be the identification of the key enabling technologies required for the success of these concepts. The Contractor may be asked to develop individual technology plans that focus on the development, risk reduction and validation of these technologies as well as explore the value and cost of future technology demonstration (including flight) programs.

   Specific objectives or work elements delegated to the Contractor will be defined in classified subtask descriptions which will be provided by the NASA Technical Monitor. The Contractor shall be fully responsible for developing a task plan and recommending the appropriate analysis and experimental investigations.

SAERS (NAS1-96013) Task Order Page 2

1. Task Order Number and Title Number: Revision:
   Title: Systems Analysis and Trade Studies for Advanced Military Aircraft

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Specific work elements will be defined in classified subtask descriptions which will be provided by the NASA Technical Monitor. The Contractor will lead two military systems studies to be conducted by the teams. Details will be specified in the subtask description provided under separate cover. The Contractor will be responsible for meeting milestones associated with his program and reporting any problems that will impact a team milestone or completion of the task.

The Contractor shall assemble the tools and expertise to conduct classified system level studies. The Contractor shall document the methodology that develops as a result of conducting the two military systems studies. The Contractor will identify deficiencies that exist based on his performance of the two studies. The Contractor will recommend a plan to address these deficiencies whether they be analytical tool improvements, database or empirical deficits or lack of sufficient risk reduction to justify acceptance of potential enabling high-risk/high-payoff technologies.

Deliverables:
The classified subtask description will clearly specify the deliverable items (systems analysis/trade study, evaluation metrics/figure-of-merit, informal and formal documentation, and presentations). The Contractor will submit a bimonthly technical progress report describing the progress on each subtask. The bimonthly report will address any problems that will impact completion of the subtasks. Communication of technical progress via direct, telephone, or electronic (fax, data transmittal, etc.) interchange and will not be limited to the bimonthly reports.

Schedule:
The classified subtask descriptions will clearly specify critical path schedule or milestone events.

Metric:
The Contractor will meet the team milestones and provide the deliverables as specified. The Contractor is encouraged to recommend improvements to the team. If these recommendations result in savings (milestones accomplished early, money saved) to the NASA system studies efforts, then the Contractor will have exceeded the expected performance.

SAERS (NAS1-96013) Task Order Page 3

1. Task Order Number and Title Number: Revision:
Title: Systems Analysis and Trade Studies for Advanced Military Aircraft

4. Government Furnished Items:
NASA FLOPS code for conducting system level studies. Macintosh, PC and graphics workstations for program development, planning, analysis, and reporting.

5. Other information needed for performance of task.
Some travel may be required for the subtasks.

6. Security clearance required for performance of work:
Top Secret required.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: NASA Technical Monitor:
Noel A. Talcott, Jr. / William J. Small
.M/S: 411 Phone: 757-864-5292

1. Task Order Number and Title BA08 Number: Revision: Title: Development of Technology For Advanced Aircraft

2. Purpose, Objective or Background of Work to be Performed:

The NASA Advanced Aircraft Program performs systems analysis and research and development work related to advancing vehicle concepts and the technology needed to ensure the survivability of future advanced aircraft. Vehicle concepts are considered in the context of requirements established by integrated research teams composed of Industry, Government and end-user technical focal points. Trade studies have and will be conducted to define the appropriate vehicle performance parameters and investigate the impact of these parameters on the vehicle characteristics. Key technical issues will be identified and addressed through analysis and/or ground and flight testing.

The Advanced Aircraft Branch is directing a NASA program aimed at investigating a novel propulsion concept identified through the above process as a key or critical program element. This program involves an alliance between NASA and several industry partners. The Contractor will participate as part of this Integrated Product Team (IPT). The Contractor shall perform the appropriate conceptual design/trade studies; experimental testing and data analysis; and deliver informal and formal documentation and presentations. Specific objectives or work elements delegated to the Contractor will be defined in classified subtask descriptions which will be provided by the NASA Technical Monitor. The Contractor shall be fully responsible for developing a task plan and recommending the appropriate analysis and experimental investigations.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Specific work elements will be defined in classified subtask descriptions which will be provided by the NASA Technical Monitor. The Contractor shall develop appropriate technology development, risk reduction and validation plans of the critical program elements. The Contractor will brief this plan to the IPT and participate in the finalization of the team program. The Contractor will lead his designated portion of the program and interface as required with the IPT members, if necessary, to ensure program milestones and deliverables are met. The Contractor will be responsible for meeting milestones associated with his program and reporting any problems that will impact a milestone or completion of the task.

Schedule:
The classified subtask descriptions will clearly specify critical path schedule or milestone events.

Metric:
The Contractor will meet the critical path elements and provide the deliverables as specified by the IPT. The Contractor is encouraged to recommend improvements to and add value to the IPT process. If these recommendations result in savings (milestones accomplished early, money saved) to the NASA program, then the Contractor will have exceeded the expected performance.

BA08

SAERS (NAS1-96013) Task Order Page 2

1. Task Order Number and Title   Number: Revision:
   Title: Development of Technology For Advanced Aircraft

3. Tasks, Deliverables and or Products, and performance measurements (continued):

The classified subtask description will clearly specify the deliverable items (concept design/trade study, evaluation metrics/figure-of-merit, experimental testing and data analysis, informal and formal documentation, and presentations). The Contractor will submit a bimonthly technical progress report describing the progress on each subtask. The bimonthly report will address any problems that will impact completion of the subtasks. Interaction with the IPT requires timely communication of technical progress to the IPT via direct, telephone or electronic (fax, data transmittal, etc.) interchange and will not be limited to the bimonthly reports.

4. Government Furnished Items:

Access to Government owned research facility to conduct approved IPT experimental test program, Macintosh, PC and graphics workstations for program development, planning, analysis, data acquisition and reporting.

5. Other information needed for performance of task.
Other:
Significant amounts of travel are anticipated for the subtasks. IPT members presently are located at LaRC, LeRC, Los Angeles, Cincinnati, and Atlanta. Interface with and participation in the team program will require multiple day trips to these locations. Travel requirements under present work order BA001, NAS1-19000, are typical and can provide an accurate estimate of requirements.

6. Security clearance required for performance of work:
Top Secret required.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: NASA Technical Monitor:
Noel A. Talcott, Jr. / William J. Small
.M/S: 411   Phone: 757-864-5292

SEARS (NAS1-96013) Task Order Page 1

1. Task Order Number:: BA10 Revision: ____ Date of Revision:_
Title: Aerodynamic and Performance Analysis of ERAST Alliance 1 Proof-of-Concept (POC) Proposals

2. Purpose, Objective or Background of Work to be Performed:
Conduct aerodynamic and performance analysis as part of independent assessments of four ERAST Alliance POC proposal being conduct by Langley's Systems Analysis Branch.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

A. The contractor shall analyze performance capabilities for two of the four proposals using the aircraft characteristics (weight, aerodynamics, propulsion) supplied by the proposing companies.

B. The contractor shall perform a lift independent drag build-up for all four POC proposals at a set of flight conditions to be specified.

C. The contractor shall estimate lift dependent drag characteristics for two of the four concepts at specific flight conditions using codes and processes specified by NASA. This analysis shall include aeroelastic effects obtained through interaction with NASA's structural analysis of the concepts.

D. The contractor shall contribute to written evaluations of the four concepts both through documentation of analyses performed and review and comment on drafts.

Deliverables:

Task A.
1. Technical memorandum summarizing results of analysis
2. Comparison of performance to estimates in company proposals

Task B.
1. Technical memorandum outlining methods and assumptions used in analysis
2. Tabulated results of analysis showing, for each flight condition, total lift independent drag broken into contributions from each major component (e.g. fuselage, wing, etc.) and from different drag sources (e.g. friction, form)

Task C.
1. Technical memorandum documenting any problems encountered in analysis and any deviation from specified analysis process
2. Tabulated results of analysis (induced drag and wing profile drag vs. lift coefficient) at each flight condition

Schedule:
Task A: Analysis completed and results reported by May 30, 1997
Task B: Analysis of first 2 concepts completed and results reported by June 6,1997
Analysis of final 2 concepts completed and results reported by June 18, 1997
Task C: Analysis of first concept completed and results reported by June 11, 1997
Analysis of second concept completed and results reported by June 18, 1997
Task D: Participation in development of written evaluations completed by July 14, 1997

SEARS (NAS1-96013) Task Order Page 2

Performance Measurements:

1. Contractor shall provide comparison of performance characteristics from own analysis to that reported in concept proposals. At a minimum this comparison should include climb performance, maximum altitude, endurance at maximum altitude, and evaluation of any large discrepancies.

2. Contractor shall provide all analysis results in a timely fashion so that there is no negative impact on NASA's ability to meet its deadlines for completion of the POC assessments.

3. Contractor shall apply engineering judgement in all performance and aerodynamic analysis to assess reasonableness of results and identify problems.

A. The contractor shall analyze performance capabilities for two of the four proposals using the aircraft characteristics (weight, aerodynamics, propulsion) supplied by the proposing companies.

B. The contractor shall perform a lift independent drag build-up for all four POC proposals at a set of flight conditions to be specified.

C. The contractor shall estimate lift dependent drag characteristics for two of the four concepts at specific flight conditions using codes and processes specified by NASA. This analysis shall include aeroelastic effects obtained through interaction with NASA's structural analysis of the concepts.

D. The contractor shall contribute to written evaluations of the four concepts both through documentation of analyses performed and review and comment on drafts.

Deliverables:

Task A.

1. Technical memorandum summarizing results of analysis
2. Comparison of performance to estimates in company proposals

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1. Technical memorandum outlining methods and assumptions used in analysis
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Task C.

1. Technical memorandum documenting any problems encountered in analysis and any deviation from specified analysis process
2. Tabulated results of analysis (induced drag and wing profile drag vs. lift coefficient) at each flight condition

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Task B: Analysis of first 2 concepts completed and results reported by June 6,1997
Analysis of final 2 concepts completed and results reported by June 18, 1997
Task C: Analysis of first concept completed and results reported by June 11, 1997
Analysis of second concept completed and results reported by June 18, 1997
Task D: Participation in development of written evaluations completed by July 14, 1997

SEARS (NAS1-96013) Task Order Page 3

4. Government Furnished Items:

Computer hardware; copies of the four POC proposals and supporting data along with order of analysis desired; process and necessary computer codes for estimating lift dependent drag; structural analysis necessary for aeroelastic piece of lift dependent drag process; flight conditions for which aerodynamic analysis is desired for each concept; and will make available methods for calculation of lift independent drag.

5. Other information needed for performance of task.

POC proposals will contain limited access information which cannot be further disseminated.

6. Security clearance required for performance of work:

Unclassified

7. Period of Performance

Task A:
Planned start date: 05/14/97 Expected completion date: 5/30/97
Task B:
Planned start date: 05/14/97 Expected completion date: 6/18/97
Task C:
Planned start date: 6/2/97 Expected completion date: 6/18/97
Task D:
Planned start date: 6/18/97 Expected completion date: 7/14/97

Planned start date: See above	Expected completion date: See above

8. NASA Technical Monitor: Mark D. Guynn

.M/S: 248 Phone: 757-864-8053

PRINTED: 5/1/97

ART/SAERS Task Order Page 1

1. Task Order Number and Title GH01 Number: Revision:
   Title: **DOPPLER GLOBAL VELOCIMETRY (DGV)**

2. Purpose, Objective or Background of Work to be Performed:
This task order encompass the application of Doppler Global Velocimetry (DGV) to the fluid mechanic measurement needs in NASA wind tunnels and for the implementation of NASA developed advancements to DGV technology.

3. Description of the Work to be Performed: The contractor shall perform the following subtasks:

1. Develop data acquisition software to acquire velocity measurement images from a three-component Doppler Global Velocimeter optical system. The software shall provide acquisition capabilities with continuous wave Argon ion laser based systems and pulsed Nd:YAG laser based systems. The software shall contain a user interface section composed of modules written in Microsoft Visual Basic for Windows NT / Windows 95 operating systems. The data acquisition software modules, in the form of 32-bit Fortran and/or C/C^{++} DLLs, shall control and obtain data images from the government owned Matrox frame grabber subsystems. The software shall also control and obtain monitoring information from the government DGV Monitoring Electronics System. The software shall provide a direct interface to the NASA supplied DGV data processing code for on-line quick-look studies of acquired test images to determine proper optical system settings. The output data images shall be compatible with NASA DGV data processing software and stored in PKZIP version 2.04 format. The DGV data acquisition software shall contain an on-line training software module including examples to help guide the first time user and to reduce training time to a minimum. The software shall also contain on-line help to provide operations and problem solution information and to guide the user through the DGV data acquisition sequences. A single executive software module shall control execution of all other modules and provide cross linking, data validation, and data transfer such that acquisition integrity is maintained as each module is executed. The software shall be error free when operating the DGV optical system in normal three-component data acquisition mode. The software shall provide the user on-screen prompts and feedback for the best optical setup to obtain velocity images with high signal-to-noise ratio.

Deliverables: The contractor shall provide:
1. DGV data acquisition source and executable software including the user interface;
2. Control and monitoring DLLs, compression and storage DLLs, and graphical subroutines for user feedback;
3. Automatic setup code to install the software;
4. Documentation to describe software installation, operation, and module processes;
5. Contractor developed software and hardware shall be provided to the government for unrestricted government use and duplication. Licenses for commercial software and hardware used by the contractor and required for operation shall be provided to the

1. Task Order Number and Title Title: **DOPPLER GLOBAL VELOCIMETRY (DGV)**	Number:	Revision:

government.

Schedule of Deliverables: Subtask 1 shall be completed by July 1, 1997.

Minimum Acceptable Performance Standards: Evaluation of contractor performance on subtask 1 will be based on the following:

- DGV data acquisition software shall meet all specifications provided in the Description of Work for subtask 1 above within the contracted cost.

- All deliverables shall be delivered by the subtask 1 completion date of July 1, 1997 while meeting all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting any one of the two standards listed below will constitute exceeding the minimum acceptable performance for subtask 1.

- User interface software for the DGV data acquisition system shall meet all specifications provided in the Description of Work for subtask 1 above within the contracted cost and:
  1. Provide operational user feedback to determine optical settings to obtain velocity images with high signal-to-noise ratio
  2. Provide multilayer help modules that describe system operations

- Delivery of all deliverables within specification, at the contracted cost and with a faster delivery time of 10% of the total working days in the performance period

2. Develop a DGV video data acquisition system based on government supplied PC-compatible microcomputers, each containing two Matrox Pulsar 10-bit video frame grabbers. The system shall consist of a master controller computer and four data acquisition subsystems comprising a Microsoft Windows NT version 4.0 network. Additionally, hardware subsystems shall be constructed to provide the necessary synchronization signals for simultaneous acquisition of data and reference images from the six data cameras and two laser frequency monitoring cameras in the DGV optical system. The signals shall control laser operation and firing, camera shutter operation and timing, and frame grabber acquisition. The appropriate control signals, generated by the four subsystems, shall be triggered by software command sequences originating in the master computer and transmitted to the subsystems via the Windows NT network. Following data acquisition, each subsystem shall poll its respective monitoring system to acquire and store

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1. Task Order Number and Title	Number:	Revision:
Title: **DOPPLER GLOBAL VELOCIMETRY (DGV)**		

the component parameters. The acquired image and parameter data are to be stored locally in the acquiring subsystem. The controlling and acquisition software shall consist of C/C^{++} DLL modules that shall be compatible with the DGV data acquisition software, subtask 1. These modules shall provide support for 10-bit analog and 10-, 12-, 14-, and 16-bit digital video cameras. The modules shall also perform all networking functions needed for remote control of subsystem data acquisition and storage. Additional C/C^{++} and/or Fortran DLL software modules shall process user selected data images in each subsystem computer to obtain velocity images which shall then be transferred to the master computer for on-line data monitoring. These modules shall also transfer the raw signal and reference data images for signal monitoring by the master computer. Software modules in the master computer shall display the signal, reference, and velocity images along with histogram plots for each data image.

Deliverables: The contractor shall provide:

1. Electronics circuits to provide computer controlled synchronization signals for laser control and firing, camera shutter operation and timing, and frame grabber data acquisition;
2. Master control software modules for network control of the subsystem operation and software execution;
3. Subsystem software modules to receive commands from the master computer and initiate synchronization timing sequences, acquire video data from its respective signal and reference cameras, compress and store the acquired images, acquire and store optical system parameters, process data images based on selections obtained from the master computer, and transmit the selected signal, reference, and velocity images to the master computer;
4. Software modules to accept image data received via the network from the subsystems, and display the signal, reference, and velocity images along with their respective histogram plots for DGV system monitoring;
5. Automatic setup code to install the software;
6. Documentation to describe software installation, operation, and module processes;
7. Contractor developed software and hardware shall be provided to the government for unrestricted government use and duplication. Licenses for commercial software and hardware used by the contractor and required for operation shall be provided to the government.

Schedule of Deliverables: Subtask 2 shall be completed by November 30, 1997.

Minimum Acceptable Performance Standards: Evaluation of contractor performance on subtask 2 will be based on the following:

- DGV video data acquisition hardware and software shall meet all specifications

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provided in the Description of Work for subtask 2 above within the contracted cost.

- All deliverables shall be delivered by the subtask 2 completion date of November 30, 1997 while meeting all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting any one of the two standards listed below will constitute exceeding the minimum acceptable performance for subtask 2.

- User interface software for the DGV video data acquisition system shall meet all specifications provided in the Description of Work for subtask 2 above within the contracted cost and:
  1. Provide operational user feedback to determine the signal-to-noise ratio of the acquired velocity images
  2. Provide multilayer help modules that describe system operations

Delivery of all deliverables within specification, at the contracted cost and with a faster delivery time of 10% of the total working days in the performance period

3. The contractor shall provide animation to describe DGV wind tunnel entries. These animations shall perform two functions: determine the most efficient optical configuration while maximizing measurement accuracy through optimal placement of the optical components; and serve as a platform for the in situ display of the velocity measurement data. The animations should represent the wind tunnel and model installation with sufficient accuracy and versatility to allow various DGV installation scenarios to be investigated to determine the most optimum configuration for implementation in the wind tunnel. Following the wind tunnel investigation, the processed data shall be incorporated in the animation and a video generated with sufficient versatility to provide the casual user with a good understanding of the flow field during testing. The following planned wind tunnel entries require animations to determine the optimal placement of the optical components:

(a) Isolated rotor flow field investigation, 14-x 22-foot Tunnel
(b) Boeing vortex wake investigation, 14-x 22-foot Tunnel
(c) Boeing trap wing test, 14-x 22-foot Tunnel
(d) Boeing trap wing test, Ames 12-foot High Pressure Tunnel

Animations of the above wind tunnel entries shall also serve as the basis for in situ display of the acquired velocity measurement data. The contractor shall incorporate representative data sets in the animations and provide video of the animations viewing the data from several viewpoints. In

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addition to the above tunnel entries, the following entry will require data animations:

(a) Isolated rotor flow field investigation, B 1212 model prep

Deliverables: The contractor shall:
1. Provide the government with computer animations of DGV installations in the facilities designated;
2. Provide and verify the best optical configuration for the subject flow field investigation.
3. Provide modified animations to include representative velocity measurements placed in situ at the proper measurement locations.
4. Provide all animations to the government in 3-D Studio, MPEG version 1, and video tape formats, along with all key frame images in JPEG format.

Schedule of Deliverables: Subtask 3 shall be completed by November 30, 1997.

Minimum Acceptable Performance Standards: Evaluation of contractor performance on subtask 3 will be based on the following:

- Delivery of all deliverables for the facilities specified in the Description of Work for subtask 3 at the contracted cost
- All deliverables are delivered by the subtask 3 completion date of November 30, 1997

Significantly Exceeds Minimum Performance Standards: Meeting any one of the two standards listed below will constitute exceeding the minimum acceptable performance for subtask 3.

- Delivery of all deliverables in the Description of Work for subtask 3 that meet all the specifications at the contracted cost and demonstrates versatility and clarity of understanding of the DGV installation and the representation of the measured flow field

- Delivery of all deliverables within specification, at the contracted cost and with a faster delivery time of 10% of the total working days in the performance period

4. Provide system administration for the two MSTB Sun Sparc 2 workstations. This support shall consist of maintaining proper system operation and upkeep of the operating system. The Sun workstations are used as gateways to external users and storage areas of data transferred and received from these users. The contractor shall maintain the operating system and all NASA

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required security provisions. The contractor shall keep a running log of all NASA security procedures, implement the procedures, and disseminate the information to NASA users of the workstations. The contractor shall implement all upgrades of software and software received from Sun for the current operating system.

Deliverables: The contractor shall:
1. Provide operating logs for the workstations including documentation of all users, hours of use, security procedures and notices received from NASA;
2. Provide documentation for software and hardware installation of system upgrades received from Sun.

Schedule of Deliverables: Subtask 4 shall be completed by November 30, 1997.

Minimum Acceptable Performance Standards: Evaluation of contractor performance will be based on the following:

- Delivery of all deliverables specified in the Description of Work for subtask 4 at the contracted cost
- All deliverables are delivered by the subtask 4 completion date of November 30, 1997

Significantly Exceeds Minimum Performance Standards: Meeting the standards listed below will constitute exceeding the minimum acceptable performance for subtask 4.

- Delivery of all deliverables in the Description of Work for subtask 4, while meeting all specifications at the contracted cost, and system downtime hours excluding operating system software and hardware upgrades not exceeding 3% of total operating hours
- Number of unauthorized accesses or use of the system not exceeding one per month

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1. Task Order Number and Title — Number: — Revision:
   Title: **DOPPLER GLOBAL VELOCIMETRY (DGV)**

4. Government Furnished Items: Building 1200, rooms 217, 108, 120.

Computers	Sun Sparc 2 (2 ea), Pentium Class PC, 486 Class Pc (2 ea)
Printers	Tektronic Phaser III, Epson Postscript, HP Laser Jet III
Video Electronics	Analogic framegrabber (2 ea), Matrox framegrabber, Hitachi RS-170 video cameras (2 ea), DVC digital cameras (2 ea), MPEG Video Editing Board, TruVision Video Editing Boards, Panasonic Laser Disk Recorder, Mitsubishi SVHS Recorder, Sony Monitor
Electronics	Micro Genius Development System, Oscilloscope, Logic Analyzer, Digital Multimeter, Signal Generator
Software	3D Studio animation software, DesignCAD 2D/3D, OrCAD, Corel Draw, Visual Basic for Windows NT, Fortran Powerstation for Windows NT, C/C++ for Windows NT

5. Other information needed for performance of task.
   Contractor shall have access to Government facilities and equipment required to support this task

6. Security clearance required for performance of work:
   All work will be unclassified

7. Period of Performance

Planned start date: May 1, 1997	Expected completion date: November 30, 1997

8. NASA Technical Monitor: David L. Gray
   M/S: 236 — Phone: 804-864-4661

SEARS (NAS1-96013) Task Order Page 1

1. Task Order Number:: GH02 Revision: ____ Date of Revision:_
Title: Cryogenic Pressure Sensors

2. Purpose, Objective or Background of Work to be Performed:
This task is a continuation of work under which (1) three prototype ESP modules have already been completed and (2) two smart sensors for Marshall Space Flight Center are nearly completed. The contractor will be responsible for design, calibrate, and analyze and NASA will fabricate and conduct field tests under this task..

Design cryogenic pressure sensors per LaRC specifications (attached) for the following applications: (1) 16-channel static measurements per electronically scanned pressure (ESP) measurement modules (3 each), (2) 48-channel static measurements based on selection of best of (1) (1 each), and (3) smart sensor measurement for the Space Shuttle Main Engine test bed at MSFC (2 each). Provide laboratory calibration data for three 16-channel static sensors. Analyze field data to verify performance under harsh field conditions..

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):
Task 1. The Contractor shall design a static pressure sensor of 48-channel cryo ESP module one, (based on the best design of the three 16-channel sensors). The Contractor shall provide laboratory calibration data per LaRC specification (attached) for all modules fabricated by LaRC (completed 1/97). The Contractor shall analyze field data for all modules in LaRC cryogenic wind tunnels (estimated completion by NASA 5/97). The Contractor shall design six 16-channel modules, based on selection of one of three prototypes, to determine fabrication reproducibility .

Deliverables:
(1) design of 1 model of 48-channel ESP cryo sensor 8/31/97
(2) laboratory calibration data of 16-channel modules (7/97)
(3) analysis of 16-ch. field data (8/1/97)
(4) design of six modules, based on selection of one of three prototypes (11/97).

Task 2. The Contractor shall design a smart sensor for use in the Space Shuttle Main Engine test bed at MSFC. The Contractor shall provide laboratory calibration data per ASTM specification (attached) for at least one sensor fabricated by LaRC. The Contractor shall compare calibration data acquired at LaRC with that at MSFC (estimated 11/97).

Deliverables:
(1) laboratory calibration data within two months after fabrication by NASA LaRC (estimated fab completion 4/97)
(2) analysis of field data within two months after NASA field test (7/97).

Task 3. The Contractor shall perform an aging test on four silicon pressure die as received from the vendor by measuring offset voltage at room temperature, at 50 degC, and again at room temperature, each for a period of at least four weeks.

Deliverables:
(1) data sheet on aging test (5/97)
(2) report on aging test (11/97).

The Contractor shall provide a final technical report. The final report is due within three months after the completion of each subtask (2/28/98).

Minimum Acceptable Performance Standards:

Evaluation of Contractor performance will be based on the following:

The superior of the three models of cryogenic ESP modules shall meet specifications provided by LaRC based on laboratory calibration and field data.

The smart sensors for the Space Shuttle Main Engine test bed shall meet specifications provided by LaRC based on laboratory calibration and field data.

The documentation and prototype smart sensors shall be delivered to LaRC.

The aging test shall provide sufficient data to determine (1) whether exposure to 50 degC for four weeks stabilizes the silicon die, (2) whether poor aging performance is related to high offset voltage.

The final technical report will contain a comprehensive description of the calibration and field service results of all sensors developed under this task assignment.

Significantly exceeds minimum acceptable performance:

An improvement of 10% over selected target specifications contained in the attachment will be judged as "exceeding" acceptable performance.

The subject specifications are accuracy, offset voltage, and stability for the ESP modules; frequency response for the dynamic pressure sensors; and accuracy, thermal error, and stability for the smart pressure sensors, as defined in the attachment.

The discovery of a definitive relationship between aging performance and offset voltage of the silicon die will be judged as a breakthrough in the art and "exceeding acceptable performance."

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4. Government Furnished Items:
   Calibration laboratory Bldg 1230 Room 138 and equipment contained therein, including a portable data acquisition system, data analysis software, and calibration equipment.

5. Other information needed for performance of task.
Contractor shall have access to Government facilities required to support this task, including but not limited to pressure calibration laboratory (Room 138, Building 1230); laboratories with equipment to measure various specifications like mechanical shock, thermal shock, etc., located in the Component Verification Building 1284A and the Pyrotechnic Laboratory Building 1158 ; and specified wind tunnels to acquire field data.

Safety approval has been obtained to operate cryogenic calibration apparatus in Bldg 1230 Room 138. Oxygen monitor is operational.

6. Security clearance required for performance of work:
None

7. Period of Performance 5/1/97-11/30/97	
Planned start date: 5/1/97	Expected completion date: 3/1/98

8. NASA Technical Monitor: Allan Zuckerwar
.M/S: 236 Phone: 757-864-4658

SEARS (NAS1-96013) Task Order Page 4

CRYOGENIC ESP MODULE: SPECIFICATIONS

Number of channels (prototype)[1]	16 or 48
Differential pressure range (prototype)[2]	±15 psi
Maximum static error	< 0.25% FSO (deviation from best fit)
Nonrepeatability[3]	< 0.25% FSO
Specification temperature range	–162 C to 55 C
Cable connections[4]	STD8400 with SJU interface box
Pressure lines	REF only; C1, C2, CAL eliminated
Ref pressure calibration levels	1, 3, 8 atm
Temperature sensors	At each pressure chip

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[1] A 48 channel module will be started under this task.

[2] Determined by rating of chip. Other ranges, e.g. ±2.5 psi and ±50 psi, are also available.

[3] Based on a number of calibration repetitions TBD.

[4] Both pressure sensor and temperature sensor data will be multiplexed to minimize number of output cables.

SEARS (NAS1-96013) Task Order Page 5
SMART PRESSURE SENSOR: SPECIFICATIONS

Accuracy

a) Maximum Static Error: Less than 0.25% of FSO
b) Maximum Nonlinearity: Less than 0.25% of FSO
c) Maximum Thermal Error: Less than 0.25% of FSO/C at T = -253 C
Less than 0.25% of FSO/C at T = +60 C

Temperature Coefficient of Offset Voltage: Less than 0.05% of FSO/C

Maximum Hysteresis: Less than 0.5% of FSO

Maximum Overpressure:

a) 8700 psia for sensor dice
b) 12 000 psia for pressure vessel

Long Term Stability: Within 1% of FSO/30 days

1. Task Order Number:: GH03 Revision: ____ Date of Revision:_
   Title: **Reference Pressure Characterization**

2. Purpose, Objective or Background of Work to be Performed:
   This task encompass the need to develop an understanding of reference pressure measurement process at NASA wind tunnels to improve data quality.

3. Description of the Work to be Performed: The contractor shall perform the following subtasks:

A. Conduct a series of laboratory experiments (Approximately four experiments) to evaluate the effects of selected variables on reference pressure measurements. The identified variables are rezero of instruments, pressure, temperature, and vibrations variations.

Deliverables: The contractor shall provide:

1. Experimental data (raw data and analyzed data)
   (Due date for the rezero experiment is May 30,1997
   for the temperature experiment is June 30,1997
   for the pressure experiment is July 30,1997
   for the vibration experiment is August 30,1997)

2. Report that analyzes each variable with statement of uncertainty of each variable that has been tested.

B. Develop documentation to describe the calibration process for Ruska instrument that is used to measure reference pressure at GDD wind tunnel. This process shall start from NIST calibration report that will be provided by NASA to the experimental results that is analyzed by item one of this task.

Deliverables: The contractor shall provide:

1. Report of the calibration process.(Due date :June 15,1997)
2. System Diagram with uncertainty statement (include precision, bias, standard deviation, and student -t. distribution) for each step of the process. (due date: Sept. 15, 1997)

C. Develop a user friendly manual for Ruska DDR 6000 instrument that includes calibration requirements, rezero procedure, internal system diagram, and do and do not functions that effect data quality.

Deliverables: The contractor shall provide:

1. User friendly Ruska DDR-6000 Manual. (Due date: August 30,1997)

Metrics:

Min. Expected : All deliverables are meet with the specified due date.

Exceeds Min. : All deliverables are meet early than the specified due date with a creative method to describe the calibration process of reference pressure and the results of four laboratory experiments.

4. Government Furnished Items:
Building 1230, rooms 243,253
Test Equipment : 2- Ruska DDR6000
2- Voltmeter
1- Dead weight tester
1- 386-PC computer with software
Government Data: - Test results Analysis
- Equipment calibration reports

5. Other information needed for performance of task.
Contractor shall have access to Government facilities and equipment required to support this task

6. Security clearance required for performance of work:
All work will be unclassified

7. Period of Performance	
Planned start date: May 1,1997	Expected completion date: October 31,1997

8. NASA Technical Monitor: Tahani R. Amer
.M/S: 234 Phone: 804-864- 5546

ᴗAERS Task Order Page 1

1. Task Order Number and Title Number: GK01 Revision:
Title: **Measurement Science Support**

2. Purpose, Objective or Background of Work to be Performed: The Measurement Science and Technology Branch has the responsibility to develop advanced measurement systems for utilization in Langley facilities. This effort requires the buildup and testing of several subcomponents. The purpose if this task is to support the construction and testing of these subcomponents along with the completion of testing facilities.

3. Description of the Work to be Performed:

The contractor shall perform the following subtasks:
Subtask 1. Operate the Hypersonic Flow Generator (HFG) at building 1200, during NASA conducted tests, using NASA supplied operational proceedures. Construct a resistance heater (presently under design by NASA personal) to allow heating of the supply gas to increase operational temperature of the HFG. Write a document describing the effect of the heater on present operations and safety procedures.

Deliverables:
a. Start up and shut down the Hypersonic Flow Generator at Building 1200 on a nearly daily basis (procedures to take about 2 hours per test day), during NASA conducted tests and using NASA supplied preliminary operational procedures.
b. Design and construct a monotube in-line resistance heater to heat supply gasses to over 1000 K stagnation temperature. The heater is a simple stainless steel electrical resistance tube.
c. Write a summary document describing the installation proceedures developed while installing the heater, and the changes in operational proceedure made necessary as a results of using the resistance heater
d. Write a summary document describing the changes in safty proceedures made necessary by the operation of the heater.

Schedule for Deliverables:
Item a. is an ongoing activity, with the schedule set by NASA personal. The tests will be conducted through April 30, 1998.
Item b. Shall be completed by April 1, 1998
Items c & d Shall be completed by April 30, 1998

Satisfactory Metrics for Deliverables:
a. The contractor operator should be able to make the facility operate at least 75% of the required time.
b. The in-line heater design will be completed Dec '97. The contractor shall construct the hardware by April '98, and complete preliminary operation with the heater by May '98.
c.& d. The required documents shall be fully completed, and be 2 to 4 typed pages pages long, by May '98.

Exceeds Metrics:
a. If the HFG is made to operate as desired (for NASA tests) over 80% of the desired test time, the operator will have exceeded present efficiency.
b. Completion of the in-line heater hardware and completion of preliminary HFG heated operation before March '98 exceeds the expected results.
c & d. Completion of required documentation before March '98 exceeds expected results.

Subtask 2. Fabricate, and make ready for installation, three complete focusing Schlieren systems for the Unitary Plan Wind Tunnel, with the capability of obtaining fields of view which would overlap and cover a total viewed length of about 60 inches. This large viewed area is needed for some future NASA planned tests. These systems will give that facility a continuous field of view of the varying density and shock flow field over models needed to properly examine the aerodynamics of the full model. The basic optical and mechanical design has been completed by NASA, but the detailed design of parts of the structure, and construction and assembly of the entire system is required to be done by the contractor.

Deliverables:
a. Make detailed designs and engineering drawing for the brackets, optical adapters and wiring layout for the focusing schlieren system design for Unitary tunnel (basic design and parts supplied by NASA).
b. Fabricate any necessary mechanical brackets and adaptors to construct three complete systems from supplied parts
c. Make detailed sketches of the assembly procedure
d. Assemble three complete systems, and have them ready to mount on the Unitary Wind Tunnel

Schedule of Deliverables:
a. Detailed design drawings are required by July 1, 1997
b. Fabrication of needed parts to be completed by July 15, 1997
c. Detailed sketches of assembly proceedure are needed by July 31, 1997
d. Three completely assembled systems ready to mount on Unitary tunnel by September 30, 1997

Satisfactory Metrics for Deliverables:
Completed documentation, completed fabrication and assembly, and successful operation of control systems for all three systems in the allowed time .

Exceeds Metrics:
a. Completion of required drawings by June 1, 1997
b. Fabrication of needed parts by June 20, 1997
c. Completion of satisfactory sketches of assembly proceedures by July 1, 1997
d. Completion of assembled systems and mounted on Unitary by July 29, 1997

Subtask 3
Machine optical witness plate fixtures per existing NASA drawings.
Deliverables:
a. Optical witness plate fixtures

Schedule of Deliverables: One optical witness plate fixture per month through December, 1997.

Satisfactory Metrics: Meets above schedule of deliverables.

Exceeds Metrics: More than 9 optical witness plate fixtures delivered in 1997

Subtask 4. Construct components for a Nd:YAG based Doppler Global Velocimeter (DGV) from drawings supplied by NASA personal. These drawings will be provided by NASA by the start of the desired work

Deliverables:
a. Receiver camera system cover (1 each)
b. Optical beam stops (20 each)
c. Parts and mounts to install the unified instrumentation system in the Unitary Plan Wind Tunnel
d. Assembled DGV Iodine vapor cell systems (3 each)

Schedule for Deliverables:
Subtask 4 shall be completed by December 30, 1997

Satisfactory Metrics for Deliverables:
All deliverables completed fully by specified time.

Exceeds Metrics:
All deliverables completed by November 30, 1997

Subtask 5. Construct components for a laser diode based Electro-Optic Holographic (EOH) systems from drawings to be supplied by NASA at the beginning of the work period.

Deliverables:
a. Sound proof cover for the EOH optical system to protect optical alignment from the noise source under measurement. (1 each)
b. EOH speckle interferometers (2 each)
c. EOH laser transmitter assemblies (1 each)
d. Fiber optic phase steppers (3 each)

Schedule for Deliverables:
All items in subtask 5 to be done in the time period of December 30, 1997 to April 30, 1998

Satisfactory Metrics for Deliverables:
All item completed in the above schedule

Exceedes Metrics:
All Items completed by March 31, 1998

⌣AERS Task Order Page 4

1. Task Order Number and Title	Number:	Revision:
Title: **Measurement Science Support**		

4. Government Furnished Items:

Access to Building 1200 laboratories and equipment.

Optical witness plate fixtures Drawings (Subtask 3).

NASA drawings for Nd:YAG based Doppler Global Velocimeter (DGV) components (subtask 5).

NASA drawings for based Electro-Optic Holographic (EOH) system components (subtasks 5).

5. Other information needed for performance of task:

The terms construct, fabricate and machine under this task implies that the contractor is to use NASA supplied parts, tools, and facility (Bld 1200) to assemble parts supplied by NASA or sub-parts made by the contractor (also using NASA supplied general drawings, material, machine facilities, and location). All drawings will either be supplied by NASA or made by the contractor, and contractor made drawings will only consist of brackets, mounts, covers, etc., or assembly drawings.

6. Security clearance required for performance of work:

All work will be unclassified.

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Gale A. Harvey
M/S: 424 Phone: 757-864-6742

1. Task Order Number and Title Number: GK02 Revision:
Title: Planning, Schedules Management and Reporting for High Speed Research Program

2. Purpose, Objective or Background of Work to be Performed:
Planning and schedules management is a project management knowledge area which provides an organized, structured approach for developing project plans, communicating across organizational lines, identifying work which needs to be accomplished to meet technical, cost and time goals, tracking actual progress against the work plan, analysis of the plan through fixed status and reporting cycles and re-planning work when internal or external organization, project objectives or constraints change.

3. The contractor shall provide planning, schedules management and reporting for the High Speed Research Program Office.

Deliverables: It is acknowledged that requirements for deliverables are modified from time to time by individual projects. The following is a list of planning and schedule management products. Attachment A has a complete description of each category of deliverables. . As requirements change, Attachment A will be changed through revisions to this task.

A. Reports
   1. Graphic:
      a. Precedence Logic Network
      b. Gantt - Bar and/or Milestone Charts
   2. Monthly Technical Report
   3. Center Director's Monthly Review
   4. Various Level II and III Management Reports
   5. Program Office Reports
      ⟨ Milestone Deliverables Interface Report
      ⟨ Deliverables Count
      ⟨ Milestone Count

B. Management Bullet/Presentation Charts
C. ARTEMIS Code required to provide unique analysis or report formats

Histroical data of past requirements of project reports is avaliable from the monitor.

PERFORMANCE METRICS

Minimum performance standards are to deliver all products on time with the following requirements:

1. Correct codes, attributes, logic which can verify that the data in the database is accurate, up to date and can support all management and working level reporting and analysis requirements
2. Data integrity in reporting. If data is to be exported from the master database and reformatted for reporting, the integrity of the original planning, and/or schedule data as calculated shall be maintained no matter what graphics or project management software is used by the contractor to produce the reports.
3. Changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database which has not been baselined will be clearly identified. Changes to a baseline plan or schedule will be reviewed and approved by the government prior to implementation.
4. The contractor shall submit copies of all products to the Technical Monitor at the same time they are delivered to the Project.

Performance which exceeds minimum accomplishment requirements:

1. Timely response to changing program requirements
2. Ability to recommend and produce new products
3. Participation in management meetings, presenting recommendations for remedial actions where possible based on analysis

4. Government Furnished Items:

The government shall provide access to the SAO HP 650C and HP 755C plotters in Bld 1209. Upgrades to ARTEMIS software will be provided as required.

5. Other information needed for performance of task.

Each organization, program or project will provide funds to cover travel costs.
Any organization, program or project unique software required to provide analysis or reports will be provided by the organization, program or project. High Speed Research Program has "Limited Exclusionary Rights to Data" policy requirements.

6. Security clearance required for performance of work:

None required

7. Period of Performance	
Planned start date 1-May-97	Expected completion date: 30-April-98

8. NASA Technical Monitor: A. M. Thomas (a.m.thomas@nasa.larc.nasa.gov)
(757) 864-9119

1. PLANNING DATABASE

The contractor shall deliver a planning database, in an electronic format compatible with government provided software (ARTEMIS). This database will have, at a minimum, the following data attributes and calculated fields. (Recognizing that different software packages may have different nomenclature a definition of terms can be found at the end of this document.)

Activity attributes will include, but are not limited to:

- unique activity number/identifier
- activity description
- activity duration
- activity calendar
- performing organization and/or responsible person
- WBS

Constraint attributes will include, but are not limited to:

- date constraints such as target start/complete, compulsory start/complete
- logic constraints such as finish to start, start to start or finish to finish
- logic leads or lags

Calculated fields will include, but are not limited to:

- Early Start
- Early Finish
- Actual Start
- Actual Finish
- Late Start
- Late Finish
- Expected (or current) Start
- Expected (or current) Finish
- Float (or slack)
- Baseline (or original) Start
- Baseline (or original) Finish
- Remaining Duration
- Missed Target Start
- Missed Target Finish

The Database Dictionary will include a description of all the data fields (calculated as well as those containing data entered by the user). If the user documentation for the chosen software has a detailed description of the fields, and it is determined that this satisfies the requirement for information about the database, it may be substituted for a contractor created database dictionary.

2. GRAPHIC REPORTS (Unique examples of desired formats will be provided by each customer):

- Logic Networks
- Management presentation/review bullet charts
- Detailed, specific Gantt Charts
- Milestone Charts
- Key Milestone Tracking Charts

Logic Network: Graphic representation in a precedence diagram method, critical path logic network format. At times all or a selected part of the planning database will be represented in the network plot. Report requirements include ability to select data to be displayed in the node boxes, color coding for critical path, in-progress vs. completed vs. not yet started activities, milestones, etc., sectioning by selected code or data field, (such as WBS, OBS, resource, etc.). In additional to simple logic, timelined logic may also be required.

Gantt Charts: Several types of gantt chart formats will be required. All data displayed will, at whatever management level required, and in whatever graphic format chosen, have direct tractability to the planning database. Data not found in the database will be clearly identified as outside the plan. The government recognizes the requirement for displaying data in certain formats often leads to the use of more than one type of graphic or presentation software package. Data integrity is required. The goal is to have the planning database software generate the charts. When the required format makes this impossible the data should be exported by the database and imported into the graphics software to insure data tractability.

Milestone Count: A management report by milestone level showing a cumulative count of planned vs. actual milestones accomplished during the reporting period.

Monthly Technical and Center Director's Reports: Consolidated Technical Report which includes information from the Propulsion Project at Lewis Research Center. Format as agreed upon by customer to provide a consolidated detailed report of key milestones.

Program Office Report: Integrated report to provide status of all milestones, interfaces and deliverables per PCD.

Management Presentations: Develop and coordinate management presentation charts and charts containing embedded graphics from various sources including camera ready visuals, drawings, and Excel sheets, etc. and all elements of a project/program into an operation plan.

Artemis Programming Support and Database Configuration Management: Standard reporting formats will be designed, programmed and maintained for the Systems Engineering and Control Branch. Specific programming to support project management(s) will be provided to develop report formats or applications required by or defined in each project's deliverables. Documentation for all applications will be maintained with updates provided as required. The programmer shall act as a point of contact for Artemis product technical support services.

Performance Tracking: A tabular list of selected activities with plan vs. actual data including, but not limited to:

- activity name
- baselined planned early start/finish dates
- actual early start/finish dates
- current projected finish if different from baseline plan
- original duration
- current remaining duration
- original float
- current remaining float
- report date

Interface Matrix Chart: Tabular list showing:

- WBS and Item name
- Responsible Organization
- Receiving Organization
- Baseline (plan) due date
- Current Projected due date
- Report Date

1. Task Order Number and Title Number: GK03 Revision:
   Title: Planning, Schedules Management and Reporting

2. Purpose, Objective or Background of Work to be Performed:
   Planning and schedules management is a project management knowledge area which provides an organized, structured approach for developing project plans, communicating across organizational lines, identifying work which needs to be accomplished to meet technical, cost and time goals, tracking actual progress against the work plan, understanding the resources required to do the work and the availability of those resources to support the work, analysis of the plan through fixed status and reporting cycles and re-planning work when internal or external organization or project objectives or constraints change.

3. The contractor shall provide planning, schedules management and/or reporting for:
   1. Hyper-X Project Office
   2. Advanced Subsonic Technology Project Office
   3. AGATE Project Office
   4. CERES Project Office
   5. 757 TSRV Modification Project (including Simulators and Software development and LVLASO experiment development and flight operations)
   6. Calibration Laboratory: Resource planning and management
   7. SAGE III, LASE, SABER, EOSDIS, GAS
   8. Artemis programming support and database configuration management

Histroical data of past requirements of these and simular projects are avaliable from the monitor.

Deliverables: It is acknowledged that requirements for deliverables are modified from time to time by individual projects. The following is a generic list of planning and schedule management products. Attachment A has a complete description of each category of deliverable. . As requirements change, Attachment A will be changed through revisions to this task.

A. Reports
   1. Graphic:
      a. Precedence Logic Network
      b. Gantt - Bar and/or Milestone Charts
      c. Resource Histograms
   2. Tabular Data Lists and Tables
B. Analytical Reports and White Papers
C. Management Bullet/Presentation Charts
D. WBS Dictionary and/or Hierarchical Graph
E. ARTEMIS Code required to provide unique analysis or report formats

PERFORMANCE METRICS

Minimum performance standards are to deliver all products on time with the following requirements:

1. Correct codes, attributes, logic which can verify that the data in the database is accurate, up to date and can support all management and working level reporting and analysis requirements
2. Data integrity in reporting. If data is to be exported from the master database and reformatted for reporting, the integrity of the original planning, and/or schedule data as calculated shall be maintained no matter what graphics or project management software is used by the contractor to produce the reports.
3. Changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database which has not been baselined will be clearly identified. Changes to a baseline plan or schedule will be reviewed and approved by the government prior to implementation.

4. For new database requirements, the contractor shall assess specific requirements and provide a plan for completion of a baseline workplan and schedule with-in one month of task initiation..
5. Schedule of deliverables is unique to each project.
6. The contractor shall submit copies of all products to the Technical Monitor prior to delivery to the Projects.

Performance which exceeds minimum accomplishment requirements:

1. Timely response to changing program requirements
2. Ability to recommend and produce new products
3. Participation in management meetings, presenting recommendations for remedial actions where possible based on analysis

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4. Government Furnished Items:

The government shall provide access to the SAO HP 650C and HP 755C plotters in Bld 1209. Updates to ARTEMIS software and/or Microsoft Project software and Expert Graph software will be provided as required.

5. Other information needed for performance of task.

Each organization , program or project will provide funds to cover travel costs.

Any organization, program or project unique software required to provide analysis or reports will be provided by the organization, program or project.

6. Security clearance required for performance of work:

Hyper-X Project Office requires an analyst with a Secret Clearance

7. Period of Performance	
Planned start date 1-May-97	Expected completion date: 30-April-98

8. NASA Technical Monitor: A. M. Thomas (a.m.thomas@nasa.larc.nasa.gov)
(757) 864-9119

Attachment A

1. PLANNING DATABASE

The contractor shall deliver a planning database, in an electronic format compatible with government provided software (ARTEMIS). This database will have, at a minimum, the following data attributes and calculated fields. (Recognizing that different software packages may have different nomenclature a definition of terms can be found at the end of this document.)

Activity attributes will include, but are not limited to:

- unique activity number/identifier
- activity description
- activity duration
- activity calendar
- performing organization and/or responsible person
- WBS

Resource attributes will include, but not be limited to:

- activity assigned to
- name
- type
- quantity required for specific activity
- quantity available by units of time
- calendar
- delays
- duration required
- cost

Constraint attributes will include, but are not limited to:

- date constraints such as target start/complete, compulsory start/complete
- logic constraints such as finish to start, start to start or finish to finish
- logic leads or lags

Calculated fields will include, but are not limited to:

- Early Start
- Early Finish
- Actual Start
- Actual Finish
- Late Start
- Late Finish
- Expected (or current) Start
- Expected (or current) Finish
- Float (or slack)
- Baseline (or original) Start
- Baseline (or original) Finish
- Remaining Duration
- Missed Target Start
- Missed Target Finish

The Database Dictionary will include a description of all the data fields (calculated as well as those containing data entered by the user). If the user documentation for the chosen software has a detailed description of the fields, and it is determined that this satisfies the requirement for information about the database, it may be substituted for a contractor created database dictionary.

2. GRAPHIC REPORTS (Unique examples of desired formats will be provided by each customer):

- Logic Networks
- Management presentation/review bullet charts
- Detailed, specific Gantt Charts
- Milestone Charts
- Resource Histograms
- Key Milestone Tracking Charts

Logic Network: Graphic representation in a precedence diagram method, critical path logic network format. At times all or a selected part of the planning database will be represented in the network plot. Report requirements include ability to select data to be displayed in the node boxes, color coding for critical path, in-progress vs. completed vs. not yet started activities, milestones, etc., sectioning by selected code or data field, (such as WBS, OBS, resource, etc.). In additional to simple logic, timelined logic may also be required.

Gantt Charts: Several types of gantt chart formats will be required. All data displayed will, at what ever management level required, and in what ever graphic format chosen, have direct tractability to the planning database. Data not found in the database will be clearly identified as outside the plan. The government recognizes the requirement for displaying data in certain formats often leads to the use of more than one type of graphic or presentation software package. Data integrity is required. The goal is to have the planning database software generate the charts. When the required format makes this impossible the data should be exported by the database and imported into the graphics software to insure data tractability.

Resource Histograms: Format will use a combination of bar and line display to compare resources available across a given time period with resources required by the project to complete work planned in the same time frame. The chart will clearly show resource overloads or underloads occur so management can quickly understand the situation and make planning decisions. (i.e. re scope work, stretch out work, make more resources available, etc.).

Key Milestone Tracking Chart: A simple management chart showing current status of key planned milestones to indicate at a glance if the milestone is on time and, if not, what is it's current projected complete date.

WBS: Graphic, hierarchical display of all or selected parts of the program Work Breakdown Structure

Float Management/Critical Path Tracking Chart: A line graph showing initial float on a project and the changes to float over time

Consolidated Technical Report: Format as agreed upon by customer to provide a consolidated report of milestones, interfaces, and deliverables.

3. TABULAR REPORTS

Out put from database
Critical Path
Performance Metrics (plan/actual variance)
Product Interface Matrix (with plan/actual data)
Resource Usage
Resource Availability

WBS Dictionary: A full description of all work breakdown structure items in a document format

Critical Path Analysis: A description of the primary and secondary critical paths in a project based on the analysis of float (slack) and total float in the project. The critical path will be defined as that in which the activities have 0 or less than 0 float. Secondary critical paths will be listed in ascending order of total float. An initial report will be made when the schedule is baselined. Further impact analysis will be made when the critical path changes from one reporting period to another.

Performance Tracking: A tabular list of selected activities with plan vs. actual data including, but not limited to:

activity name
planned early start/finish dates

actual early sta. finish dates
current projected finish if different from baseline plan
original duration
current remaining duration
original float
current remaining float
report date

Interface Matrix Chart: Tabular list showing:
WBS and Item name
Responsible Organization
Receiving Organization
Baseline (plan) due date
Current Projected due date
Report Date

Management Presentations: Develop and coordinate management presentation charts and charts containing embedded graphics from various sources including camera ready visuals, drawings, and Excel sheets, etc. and all elements of a project/program into an operation plan. These efforts will be performed supporting the High-Speed Research Program, and all other project/programs within the Space Projects Office (CERES, SAGE III, LASE, SABER, EOSDIS, GAS). These will be produced on a daily, weekly, monthly, quarterly, and as needed basis to ensure communication of information needed by all levels of management to make decisions.

Artemis Programming Support And Database Configuration Management: Standard reporting formats will be designed, programmed and maintained for the Systems Engineering and Control Branch. Specific programming to support project management(s) will be provided to develop report formats or applications required by or defined in each project's deliverables. Documentation for all applications will be maintained with updates provided as required. Upgrades to the Artemis software will be installed and maintained. Technical assistance and trouble shooting will be provided to all users. The programmer shall act as a point of contact for Artemis product technical support services.

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number: ~~6K004~~ 6K04 **Revision:** _____ **Date of Revision:**_

Title: STAR Antenna

2. Purpose, Objective or Background of Work to be Performed:

Provide Mechanical Engineering and Design for the STAR Antenna Development Program. NASA internal document, "Hydrostar Proof of Concept Mechniical Proposal" dated 11-26-96 defines the interface and design requirements for the STAR Antenna. The contractor will provide engineering services for the development of STAR antenna support and test hardware as defined in this document. The program will also require contractor to provide modifications to the design during the fabrication, delivery, assembly, and integration of the hardware (see section 3.1.2).

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Design and develop the components and assemblies for a deployable STAR antenna proof-of-concept model. The designs shall be prepared with the ANVIL 1000 or Pro-Engineer CAD source codes as appropriate with Pro-Engineer as a preferred deliverable. Engineering detailed drawing deliverables of as-built condition will be provided as paper copies and electronic copies compatible with LaRC CAD source codes.

3.1 Performance

Performance will vary from "Minimally Acceptable (MA)" to "Substantially Exceeds(SE)" ratings based on the following criteria:

3.1.1 Ability to meet delivery schedules for all designs and drawings. Delivery within two weeks of the stated milestone will constitute a "MA" rating and delivery two weeks ahead of schedule will constitute a "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control. Delivery schedules deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2 Manufacturability of designed components per contractor-generated engineering detailed drawings will be rated by the ability of final release engineering detailed drawings to describe accurately as-built condition of manufactured components and assemblies. Forty hours of engineering drafting changes required to make final release drawing in full compliance with as-built condition shall constitute "MA" rating and six hours of required changes shall constitute "SE" rating.

3.2 Deliverables

3.2.1 Deployable STAR Antenna Structural Assembly

Develop and design a deployable STAR antenna structural assembly, incorporating joint mechanisms, ground screen, and cabling. Generate engineering detailed drawings for components and assemblies.

3.2.2 Joint Mechanisms

Develop and design joint mechanisms to be used on the deployable STAR antenna structural assembly (see 3.2.1). Generate engineering detailed drawings for components and assemblies.

3.2.3 Ground Support Equipment and Fxturing

Design and develop ground support equipment and fixturing to support the testing of the antenna assembly (see 3.2.1) and joint mechanisms (see 3.2.2), including (but not limited to) 0-g fixtures, lifting fixtures, test stands, and shipping containers. Generate engineering drawings for the components and assemblies.

4. Government Furnished Items:

NASA internal document, "Hydrostar Proof of Concept Mechniical Proposal" 11-26-96

Government Furnished Property and software will be furnished for the design, fabrication and testing of the deliverable items.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:

None.

7. Period of Performance	
Planned start date: 05/01/1997	Expected completion date: 01/30/1998

8. NASA Technical Monitor: Sharon K. Crockett
M/S: 434 Phone: 757-864-7167

1. Task Order Number: GK05 Revision: 1 Date of Revision: 7-21-97

Title: PERSEUS Wing Testing.

2. Purpose, Objective or Background of Work to be Performed:

As part of NASA's Enviromental Research Aircraft and Sensors Technology (ERAST) program , NASA LaRC is performing structural tests of the Perseus aircraft wing. Contractors under NAS1-19000 developed hardware for testing of the PERSEUS Wing specimens. Under this task the contractor is to provide recomendations for the most effective use of the test hardware by the LaRC principal investigator. The task also provides for development of a limited number of engineering drawings to support fabrication of hardware. The task also provides for development of up to 15 drawings to support fabrication of hardware.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall review the wing test procedures and provide written reports of recommended changes for improvement of the existing wing torque test hardware operation. The contractor shall provide designs to be used to assemble and test the Perseus wing loading hardware. It is estimated that the maximum number of drawings is 15. During the analysis of the test apparatus, the contractor shall provide a list of recommendations to NASA for the assembly and integration of the Perseus test object to the test hardware and instrumentation. The deliverables shall include paper and electronic copies of modified engineering drawings, procedures, and recommendations. All final release drawings of drawings modified or generated in support of this task shall reflect the 'as-built' condition of fabricated hardware. Actual performance schedules and deliverables are listed in section 3.4 below.

3.1. Performance will be rated from "minimally acceptable" (MA) to "substantially exceeds" (SE) based on the functionality of the designs, ability to build and integrate the test apparatus per existing drawings, efficiency of the integration/assembly process, and ability to meet project schedules. Specific metrics for this task are:

3.2. Ability to support schedules. Completion of contractor-controlled milestones two weeks ahead of schedule shall be considered as SE performance. Completion of milestones no later than two weeks after scheduled dates shall be considered MA performance. Completion of milestones two weeks ahead of scheduled dates shall be considered SE performance

3.3. Ability of final release drawings to describe accurately the 'as-built condition' of delivered hardware. This will be measured by: 20 hours of LaRC-provided engineering drafting to bring contractor's final release drawing package to 'as-built' compliance shall constitute MA performance while 4 hours of engineering drafting modifications shall constitute SE performance.

3.4. The performance of the following activities is required for the successful completion of this Task.

	ACTIVITY	COMPLETION
3.4.1.	Review the wing test procedures and provide written report of recommended changes for improvement of the existing wing torque test hardware operation.	COMPLETE

3.4.2. Provide recommendations report for assembly of the wing bending test setup. Provide summary report of test operations.	COMPLETE
3.4.3. Provide hardware report of assembly procedure recommendations design drawings for the test effort operations. Review modifed test hardware to complete LaRC wing load test operation.	**DECEMBER 31, 1997**

4. Government Furnished Items:

Government Furnished Property will be furnished for the design, fabrication and testing of the deliverable items. All testing hardware and instrumentation will be government furnished equipment.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:

None.

7. Period of Performance	
Planned start date: 05/01/1997	Expected completion date: 12/31/1997

8. NASA Technical Monitor:
.M/S: 432 William M. Berrios Phone: 757-864-7183

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number:: GK06 **Revision:** _____ **Date of Revision:**_

Title: Origins Precision Deployment Engineering Test articles.

2. Purpose, Objective or Background of Work to be Performed:
Provide Engineering design and development of high precision mechanisms in support of Langley's precision deployment technology program currently funded under the Origins Product Integration Team (RTA 632-10-14-40). Origins PIT program is responsible for advancing high precision deployment technology for application to next generation space science missions such as the Next Generation Space Telescope (NGST). The specific objectives of the work to be performed under the present task are to: 1) develop a new high-precision latch mechanism for deployable structures; 2) aide in the development of test apparatus for experimental characerization of the load-cycle response of this latch; and 3) adapt an existing high-precision revolute joint design for use in the U. S. Air Force UltraLITE ground testbed.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):
The contractor will design and develop a high precision prototype latch mechanism for retrofitting into an existing deployable telescope metering truss. Also, the contractor will adapt the design of an existing revolute joint for incorporation into the UltraLITE truss test article (four each) to be built by the U. S. Air Force. Finally, the contractor will design and develop a test setup for the LaRC for use in load-cycle testing of the newly developed latch joint. All delivered items shall be readily useable by civil service personnel for testing or design modification of electronic developed drawings for design optimization. The designs shall be prepared with the ANVIL 1000 or Pro-Engineer CAD source codes with Pro-Engineer as the preferred CAD tool. Paper and electronic copies of engineering and assembly drawings representing 'as-built' condition of delivered hardware shall also be deliverables. All hardware will be purchased from vendors or manufactured by the U.S government per contractor specifications. The contractor will deliver final mechanism assemblies for integration of these assemblies into component test apparatus and/or structural testbeds.

3.1. *PERFORMANCE:*
Performance will vary from "Minimally Acceptable (MA) to Substantially Exceeds (SE)" ratings based on the ability to meet the performance metric targets for deliverables 3.2.1, 3.2.2, 3.2.3, and the following criteria:

3.1.1. Ability to meet delivery schedules for all mechanism assemblies. Delivery within two weeks of stated milestones will constitute "MA" and delivery two weeks ahead of schedule will constitute "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control. Delivery schedule deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2. Manufacturability of designed components per contractor-generated engineering detail drawings.

3.1.3. Ability of final release engineering detailed drawings to describe accurately 'as-built-condition' of delivered components and assemblies. 40 hours of engineering drafting required to make final release drawing in full compliance with "as-built-condition" shall constitute "MA" and 6 hours of required changes shall constitute "SE" rating.

3.1.4. Ability to complete all test activities with delivered test setup. 70% completion of tests will constitute "MA" and 95% percent will constitute "SE".

3.2. *DELIVERABLES:*

The listed items shall constitute the specific deliverables for this task.

DELIVERABLE	DATE
3.2.1. *Adapt existing high-precision revolute joint for the UltraLITE testbed*	6/15/97

The contractor is to adapt an existing high-precision revolute joint design for use in the UltraLITE testbed structure under development at the U.S. Air Force Phillips Laboratory. The contractor is to deliver four revolute joints mechanism assemblies to interface with the UltraLITE hardware.

PERFORMANCE METRIC: The revolute joint assemblies shall be capable of carrying a minimum of 100 lb_f of tension and compression load, and meet interface requirements per UltraLITE program specifications for easy integration onto the UltraLITE testbed.

3.2.2 *Design and develop a zero-freeplay, micron-repeatable latch joint* — 6/15/97

The contractor is to complete the design and development for an end-of-deployment latch joint for retrofitting into an existing deployable telescope metering truss. The latch is to incorporate existing tapered tongue-and-groove interfaces adapted from LaRC-developed erectable truss hardware and a preload mechanism which effectively preloads the tongue-and-groove interfaces. The contractor is to generate three copies of the mechanism assemblies for component testing and retrofitting into existing truss hardware.

PERFORMANCE METRIC: The joint should exhibit no more than 3% hysteresis in response to quasi-static extensional load-cycling.

3.2.3 *Develop laboratory test set-up for load-cycle test of latch joints* — 7/31/97

The contractor is to develop test apparatus necessary for quasi-static load-cycle testing of new latch joints (developed under task 3.2.2 herein). The contractor shall use Government test instrumentation and LaRC facilities to support testing of the latch assemblies, and shall deliver an integrated test setup that shall support the completion of test activities by 7/31/97. LaRC will responsible for the timely delivery of required equipment, calibration services, and data taking. The contractor shall develop specifications for developing final test setup configuration.

PERFORMANCE METRIC: The test apparatus shall enable extensional load-cycle testing of latch hardware up to 100 lb_f of tension and 100 lb_f of compression load. Also, the test apparatus shall accomodate at least two displacement-measurement transducers for load-cycle response measurements.

SAERS (NAS1-96013) Task Order Page 3

4. Government Furnished Items:
Existing design of UltraLITE truss test article (four each) to be built by the U. S. Air Force
Government Furnished Property and software will be furnished for the design, fabrication and testing of the deliverable items.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:
None.

7. Period of Performance	
Planned start date: 05/01/1997	Expected completion date: 07/31/1997

8. NASA Technical Monitor:
.M/S: William M. Berrios Phone: 757-864-7183

1. Task Order Number: GK07	Revision:
Title: Conduction of Tests and Instrument Operations for the CERES Project/EOS Spacecraft	

2. **Background of work to be performed:**

The Clouds and Earth Radiant Energy System (CERES) Project is responsible for the development, spacecraft integration and testing (I&T), deployment and initial in-orbit operation of CERES instruments. The CERES instruments are broadband scanning radiometers with the capability of operating in either a cross track scan mode or a biaxial scan mode. The CERES instruments provide data on the Earth's and atmospheric radiation budget from the top of the atmosphere to the surface of the Earth. The CERES instruments are an improved and modified version of the Earth and Radiation Budget Satellite (ERBS). The CERES instruments will provide three spectral channels over the range of 0.3 to 50.0 micrometers. The CERES Flight Model 1 (FM1) and Flight Model 2 (FM2) instruments have been delivered to Lockheed Martin Missiles and Space (LMMS), King of Prussia, Pennsylvania and integrated on to the Earth Observation System AM (EOS-AM) spacecraft for system verification and pre-launch environmental testing. The EOS-AM spacecraft is scheduled for launch in June 1998.

The Contractor shall be responsible for all of the CERES instrument's performance verification, flight readiness testing and health operations. This is done by developing and executing procedures to operate and monitor the CERES Instrument Ground Support Equipment (IGSE), and thereby the CERES instrument, to collect information defining and verifying the CERES instrument performance. The performance requirements are defined via engineering documentation furnished by the manufacturer, TRW. The IGSE consists of an Instrument Interface Station (IIS) and a Test Operator's Station (TOS) which allow operation of the CERES instrument either directly or through the EOS-AM Project's LMMS Spacecraft Instrument Ground Support Equipment (SGSE). An example of an interface system is shown in Figure 1. Additionally, as part of the IGSE, there is an Interface Simulation Unit (ISU) which is used to test the IIS to CERES interface prior to connection. The subtasks specified herein are to be performed throughout the entire period of integrating the CERES instrument to the EOS-AM Spacecraft, during the pre-flight environmental tests and launch readiness operations.

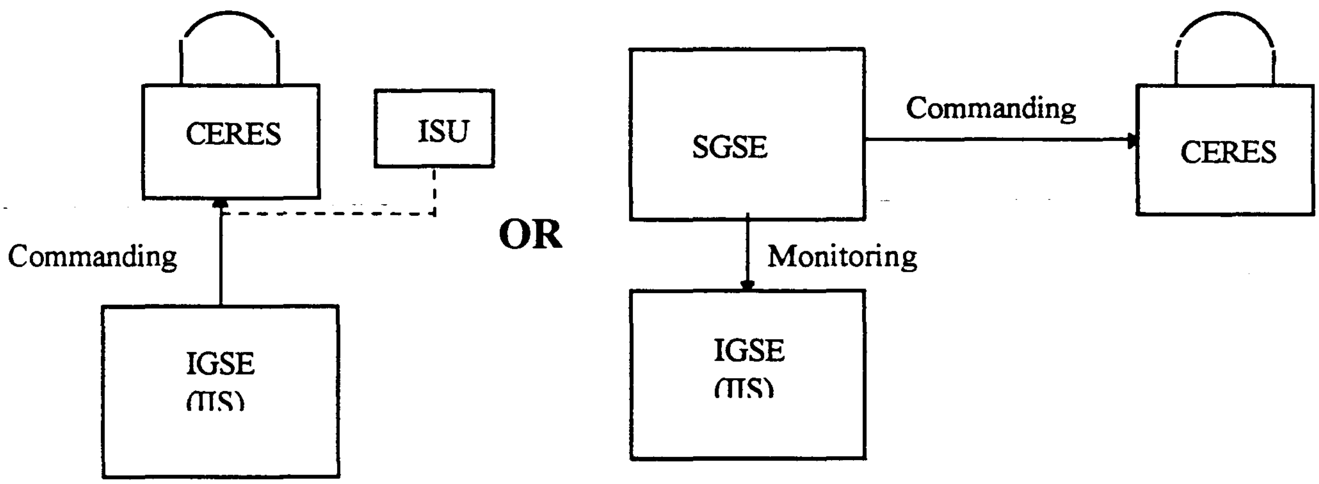

Figure 1: CERES instrument GSE configurations

3. Task description:

1. The Contractor shall modify existing CERES test procedures required for EOS AM test operations. The procedural content of the day to day EOS AM test operations vary according to test objectives but will include at least one and possibly all of the following activities:

a. Verification of the CERES instrument's functional status in terms of it being ready for I&T operations. This will be accomplished through the execution of the "CERES Aliveness Test Procedure.

b. Verification that the CERES instrument's major components and subsystems are operational within their designed specifications. This will be accomplished through the execution of the "CERES Abbreviated Functional Test (AFT) Procedure".

c. Verification that the CERES instrument's components and subsystems are fully functional with respect to their operational designed specifications. This will be accomplished through the execution of the "CERES Comprehensive Functional Test (CFT) Procedure".

NOTE: It is anticipated the normal test operations, and therefore the procedures, will not change significantly following an initial test period of 2 months.

As part of this task, the Contractor shall provide real time information regarding execution of the above mentioned test procedures and instrument operations to LMMS during testing. Additionally, the Contractor shall develop, as necessary, special test procedures to troubleshoot and verify anomalous conditions that may occur during the execution the above mentioned tasks. Also, the Contractor shall operate the IGSE or a computer with CERES Bench Checkout Unit (BCU) software to play back data files for analysis of a recorded anomalous operation.

2. The Contractor shall execute the above mentioned test procedures via the IIS when required (see attached schedule). Also, provide operations monitoring via IGSE when the above mentioned test procedures are executed by the LMMS Operations Team via the SGSE. All of these operations will occur according to the attached LMMS EOS- AM I&T schedule.

3. The Contractor shall maintain Log Books/Records tracking the operating time of the CERES instrument, executed test procedures and operations data files.

4. The Contractor shall have at least one representative participate in weekly CERES Project meetings dealing with the EOS-AM schedule, CERES schedule, and instrument operations.

5. The Contractor shall review EOS-AM I&T test procedures and schedules, TRW and NASA performance specifications, IGSE configuration or design changes, data analyses, trending data and any other documents related to or effecting the operation and performance of the CERES instrument. The Contractor shall provide verbal and written assessments of these items to the CERES Project. The assessment should include a discussion of the clarity, completeness, and applicability of the items to the CERES instrument operations.

6. The Contractor shall pack in existing shipping containers all of CERES IGSE and documentation necessary to support launch activities at Vandenburg AFB in California. Also, the Contractor shall unpack and set up the IGSE in California to support EOS-AM/CERES pre-launch, launch and post-launch operation activities.

****Schedule time table:** The timetable is defined according to the attached table of EOS-AM/CERES Integration and Test events as well as the events necessary to prepare the CERES instrument and IGSE for shipment to Vandenburg AFB in California. The attached timetable is subject to change as Integration and Test (I&T) events and anomalies occur. (The contractor shall notify NASA of any changes to task plans or cost that will require a revision to the task requirements.

Deliverables:

1. Preliminary copy of above mentioned procedures four weeks (20 working days) prior to the scheduled test.

2. Final copy of above mentioned procedures two weeks (10 working days) prior to the actual test. The Final copy, once approved, will be the Test Procedure used to conduct the appropriate test. ***Note: Any changes to the test procedure after this review will be RED Lined into the procedure. If numerous procedural changes are required the CERES Project Staff will make a determination as to whether or not the procedure shall be rewritten prior to proceeding with the test. If the Project determines the changes should be made, the Contractor shall incorporate all Red line changes into the procedure prior to the test event.***

3. Within 30 minutes following the formal completion of an operational test procedure or any other CERES instrument operation, the Contractor shall provide a brief written summary using the "Quick-Look" report of any anomalies that occurred during the operation(s); and, status of both the instrument and IGSE.

4. Within two weeks (10 working days) after the formal completion of a Test, generate a final report(s) providing details related to the executed procedure and the health of the instrument at the test(s) completion.

5. Monthly (by the 1st of the each month or the next working day) report(s) detailing current status of the development of Test Procedure(s), Test(s) completed, current Test(s) being executed, CERES instrument and CERES IGSE.

Metrics:

1. Satisfactory effort:
   a. All of the CERES instrument and IGSE operations are executed in a manner such that the CERES instrument's operational readiness is maintained and the spacecraft I&T and Launch schedules are met. Note that this is not to include any Spacecraft, SGSE, CERES instrument or IGSE failures outside the CERES Project or Contractor's control.
   b. All of the above mentioned procedures and reports follow the established CERES Project standard format and are delivered as scheduled and accepted with little or minor change post review by the CERES Project Staff.
   c. All of the above mentioned procedures will be of the high quality in terms of organization, thoroughness, completeness and readability as determined by the CERES Project reviewers.
   d. All appropriate flight hardware product assurance and cleanroom policies and plans are followed.
2. Exceeds effort:
   a. All of the CERES instrument and IGSE operations are executed in an efficient manner such that the CERES instrument's operational readiness is maintained somewhat ahead of the spacecraft I&T and Launch schedules . Note that this is not to include any Spacecraft, SGSE, CERES instrument or IGSE failures outside the CERES Project or Contractor's control.
   b. All of the above mentioned procedures and reports are delivered 25% ahead of the required scheduled time and accepted with little or no change post review by the CERES Project Staff.
   c. All of the above mentioned procedures will be of exceptional quality in terms of organization, thoroughness, completeness and readability as determined by the CERES Project reviewers.
   d. Contractor's response to anomaly events and schedule changes are timely and effective as determined by the CERES Project Staff.
   e. All appropriate flight hardware product assurance and cleanroom policies and plans are followed.

4. Other Information:

1. Electro-Static Discharge (ESD) certification is required to handle the instrument and IGSE.
2. The IGSE is flight critical hardware and subject to established NASA and CERES Product Assurance Policies and Plans.
3. Adherence to contamination control policy and procedures is required to support space flight cleanroom CERES instrument operations.
4. All of the CERES operational test procedures will be approved by the CERES Project prior to execution.
5. All tests will be scheduled with and coordinated through the CERES Project and LMMS/EOS-AM personnel.

5. Government Furnished items:

1. Access to a 486 computer or better and software as required to develop and modify above mentioned test procedures or execute CERES BCU instrument operational software for training and analyses. The software will include Dos 3.1 or better, Windows 3.1 or better, Microsoft Office with Word 6.0 and Excel 5.0, Eudora and PC/TCP. This will be the minimum software provided; however, the CERES Project may provide other software as determined necessary by the Contractor to support this task.
2. Access to the CERES IGSE hardware and the TRW and CERES Project documentation as required to operate the CERES instrument(s) both directly and via SGSE. This equipment may also be used on a non test interference basis for data analysis, operator training, evaluation of new procedures and troubleshooting of anomalies as they may occur. Use of the CERES IGSE shall be scheduled and coordinated through the CERES Project.
3. All of the shipping containers necessary for shipment of the IGSE and documentation.

6. Security clearance required for performance of work:

None.

7. Travel

Travel to King of Prussia, Pennsylvania and Vandenburg Airforce Base, California will be required to conduct instrument operations in support of this task.

8. Period of Performance	
Planned start date: 05/01/1997	Expected completion date: 4/30/98

8. NASA Technical Monitor: Charles E. Jenkins Jr.
M/S: 431 Phone: 757-864-7080

EOS-AM Schedule
FM1 FM2 CERES Instruments
5/27/97

1	EOS AM I&T	388	3/19/97	8/25/98		
2	Badging, SIS Training	1	3/19/97	3/19/97	2TC,2TO,2QA,TPE,2C.B.K.	
3	Delivery and Bat testing	3	3/20/97	3/22/97	2TC,2TO,2QA,TPE,2C.B.K.	
4	Pre-Integration az 0 ref test	1	3/22/97	3/22/97	TPE,C,QA,TC,OM	
5	AZ zero stop fix. test	1	3/26/97	3/26/97	TPE,C,TC,QA	
6	FM1 & 2 mech. Integ. to AM	2	3/26/97	3/27/97	2C,TPE,TO,TC,QA	
7	FM1 & FM2 elect. Integ. to AM	4	4/16/97	4/21/97	2C,TPE,QA,TC,TO	
8	Abbreviated Functional Test	4	4/21/97	4/24/97	C,2TC,2TO	
9	Abbreviated Functional Test	4	4/25/97	4/30/97	C,Vogler,Estes	
10	SC Compatability Test	10	7/8/97	7/19/97	C,2TC,4TO	
11	TDRSS Compatibility test 2-shifts	11	8/4/97	8/16/97	C,2TC,4TO	
12	SC Compatability test 2-shifts	11	9/2/97	9/16/97	2TC,C,4TO	
13	T/V Blancket Install. 2-shifts	8	9/16/97	9/25/97	C,2TC,4TO	
14	EMC test 2-shifts	7	9/26/97	10/5/97	C,2TC,4TO	
15	T/Vac prep. 2-shifts	18	10/5/97	10/25/97	C,2TC,4TO	
16	T/Vac & T/Bal test 3-shifts	32	10/26/97	12/8/97	C,3TC,6TO	
17	SC Functional test 2-shifts	6	12/15/97	12/22/97	C,2TC,4TO	
18	Alignment verification 2-shifts	6	12/31/97	1/7/98	C,2TC,4TO	
19	Acqustic test 2-shifts	7	1/15/98	1/23/98	C,2TC,4TO	
20	SC Functional test 2-shifts	8	1/20/98	1/29/98	C,2TC,4TO	
21	Alignment verification 2-shifts	2	1/30/98	1/31/98	C,2TC,4TO	
22	Pyro test 2-shifts	6	2/8/98	2/13/98	C,TC,2TO	
23	Alignment verification 2-shifts	6	2/19/98	2/25/98	C,2TC,4TO	
24	SC CPT 100 hrs. operation 3-shifts	11	3/1/98	3/13/98	C,3TC,6TO	
25	SC ground sys. test 2-shifts	2	3/14/98	3/16/98	C,2TC,4TO	
26	SC mass properties test 2-shifts	4	3/24/98	3/27/98	C,2TC,4TO	
27	Prep. for shipment 2-shifts	3	3/31/98	4/2/98	C,2TC,4TO	
28	SC pre-ship review	1	4/2/98	4/2/98	C	
29	Contingency	33	4/2/98	5/18/98		
30	SC ship to Vandenburg	2	4/3/98	4/6/98	C	
31	Launch Site Operations	57	5/4/98	7/21/98	2C,2TC,4TO	
32	Launch, Vandenburg, AFB	1	6/29/98	6/29/98	C,2TO,2TC	
33	Post launch ops./GSFC	7	6/29/98	7/7/98	C,TC	
34	Open doors	3	8/5/98	8/7/98	C,TC	
35	Deep space manuver	3	8/21/98	8/25/98	C,TC	

1. Task Order Number	GK08	Revision:
Title: Conduction of Tests and Instrument Operations for the CERES Project/TRMM Spacecraft		

2. **Background of work to be performed:**

The Clouds and Earth Radiant Energy System (CERES) Project is responsible for the development, spacecraft integration and testing (I&T), deployment and initial in-orbit operation of CERES instrument. The CERES instrument is a broadband scanning radiometer with the capability of operating in either a cross track scan mode or a biaxial scan mode. The CERES instrument provides data on the Earth's and atmospheric radiation budget from the top of the atmosphere to the surface of the Earth. The CERES instrument is an improved and modified version of the Earth and Radiation Budget Satellite (ERBS). The CERES instrument will provide three spectral channels over the range of 0.3 to 50.0 micrometers. The CERES Protoflight Model (PFM) instrument has been delivered to GSFC and integrated on to the Tropical Rainfall Measurement Mission (TRMM) spacecraft for system verification and pre-launch environmental testing. The TRMM spacecraft is scheduled for launch in November 1997.

The Contractor shall be responsible for all of the CERES instrument's Functional verification, flight readiness testing and health operations. This is done by developing and executing procedures to operate and monitor the CERES Instrument Ground Support Equipment (IGSE) and thereby the CERES instrument to collect information defining and verifying the CERES instrument Functional. The Functional requirements are defined via engineering documentation furnished by the manufacturer, TRW. The IGSE consists of an Instrument Interface Station (IIS) and a Test Operators Station (TOS) which allow operation of the CERES instrument either directly or through the TRMM Project's Spacecraft Ground Support Equipment (SGSE). These interfaced systems are shown in Figure 1. Additionally, as part of the IGSE, there is an Interface Simulation Unit (ISU) which is used to test the IIS to CERES interface prior to connection. The subtasks specified herein are to be performed throughout the entire period of integrating the CERES instrument to the TRMM Spacecraft, during the pre-flight environmental tests and launch readiness operations.

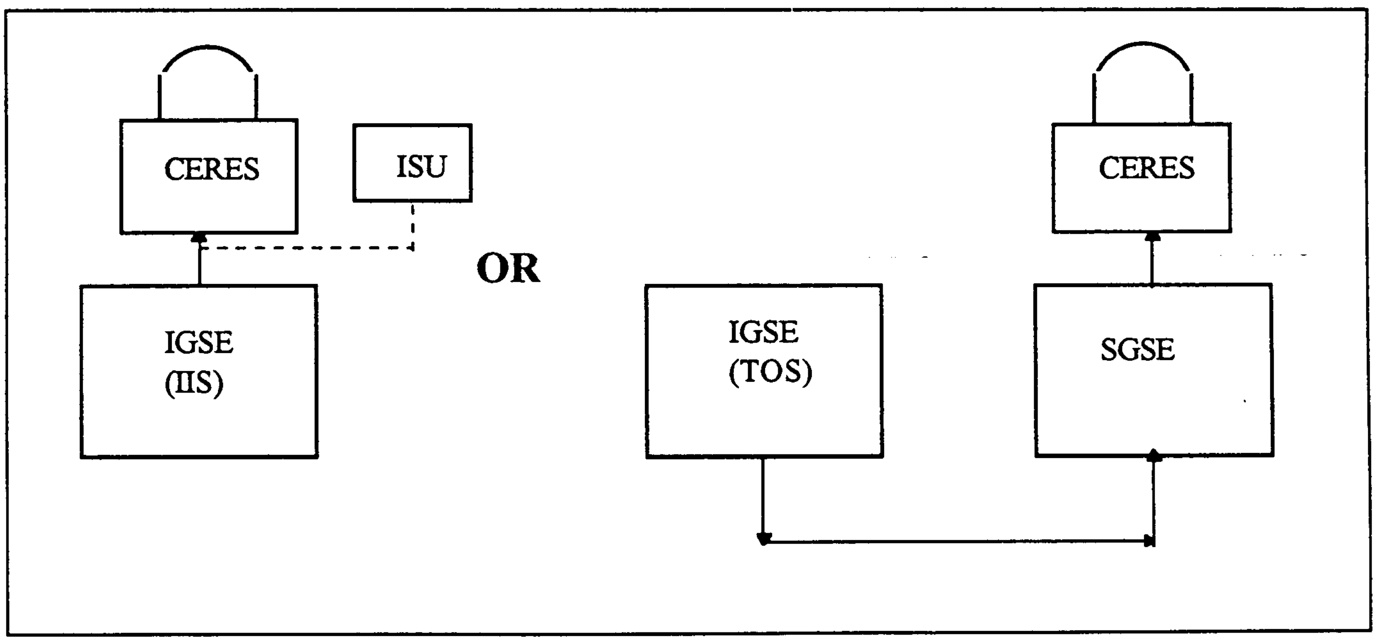

Figure 1: CERES instrument GSE configurations

3. **Task description:**

1. The Contractor shall modify existing CERES test procedures required for EOS AM test operations. The procedural content of the day to day EOS AM test operations vary according to test objectives but will include at least one and possibly all of the following activities:

a. Verification of the CERES instrument's functional status in terms of it being ready for I&T operations. This will be accomplished through the execution of the "CERES Aliveness Test Procedure". This test shall be completed in 30 minutes *.

b. Verification that the CERES instrument's major components and subsystems are operational within their designed specifications. This will be accomplished through the execution of the "CERES Abbreviated Functional Test (AFT) Procedure". This test shall be completed in 2 hours *.

c. Verification that the CERES instrument's components and subsystems are fully functional with respect to their operational designed specifications. This will be accomplished through the execution of the "CERES Comprehensive Functional Test (CFT) Procedure". This test shall be completed in 12 hours *.

* These time limits are set by the TRMM Project at GSFC. During TRMM I&T activities which call out for the CERES instrument to operate, the times quoted above are effected by the following:

1) TRMM spacecraft operations
2) The other four TRMM instrument operations.

Both of these may impact the time allotted to complete the above procedures. The TRMM Project has indicated that the allotted time can be extended depending on the need for the data and actual TRMM timeline with respect to the TRMM schedule. Also, note that the times quoted above will always be allotted if needed by the TRMM Project as a minimum.

As part of this task, the Contractor shall provide real time information regarding execution of the above mentioned test procedures and instrument operations to GSFC during testing. Additionally, the Contractor shall develop , as necessary, special test procedures to troubleshoot and verify anomalous conditions that may occur during the execution the above mentioned tasks. Also, the Contractor shall operate the IGSE or a computer with CERES Bench Checkout Unit (BCU) software to play back data files for analysis of a recorded anomalous operation.

2. The Contractor shall execute the above mentioned test procedures according to the TRMM Project schedule (see attached schedule **). This activity will be coordinated with the CERES Project.

3. The Contractor shall maintain Log Books/Records tracking the following: 1) operating time of the CERES instrument, 2) executed test procedures, and 3) operations data files.

4. The Contractor shall have at least on representative participate in weekly CERES Project meetings dealing with the TRMM schedule, CERES schedule and instrument operations. (i.e. as task schedule permits)

5. The Contractor shall review TRMM I&T test procedures and schedules, TRW and NASA Functional specifications, IGSE configuration or design changes, data analyses, trending data and any other documents related to or effecting the operation and performance of the CERES instrument. The Contractor shall provide verbal and written assessments of these items to the CERES Project. The assessment should include a discussion of the clarity, completeness, and applicability of the items to the CERES instrument operations.

6. The Contractor shall pack in existing shipping containers all of CERES IGSE and documentation necessary to support launch activities in JAPAN. Also, the Contractor shall unpack and set up the IGSE in JAPAN to support TRMM/CERES pre-launch, launch and post-launch operation activities.

****Schedule time table:** The timetable is defined according to the attached table of TRMM/CERES Integration and Test events as well as the events necessary to prepare the CERES instrument and IGSE for shipment to JAPAN. The attached timetable is subject to change as Integration and Test (I&T) events and anomalies occur.

Deliverables:

1. Preliminary copy of above mentioned procedures four weeks (20 working days) prior to the scheduled test.

2. Final copy of above mentioned procedures two weeks (10 working days) prior to the actual test. The Final copy, once approved, will be the Test Procedure used to conduct the appropriate test. ***Note: Any changes to the test procedure after this review will be RED Lined into the procedure. If numerous procedural changes are required the CERES Project Staff will make a determination as to whether or not the procedure shall be rewritten prior to proceeding with the test. If the Project determines the changes should be made, the Contractor shall incorporate all Red line changes into the procedure prior to the test event.***

3. Within 30 minutes following the formal completion of an operational test procedure or any other CERES instrument operation, the Contractor shall provide a brief written summary using the "Quick-Look" report of any anomalies that occurred during the operation(s); and, status of both the instrument and IGSE.

4. Within two weeks (10 working days) after the formal completion of a Test, generate a final report(s) providing details related to the executed procedure and the health of the instrument at the test(s) completion.

5. Monthly (by the 1st of the each month or the next working day) report(s) detailing current status of the following: 1) development of Test Procedure(s), 2) Test(s) completed, 3) current Test(s) being executed, 4) CERES instrument and 5) CERES IGSE.

Metrics:

1. Satisfactory effort:

   a. All of the CERES instrument and IGSE operations are executed in a manner such that the CERES instrument's operational readiness is maintained and the spacecraft I&T and Launch schedules are met. Note that this is not to include any Spacecraft, SGSE, CERES instrument or IGSE failures outside the CERES Project or Contractor's control.

   b. All of the above mentioned procedures and reports follow the established CERES Project standard format and are delivered as scheduled and accepted with little or minor change post review by the CERES Project Staff.

   c. All of the above mentioned procedures will be of the high quality in terms of organization, thoroughness, completeness and readability as determined by the CERES Project reviewers.

   d. All appropriate flight hardware product assurance and cleanroom policies and plans are followed.

2. Exceeds effort:

   a. All of the CERES instrument and IGSE operations are executed in an efficient manner such that the CERES instrument's operational readiness is maintained somewhat ahead of the spacecraft I&T and Launch schedules . Note that this is not to include any Spacecraft, SGSE, CERES instrument or IGSE failures outside the CERES Project or Contractor's control.

   b. All of the above mentioned procedures and reports are delivered 25% ahead of the required scheduled time and accepted with little or no change post review by the CERES Project Staff.

   c. All of the above mentioned procedures will be of exceptional quality in terms of organization, thoroughness, completeness and readability as determined by the CERES Project reviewers.

   d. Contractor's response to anomaly events and schedule changes are timely and effective as determined by the CERES Project Staff.

   e. All appropriate flight hardware product assurance and cleanroom policies and plans are followed.

4. **Other Information:**

1. Electro Static Discharge (ESD) certification is required to handle the [illegible]ument and IGSE.

2. The IGSE is flight critical hardware and subject to established NASA and CERES Product Assurance Policies and Plans.

3. Adherence to contamination control policy and procedures is required to support space flight cleanroom CERES instrument operations.

4. All of the CERES operational test procedures will be approved by the CERES Project prior to execution.

5. All tests will be scheduled with and coordinated through the CERES Project and GSFC/TRMM personnel.

5. Government Furnished items:

1. Access to a 486 computer or better and software as required to develop and modify above mentioned test procedures or execute CERES BCU instrument operational software for training and analyses. The software will include DOS 3.1 or better, Windows 3.1 or better, Microsoft Office with Word 6.0 and Excel 5.0, Eudora and PC/TCP. This will be the minimum software provided; however, the CERES Project may provide other software as determined necessary by the Contractor to support this task.

2. Access to the CERES IGSE hardware and the TRW and CERES Project documentation as required to operate the CERES instrument(s) both directly and via SGSE. This equipment may also be used on a non test interference basis for data analysis, operator training, evaluation of new procedures and troubleshooting of anomalies as they may occur. Use of the CERES IGSE shall be scheduled and coordinated through the CERES Project.

3. All of the shipping containers necessary for shipment of the IGSE and documentation to Japan.

6. Security: None Required.

7. Travel:

1. Trips to GSFC and Japan are expected to conduct instrument operations in support of this task.

8. Period of Functional:

1. Planned start date: 1 May 1997

2. Expected completion date: 31 December 1997

9. NASA Technical Monitor

Charles E. Jenkins Jr. M/S 431 Phone 804-864-7080

TRMM Schedule
CERES PFM Instrument
5/27/97

110	GSE Troubleshho & Repair	3	4/29/97	5/1/97	J. Donaldson
111	CPT #3, 3 Shifts; Sa, Su	6	4/28/97	5/3/97	QA,2TC,2TO,C-Hickman
112	CPT #3, 3 Shifts; Sa, Su	2	5/5/97	5/6/97	QA,C-Beatty,2TC,2TO
113	End to End Mission Sim #2; 3 Shifts	4	5/7/97	5/10/97	QA,C-Beatty,2TC,2TO
114	PFM Internal cleaning	1	5/13/97	5/13/97	TC,TO,B.Killough,C-Jenkins
115	PFM MLI repair	1	5/13/97	5/13/97	TC,TO,B.Killough,C-Jenkins
116	PFM alignment- 2nd shift	1	5/13/97	5/13/97	TC,TO,P.Brown,C-Jenkins
117	NASDA Training	1	5/23/97	5/23/97	I&T Suppport Team/Launch
118	CPT #4, 3 Shifts	7	6/2/97	6/8/97	3TC,3TO,C-Hickman
119	Mission Sim #3; 3 Shifts2..contigent	4	6/10/97	6/13/97	3TC,3TO,C-Beatty
120	I&T Schedule Contingency; 2 Holidays	54	6/14/97	8/9/97	As required
121	Pack EGSE for Shipment	5	6/16/97	6/20/97	C,TC,TO,QA
122	Pack MGSE for Shipment	5	6/15/97	6/19/97	
123	Ship GSE to Japan	42	6/26/97	8/9/97	
124	Transportation Meeting	1	7/8/97	7/8/97	
125	Launch Site I&T	90	8/1/97	10/29/97	
126	PSRR	2	8/6/97	8/7/97	
127	OBS Delivered to Launch Site	18	8/9/97	8/26/97	
128	GSE Shipm. Contingency	3	8/13/97	8/15/97	
129	Ship OBS to Japan	1	8/13/97	8/13/97	
130	Launch Site CPT IGSE set-up/Japan	5	9/5/97	9/9/97	C,TC,TO
131	Launch site CPT/Japan	11	9/10/97	9/20/97	C,2TC,2TO
132	Red/Grn tag, Alive test & launch/Japan	20	10/13/97	11/1/97	C,TC,TO
133	Aliveness test /GSFC	1	10/22/97	10/22/97	C,TC,TO
134	Launch Readiness Review/Japan	2	11/1/97	11/1/97	C,TC
135	Post Launch Support @GSFC	5	11/1/97	11/5/97	C,TC,TO
136	Main door open @ GSFC	3	12/1/97	12/3/97	C,TC,TO
137	Deep Space Manuver @ GSFC	3	12/8/97	12/10/97	C,TC,TO

1. Task Order Number and Title Number: GK09 Revision: 1 Date:6/11/97
   Title: 757 Pallet Environmental Control System(ECS)

2. Purpose, Objective or Background of Work to be Performed:

A description of the revised tasks are as follows:

1. Sub task 1A and 1B are modified from the delivery of a critical design review to the delivery of an informal peer review.
2. Sub task 2 has been modified to change the task deliverables from a Pallet Exhaust System Design, to an Onyx Air Control Subsystem Cooling Hardware design.

   The objective of this task is to provide mechanical engineering tasks for the 757 Transport Research Facilities (TRF) Project to conduct the Environmental Control System(ECS) and structural modifications . The tasks will encompass three functions: 1) Conceptualization of the design by including customer requirements, 757 aircraft and experimental system pallet spatial limitations and the ECS analysis provided by the NASA 757 ECS lead engineer. 2) The design, which shall include preliminary layouts, detail, assembly and installation drawings for fabrication including detailed parts lists. 3) Configuration control, ensure the manufactured and installed hardware complies with the engineering drawings by keeping revisions up to date.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall complete the following specific design task items for installation in the NASA 757 aircraft to modify and direct the existing environmental control system to ensure the Transport Research system pallets and other hardware are sufficiently cooled during operations. The designs encompass two major system components on the 757 aircraft; an Exhaust Plenum Unit system that is a unique cooling and ducting system for an Onyx SGI computer pallet, and the cooling subsystem supply hardware. In addition, the contractor shall provide a task to update drawings and stress reports to comply with as-built and installed hardware for the defined drawings.

The deliverables shall include drawing hard copies as well as electronic files of the following engineering tasks performed using the Anvil 1000MD or ProEngineer CAD software systems as appropriate.

1. Onyx Air Control System Delivery: June 30 1997

A. Main Exhaust Plenum Unit I
   1. Top adapter
   2. Floor adapter
   3. Exhaust vent (aft)
      a) Exit grille frame
      b) Hanger supports

   4. Informal Peer Design Review to be conducted on the completed design prior to committing the design to production June 9, 1997

B. Main Exhaust Plenum Unit II
   1. Top adapter
   2. Floor adapter
   3. Exhaust vent (aft)
      a) Exit grille frame
      b) Hanger supports

   4. Informal Peer Design Review to be conducted on the completed design prior to committing the design to production June 9, 1997

A data package must be completed by the contractor containing drawings and analysis to be delivered one day prior to the ECS project Critical Design Review .
The contractor is required to attend this CDR as contributing team members.

Onyx Pallet system requirements: Operating temperature range of 41-95 deg F at sea level, 41-86 deg F at 5000 ft altitude and 10-80% non-condensing humidity (note that the thermal loading analysis has been performed by LaRC and the contractor shall provide detail engineering drawings from existing concepts provided by the ECS technical project engineer).

2. Onyx Air Control subsystems Cooling Supply Hardware

A. ECS Hatch Plenum Delivery: August 29 1997
B. Plenum Box Adapters Delivery: August 29 1997
C. Butterfly Valve modifications Delivery: July 24 1997
D. Valve/Duct support Hardware Delivery: August 291997
E. Peer Design Review August 15 1996

Design an ECS Hatch Plenum and Box Adapters as specified to separate air flow from the Onyx Main Exhaust Plenum from the forward cargo bay interior. The Butterfly valve is an existing component that must be modified to meet the Transport Research Facilities Thermal Analysis leakage rate of no more than 0.1 percent of the total Onyx supply flow. Design the valve duct support hardware as required to attach the valve and Onyx supply duct to the aircraft structure.

3. Detail/Assembly Drawing Revisions

The contractor shall attend a 757 project review meeting to obtain requirements for this task. The contractor shall update drawings; 419448, 419451, 419455, and the stress report for the 757 flight deck Observer seat and Jump seat to reflect the as-built hardware and installation on the aircraft. This task is required to meet quality standards set forth by LHB 7910.1 Flight Research Program Management.

This task is required to be delivered on June 2, 1997.

Performance metrics of the preceding tasks will be ; "minimally acceptable"(MA) or "substantially exceeds"(SE) based on the following criteria:

3.1 <u>The functionality of the designs</u>. Designs will be required to meet compliance with quality standards set forth by the Flight Operations Systems Division, Quality Assurance Office according to LHB 7910.1 and the manufacturability of components and assemblies as reviewed by the NASA Technical Project Engineer (TPE) for the 757 TRF project and the designs shall be controlled by the TRF Project Interface Control Document: TRF 007. Seven percent of the total cost to redesign dictates an "MA" rating and two percent or less of the total cost dictates an "SE".

3.2 <u>The quality of drawings and detail assemblies and the ability for the final release of drawings to accurately describe the "as-built" hardware and installations.</u> Seven percent of the total cost of engineering drafting required to make final release in full compliance with the Drawing requirements standards, Mil-T-31000 and Mil-STD-100E, shall constitute an "MA" and two percent or less of the total cost shall constitute an "SE" rating.

3.3 <u>The ability to meet the delivery schedule.</u> Delivery within 2 weeks of stated milestones constitutes an " MA" and delivery ahead of or on schedule milestones shall constitute an "SE" rating. The contractor shall be evaluated for ability to meet schedules solely under the control of the contractor and not deficiencies caused by U.S. Government or general industry anomalies

4. Government Furnished Items:
The use of government support computers and software programs may be required during the performance of this task, and periodic participation in study team status reviews at LaRC will be necessary.

5. Other information needed for performance of task.
No travel is required during the performance period.

Documents that apply:

LHB 7910.1 Flight Research Program Management
TRF.007 Interface Control Document for B757 Aircraft workstation Pallet Configuration.
LaRC Drawings: 319193, 319654A,319653A,319652A,319655,319656,319335, 319659, 319650 (obtained through Aeronautical Mechanical Systems Division/Engineering Design Branch through the TPE)
Mil-std-100E
Mil-T-31000
LaRC Memo dated April 9, 1997 Minutes from the critical design review for the Environmental Control System for the B757 Aircraft

6. Security clearance required for performance of work:
none

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: August 29, 1997

8. NASA Technical Monitor: Wendy F. Pennington
.M/S: 432 Phone: 804-864-7126

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title GKØ9 Number: Revision:
   Title: 757 Pallet Environmental Control System(ECS)

2. Purpose, Objective or Background of Work to be Performed:

The objective of this task is to provide mechanical engineering tasks for the 757 Transport Research Facilities (TRF) Project to conduct the Environmental Control System(ECS) Modifications. The tasks will encompass three functions: 1) Conceptualization of the design by including customer requirements, 757 aircraft and experimental system pallet spatial limitations and the ECS analysis provided by the NASA 757 ECS lead engineer. 2) The design, which shall include preliminary layouts, detail, assembly and installation drawings for fabrication including detailed parts lists. 3) Configuration control, ensure the manufactured and installed hardware complies with the engineering drawings by keeping revisions up to date.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall complete the following specific design task items for installation in the NASA 757 aircraft to modify and direct the existing environmental control system to ensure the Transport Research system pallets and other hardware are sufficiently cooled during operations. The designs encompass two major system components on the 757 aircraft; an Exhaust Plenum Unit system that is a unique cooling and ducting system for an Onyx SGI computer pallet and an Air Exhaust system that has common hardware to all other TRF research pallets.

The deliverables shall include drawing hard copies as well as electronic files of the following engineering tasks performed using the Anvil 1000MD or ProEngineer CAD software systems as appropriate.

Onyx Air Control System Delivery: June 29 1997

A. Main Exhaust Plenum Unit I
   1. Top adapter
   2. Sidewall grille adapter
   3. Exhaust vent (aft)
      a) Exit grille frame
      b) Hanger supports

   4. Critical Design Review June 9, 1997

Onyx Pallet system requirements: Operating temperature range of 41-95 deg F at sea level, 41-86 deg F at 5000 ft altitude and 10-80% non-condensing humidity (note that the thermal loading analysis has been performed by LaRC and the contractor shall provide detail engineering drawings from existing concepts provided by the ECS technical project engineer).

Pallet Exhaust Air System

A.	Fan Plenum Box Modifications	Delivery: August 29 1997
B.	Plenum Box adapters	Delivery: August 29 1997
C.	Cabin wall duct works	Delivery: July 24 1997
D.	Floor vent adapters	Delivery: August 291997
E.	Critical Design Review	August 15 1997

TRF research pallets shall have common ducting and plenum designs that cool pallets to a maximum operating temperature of 110 deg F and minimize condensation. (The contractor shall provide the engineering drawings based upon thermal analysis performed by LaRC ECS technical project engineer).

Performance metrics of the tasks will be ; "minimally acceptable"(MA) or "substantially exceeds"(SE) based on the following criteria:

3.1 <u>The functionality of the designs</u>. Designs will be required to meet compliance with quality standards set forth by the Flight Operations Systems Division, Quality Assurance Office according to LHB 7910.1 and the manufacturability of components and assemblies as reviewed by the NASA Technical Project Engineer (TPE) for the 757 TRF project and the designs shall be controlled by the TRF Project Interface Control Document: TRF 007. Seven percent of the total cost to redesign dictates an "MA" rating and two percent or less of the total cost dictates an "SE".

3.2 <u>The quality of drawings and detail assemblies and the ability for the final release of drawings to accurately describe the "as-built" hardware and installations.</u> Seven percent of the total cost of engineering drafting required to make final release in full compliance with the Drawing requirements standards, Mil-T-31000 and Mil-STD-100E, shall constitute an "MA" and two percent or less of the total cost shall constitute an "SE" rating.

3.3 <u>The ability to meet the delivery schedule.</u> Delivery within 2 weeks of stated milestones constitutes an " MA" and delivery ahead of or on schedule milestones shall constitute an "SE" rating. The contractor shall be evaluated for ability to meet schedules solely under the control of the contractor and not deficiencies caused by U.S. Government or general industry anomalies

4. Government Furnished Items:

The use of government support computers and software programs may be required during the performance of this task, and periodic participation in study team status reviews at LaRC will be necessary.

5. Other information needed for performance of task.

No travel is required during the performance period.

Documents that apply:

LHB 7910.1 Flight Research Program Management
TRF.007 Interface Control Document for B757 Aircraft workstation Pallet Configuration.
LaRC Drawings: 319193, 319654A,319653A,319652A,319655,319656,319335 (obtained through Aeronautical Mechanical Systems Division/Engineering Design Branch through the TPE)
Mil-std-100E
Mil-T-31000
LaRC Memo dated April 9, 1997 Minutes from the critical design review for the Environmental Control System for the B757 Aircraft

6. Security clearance required for performance of work:

none

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: August 29, 1997

8. NASA Technical Monitor: Wendy F. Pennington
.M/S: 432 Phone: 804-864-7126

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title GK/10 Number: Revision:
   Title: LaRC Pyrotechnic Support

2. Purpose, Objective or Background of Work to be Performed:

   Purpose: Provide support for LaRC pyrotechnic operations.

   Objective: Fulfill LaRC safety requirements of Certified Pyrotechnic Technicians in accomplishing pyrotechnic operations without loss or damage to property or harm to personnel, per LHB 1710.7, "Use and Handling of Explosives and Pyrotechnics."

   Background: AMSD has assumed the responsibility for supporting Langley program personnel for pyrotechnic operations.

3. Tasks, Deliverables and or Products, and performance measurements:

   The contractor shall provide support to accomplish the following:

Subtasks: 1. Receive, inventory and store shipments of pyrotechnics. Participate in annual inventory of stored pyrotechnics.

Deliverables: Pyrotechnics safely and securely stored in the appropriate facilities.

Metrics: Minimally acceptable: No shipment is left overnight at Shipping and Receiving or at the NASA main gate.

Exceeds: All shipments are properly stored and all inventories are updated, and the user informed of receipt within two days of receipt.

2. Transport pyrotechnics to operational sites, within or outside LaRC as required.

Deliverables: Pyrotechnics safely transported into the custody of properly certified personnel.

Metrics: Minimally acceptable: Meets delivery schedule within two days of requested delivery time.

Exceeds: Meets delivery schedule exactly.

3. Provide hands-on training to LaRC personnel designated to accomplish pyrotechnic operations in non-dedicated pyrotechnic facilities.

Deliverables: LaRC personnel adequately trained in pyrotechnic operations to avoid harm to individuals or damage to facilities.

Metrics: Minimally acceptable: Provides lectures to introduce pyrotechnic operations and procedures.

Exceeds: Provide above lectures and works with assigned project personnel at the work site to walk through and approve procedures.

4. Participate with personnel in non-dedicated pyrotechnic facilities in drafting procedures and assembly and checkout of pyrotechnic systems and hardware.

Deliverables: Operational procedures that provide reliable accomplishment of the pyrotechnic operations, while minimizing risk to personnel and facilities.

Metrics: Minimally acceptable: Provide review of procedures.

Exceeds: Works with project personnel to provide procedural guidelines and participates in developing and approving procedures.

5. Conduct pyrotechnic tests in LaRC dedicated or non-dedicated facilities.

Deliverables: Procedures to accomplish tests and data collected.

Metrics: Minimally acceptable: Provides procedures to just meet requirements.

Exceeds: Actively communicates with requester to maximize the amount of data collected within allocated funding.

6. Maintain dedicated pyrotechnic test facilities and equipment and participate in annual review of facility grounding and lightning protection.

Deliverables: Fully operational, safe, secure facilities.

Metrics: Minimally acceptable: Facilities/equipment just meets operational capabilities.

Exceeds: Actively checks facilities and equipment and recommends modification, repair and upgrade.

SAERS (NAS1-96013) Task Order Page 3

Title: LaRC Pyrotechnic Support

4. Government Furnished Items: The pyrotechnic test facilities, which include Buildings 1158 and 1158A for pyrotechnic storage, 1159 for assembly of pyrotechnic components and systems and environmental, electrical and functional testing, 1160 and 1161 for assembly of pyrotechnic components and systems, and testing in 1161. Equipment for monitoring, data acquisition, computers, etc.

5. Other information needed for performance of task. LHB 1710.7, "Use and Handling of Explosives and Pyrotechnics."

6. Security clearance required for performance of work: Unclassified

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: Ongoing

8. NASA Technical Monitor: Laurence J. Bement M/S: 431 Phone: 804-864- 7084

PRINTED: 4/29/97

1. Task Order Number ~~GK0~~ GK11	Number:	Revision
Title: Equipment manager for the CERES Project/TRMM and EOS-AM Spacecraft		

2. Background of work to be performed:

The Clouds and Earth Radiant Energy System (CERES) Project is responsible for the development, spacecraft integration and testing (I&T), deployment and initial in-orbit operation of CERES instrument. The CERES instrument is a broadband scanning radiometer with the capability of operating in either a cross track scan mode or a biaxial scan mode. The CERES instrument provides data on the Earth and atmospheric radiation budget from the top of the atmosphere to the surface of the Earth. The CERES instruments are improved and modified versions of the Earth and Radiation Budget Satellite (ERBS). The CERES instruments will provide three spectral channels over the range of 0.3 to 50.0 micrometers. The CERES Protoflight Model (PFM) instrument has been delivered to GSFC and integrated on to the Tropical Rainfall Measurement Mission (TRMM) spacecraft for system verification and pre-launch environmental testing. Also, the CERES Instruments, Flight Model (FM) 1 and FM2, have been delivered to Lockheed Martin Missles Systems (LMMS) and integrated on to the Earth Observatory System-AM (EOS-AM) spacecraft for system verification and pre-launch environmental testing. The TRMM spacecraft is scheduled for launch in November 1997 and the EOS-AM spacecraft is scheduled for launch in June 1998.

The Contractor shall be responsible for maintaining records of the CERES instrument's ISGE, MGSE and related GSE during the I&T phase and post launch storage. The IGSE consists of an Instrument Interface Station (IIS) and a Test Operators Station (TOS) which allow operation of the CERES instrument either directly or through the Spacecraft Ground Support Equipment (SGSE). These interfaced systems are shown in Figure 1 and 2. Additionally, as part of the IGSE, there is an Interface Simulation Unit (ISU) which is used to test the IIS to CERES interface prior to connection. The MGSE consists of shipping containers, shipping fixtures, handling fixture and lifting slings. The subtasks specified herein are to be performed throughout the entire period of integrating the CERES instrument to the TRMM and EOS-AM Spacecrafts, during the pre-flight environmental tests, launch readiness operations, post launch GSE return and storage.

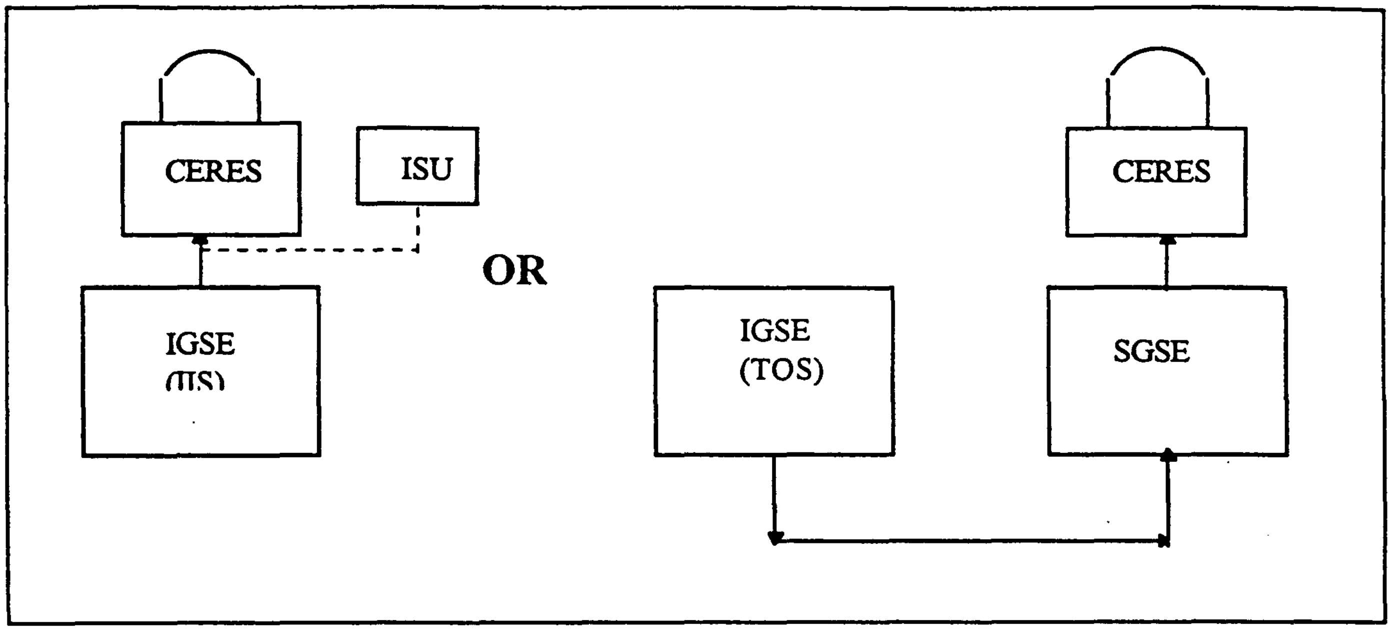

Figure 1: CERES PFM instrument GSE configurations

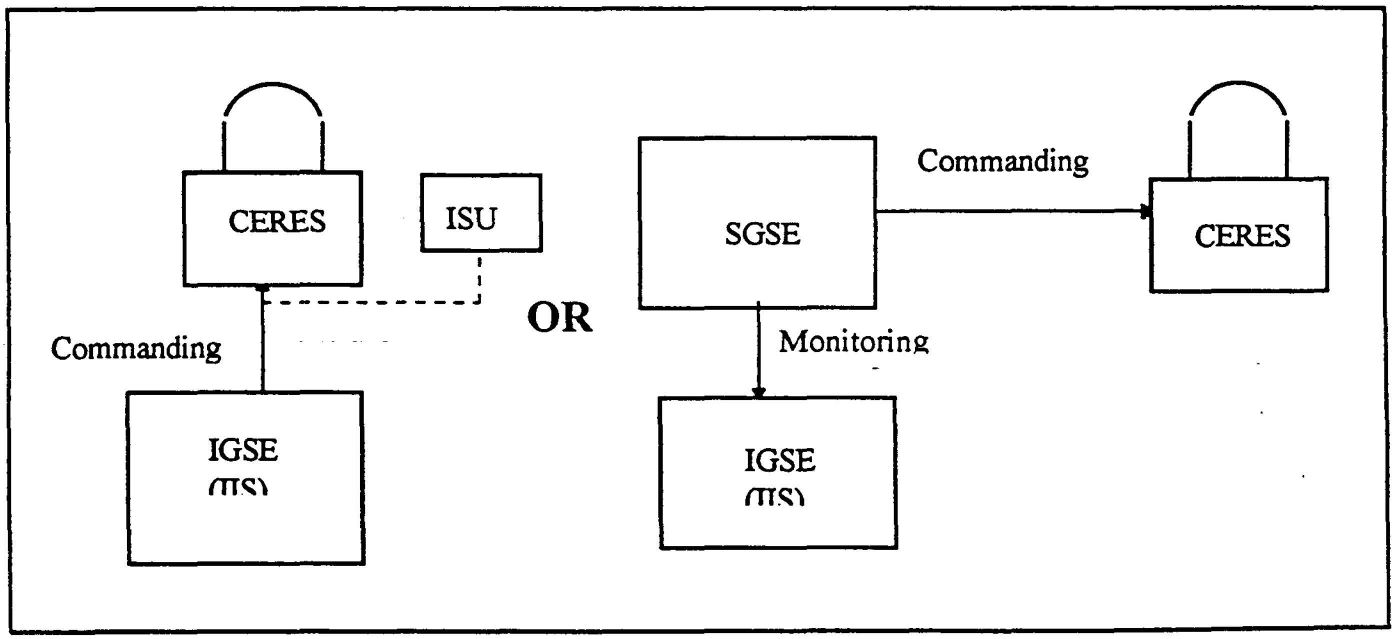

Figure 2: CERES FM1 & FM2 instruments GSE configurations

3. **Task description:**

The Contractor shall keep and maintain proper records for the CERES Project's PFM, FM1 and FM2 along with the associated GSE. This task shall include but not be limited to the following support subtasks:

a. Develop and maintain CERES PFM, FM1 and FM2 IGSE and MGSE records to include:

   1. Equipment Control Number (ECN) assignment
   2. Equipment shipping and receiving documentation
   3. Equipment location accountability

b. IGSE and MGSE equipment scheduled maintenance.
c. Shipping documentation review.
d. Shipping process overview and GSE accountability.

Schedule time table:

Records shall be maintained at all times during the CERES Project I&T Phases through post launch storage activity.

Deliverables:

Monthly reports detailing GSE location and periodic maintenance status.

Metrics:

1. Satisfactory effort:

a. Maintains the previously mentioned records in a manner which allows coordination of events to occur without any schedule delay.

b. Provides monthly reports detailing GSE location and periodic maintenance status on the first Monday of each Month.

2. Exceeds effort:

a. Maintains the previously mentioned records in a manner which allows coordination of events to occur ahead of schedule or such that a schedule gain is achieved.

b. Provides monthly reports detailing GSE location and periodic maintenance status before the first day of each Month.

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4. Other Information:

1. Electro-Static Discharge (ESD) certification is required to handle the instrument and IGSE.

2. The IGSE is flight critical hardware and subject to established NASA and CERES Product Assurance Policies and Plans.

3. Adherence to contamination control policy and procedures is required to support space flight cleanroom CERES instrument operations.

4. All of the CERES operational test procedures will be approved by the CERES Project prior to execution.

5. All tests will be scheduled with and coordinated through the CERES Project for both GSFC/TRMM and LMMS/EOS-AM.

5. Government Furnished items:

1. Access to a 486 computer or better and software as required to develop and modify above mentioned logistics records and reports. The software will include DOS 3.1 or better, Windows 3.1 or better, Microsoft Office with Word 6.0 and Excel 5.0, Eudora and PC/TCP. This will be the minimum software provided; however, the CERES Project may provide other software as determined necessary by the Contractor to support this task.

2. Access to the CERES IGSE hardware and the TRW and CERES Project documentation as required for record keeping and to monitoring the scheduled of certification maintenance. This equipment may also be used on a non testinterference basis for data analysis, operator training, evaluation of new procedures and troubleshooting of anomalies as they may occur. Use of the CERES IGSE and MGSE shall be scheduled and coordinated through the CERES Project.

6. Security: None Required.

7. Travel:

Periodic trips to GSFC, LMMS and Japan are expected to conduct this task. The attached schedule defines the dates and times of the operation. Note: These trips may be scheduled to coincide with instrument operation activities in order to control travel costs.

8. Period of performance:

1. Planned start date: 1 May 1997 2. Expected completion date: July 31, 1998

9. NASA Technical Monitor Charles E. Jenkins Jr. M/S 431 Phone 804-864-7080

CERES-PFM/TRMM Schedule as of 4/15/97 prepared by C.E.Jenkins, Jr. (c.e.jenkins@larc.nasa.gov)
TC- Test Cconductor, TO-Test Operator are Lockheed positions

ID	TASK	Duration	Start	End	Staff
109	CPT #3, 3 Shifts; Sa, Su	8	4/28/97	5/5/97	
110	CPT #3, 3 Shifts; Sa, Su	2	4/28/97	4/29/97	QA,2TC,2TO,T-Adams,C-Beatty
111	CPT #3, 3 Shifts; Sa, Su	3	4/30/97	5/2/97	QA,2TC,2TO,C-Beatty
112	CPT #3, 3 Shifts; Sa, Su	3	5/3/97	5/5/97	QA,2TC,2TO,T-Appleby,C-Hickman
113	End to End Mission Sim #2; 3 Shifts	4	5/7/97	5/10/97	TC,TO,QA,T-Davis,C-Hickman
114	PFM Internal cleaning	1	5/13/97	5/13/97	TC,TO,C,B.K.
115	PFM MLI repair	1	5/13/97	5/13/97	TC,TO,C,B.K.
116	PFM alignment	1	5/13/97	5/13/97	TC,TO,C
117	CPT #4, 3 Shifts	7	6/2/97	6/8/97	TC,TO,C
118	Mission Sim #3; 3 Shifts2..contigent	4	6/10/97	6/13/97	3TC,3TO,C
119	I&T Schedule Contingency; 2 Holidays	54	6/14/97	8/9/97	As required
120	Pack EGSE for Shipment	5	6/15/97	6/19/97	C,TC,TO,QA
121	Pack MGSE for Shipment	5	6/15/97	6/19/97	
122	Ship GSE to Japan	42	6/26/97	8/9/97	
123	Launch Site I&T	90	8/1/97	10/29/97	
124	OBS PSRR	2	8/6/97	8/7/97	
125	OBS Delivered to Launch Site	18	8/9/97	8/26/97	
126	GSE Shipm. Contingency	3	8/13/97	8/15/97	
127	Ship OBS to Japan	1	8/13/97	8/13/97	
128	Launch site CPT	11	9/10/97	9/20/97	C,2TC,2TO
129	Red/Grn tag walkdwn, Alive test & launch	20	10/13/97	11/1/97	C,TC
130	Launch Readiness Review	1	11/1/97	11/1/97	C,TC

CERES FM1 & FM2/EOS-AM Schedule as of 4/17/97 prepared by C.E.Jenkins, Jr.

TC- Test Cconductor, TO-Test Operator are Lockheed positions

ID	Task	Duration	Start	End	Staff	
1	EOS AM I&T	363	3/19/97	7/21/98		
2	Badging, SIS Training	1	3/19/97	3/19/97	2TC,2TO,2QA,TPE,2C.B.K.	
3	Delivery and Bat testing	3	3/20/97	3/22/97	2TC,2TO,2QA,TPE,2C.B.K.	
4	Pre-Integration az 0 ref test	1	3/22/97	3/22/97	TPE,C,QA,TC,O M	
5	AZ zero stop fix. test	1	3/26/97	3/26/97	TPE,C,TC,QA	
6	FM1 & 2 mech. Integ. to AM	2	3/26/97	3/27/97	2C,TPE,TO,TC,QA	
7	FM1 & FM2 elect. Integ. to AM	4	4/16/97	4/21/97	2C,TPE,QA,TC,TO	
8	Abbreviated Functional Test	4	4/21/97	4/24/97	C,2TC,2TO	
9	Abbreviated Functional Test	4	5/12/97	5/15/97	C,2TC,2TO	
10	Abbreviated Functional Test	4	5/26/97	5/29/97	C,2TC,2TO	
11	Abbreviated Functional Test	4	6/9/97	6/12/97	C,2TC,4TO	
12	Abbreviated Functional Test	4	6/23/97	6/26/97	C,2TC,4TO	
13	SC Compatability Test	10	7/8/97	7/19/97	C,2TC,4TO	
14	TDRSS Compatibility test 2-shifts	11	8/4/97	8/16/97	C,2TC,4TO	
15	SC Compatability test 2-shifts	11	9/2/97	9/16/97	2TC,C,4TO	
16	T/V Blancket Installation 2-shifts	8	9/16/97	9/25/97	C,2TC,4TO	
17	EMC test 2-shifts	7	9/26/97	10/5/97	C,2TC,4TO	
18	T/Vac prep. 2-shifts	18	10/5/97	10/25/97	C,2TC,4TO	
19	T/Vac & T/Bal test 3-shifts	32	10/26/97	12/8/97	C,3TC,6TO	
20	SC Functional test 2-shifts	6	12/15/97	12/22/97	C,2TC,4TO	
21	Alignment verification 2-shifts	6	12/31/97	1/7/98	C,2TC,4TO	
22	Acqustic test 2-shifts	7	1/10/98	1/19/98	C,2TC,4TO	
23	SC Functional test 2-shifts	8	1/20/98	1/29/98	C,2TC,4TO	
24	Alignment verification 2-shifts	1	1/30/98	1/30/98	C,2TC,4TO	
25	Pyro test 2-shifts	3	2/8/98	2/10/98	C,TC,2TO	
26	Alignment verification 2-shifts	4	2/21/98	2/25/98	C,2TC,4TO	
27	SC CPT 100 hrs. operation 3-shifts	11	3/1/98	3/13/98	C,3TC,6TO	
28	SC ground sys. test 2-shifts	2	3/14/98	3/16/98	C,2TC,4TO	
29	SC mass properties test 2-shifts	4	3/24/98	3/27/98	C,2TC,4TO	
30	Prep. for shipment 2-shifts	3	3/31/98	4/2/98	C,2TC,4TO	
31	SC pre-ship review	1	4/2/98	4/2/98	C	
32	Contingency	33	4/2/98	5/18/98		
33	SC ship to Vandenburg	2	4/3/98	4/6/98	C	
34	Launch Site Operations	57	5/4/98	7/21/98		
35	Launch, Vandenburg, AFB	1	6/29/98	6/29/98		

~~Wolf task doc~~

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number and Title 6-K12 Number: Revision:
   Title: Development of Advanced Canopy Severance.

2. Purpose, Objective or Background of Work to be Performed:

   Purpose: Develop a fighter aircraft canopy severance method to allow through-canopy ejection of crewmembers.

   Objective: Reduce the strength of fighter aircraft canopies to a level that will allow the kinetic energy of ejecting seats/crewmembers to strike and open the canopies.

   Background: Existing aircraft escape systems require the jettison of high-strength, bird strike-resistant canopies for uninhibited ejection of crewmembers. Through-canopy ejection will allow considerable savings in ejection times, system complexity and weight.

3. Tasks, Deliverables and or Products, and performance measurements (continued):

   The contractor shall conduct functional tests on canopy materials to demonstrate the application of augmented shock wave fracturing to through-canopy crew escape. The work will be subdivided into subtasks, which will be accomplished sequentially in the order presented. The contractor shall provide drawings on test fixtures, which will be manufactured by NASA.

Subtasks: 1. The contractor shall evaluate the effects of the following variables on augmented shock wave fracturing of the F-16 aircraft canopy:

a. The use of Detasheet
   - Fracture performance vs explosive density and explosive propagation velocity
   - Fracture performance vs explosive load
   - Fracture performance vs canopy thickness
   - Initiation sensitivity
   - Change in direction of fracture lines

b. Compare the above to mild detonating fuse

c. Detasheet performance effects due to:
   - Degree of canopy curvature
   - Proximity of fracture lines to canopy frame

Deliverables: Performance data from experimental measurements taken in a, b, and c above.

Metrics: Minimally acceptable - Less than complete fracture of polycarbonate in test specimens by July 1, 1997.

Exceeds - Total fracture of polycarbonate test specimens with data delivered prior to July 1, 1997.

Title: Development of Advanced Canopy Severance

3. Tasks, Deliverables and or products, and performance measurements (continued):

Subtasks: 2.The contractor shall demonstrate augmented shock wave fracturing of a full-scale F-16 aircraft canopy with Detasheet. The fracture pattern will be based on the fracture capabilities of the Detasheet and crew egress requirements. Determine pushout forces required to allow an ejection seat mockup to pass through the canopy.

Deliverables: Document assembly patterns and procedures, high-speed photographic coverage of test, and force versus displacement plot of simulated seat pushout.

Metrics: Minimally acceptable - Achieving seat mockup pushout forces that are greater than 2,000 pounds-force by February 1, 1998.

Substantially exceeds - Achieving seat mockup pushout forces that are less than 1,000 pounds-force with the data delivered prior to February 1, 1998.

Subtasks: 1. The contractor shall evaluate the effects of the functional variables on augmented shock wave fracturing of injection-molded canopies.

a. The use of Detasheet
- Fracture performance vs explosive load
- Fracture performance vs canopy thickness
- Change in direction of fracture lines

b. Detasheet performance effects due to:
- Degree of canopy curvature
- Proximity of fracture lines to canopy frame

Deliverables: Performance data from experimental measurements.

Metrics: Minimally acceptable - Less than complete fracture of polycarbonate in test specimens by April 30, 1998.

Exceeds - Total fracture of polycarbonate test specimens with data delivered prior to April 30, 1998 for the date.

SAERS (NAS1-96013) Task Order Page 3

Title: Development of Advanced Canopy Severance

4. Government Furnished Items:

The Pyrotechnic Test Facility, which includes assembly and test cells, all performance monitoring equipment, data acquisition systems, computers, etc. Also supplied will be all explosive materials and aircraft canopies necessary to accomplish the required tests. Aircraft canopy fracture and design requirements will be supplied by the NASA Technical Monitor, prior to initiating scheduled activities on each task.

5. Other information needed for performance of task.

NONE

6. Security clearance required for performance of work: Unclassified

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Laurence J. Bement
.M/S: 431 Phone: 804-864- 7084

1. Task Order Number GK13	Revision
Title: Computer operations support of the CERES Project/TRMM and EOS-AM Spacecraft.	

2. Background of work to be performed:

The Clouds and Earth Radiant Energy System (CERES) Project is responsible for the development, spacecraft integration and testing (I&T), deployment and initial in-orbit operation of CERES instrument. The CERES instrument is a broadband scanning radiometer with the capability of operating in either a cross track scan mode or a biaxial scan mode. The CERES instrument provides data on the Earth and atmospheric radiation budget from the top of the atmosphere to the surface of the Earth. The CERES instruments are improved and modified versions of the Earth and Radiation Budget Satellite (ERBS). The CERES instruments will provide three spectral channels over the range of 0.3 to 50.0 micrometers. The CERES Protoflight Model (PFM) instrument has been delivered to GSFC and integrated on to the Tropical Rainfall Measurement Mission (TRMM) spacecraft for system verification and pre-launch environmental testing. Also, the CERES Instruments, Flight Model (FM) 1 and FM2, have been delivered to Lockheed Martin Missles Systems (LMMS) and integrated on to the Earth Observatory System-AM (EOS-AM) spacecraft for system verification and pre-launch environmental testing. The TRMM spacecraft is scheduled for launch in November 1997 and the EOS-AM spacecraft is scheduled for launch in June 1998.

The Contractor shall be responsible for all of the CERES instrument's computer operations performance during verification, flight readiness and health operations testing. This is done essentially by assisting in the development of executing procedures; and, managing software and hardware configuration changes. This task will be completed in a manner to allow proper operation and monitoring of the CERES Instrument Ground Support Equipment (IGSE) and thereby the CERES instrument which will permit the collection of information defining and verifying the CERES instrument performance. The instruments' performance requirements are defined via engineering documentation furnished by the manufacturer, TRW. The IGSE consists of an Instrument Interface Station (IIS) and a Test Operators Station (TOS) which allow operation of the CERES instrument either directly or through the TRMM Project's Spacecraft Ground Support Equipment (SGSE). These interfaced systems are shown in Figures 1 and 2. Additionally, as part of the IGSE, there is an Interface Simulation Unit (ISU) which is used to test the IIS to CERES interface prior to connection. The subtasks specified herein are to be performed throughout the entire period of integrating the CERES instrument to the TRMM Spacecraft, during the pre-flight environmental tests and launch readiness operations.

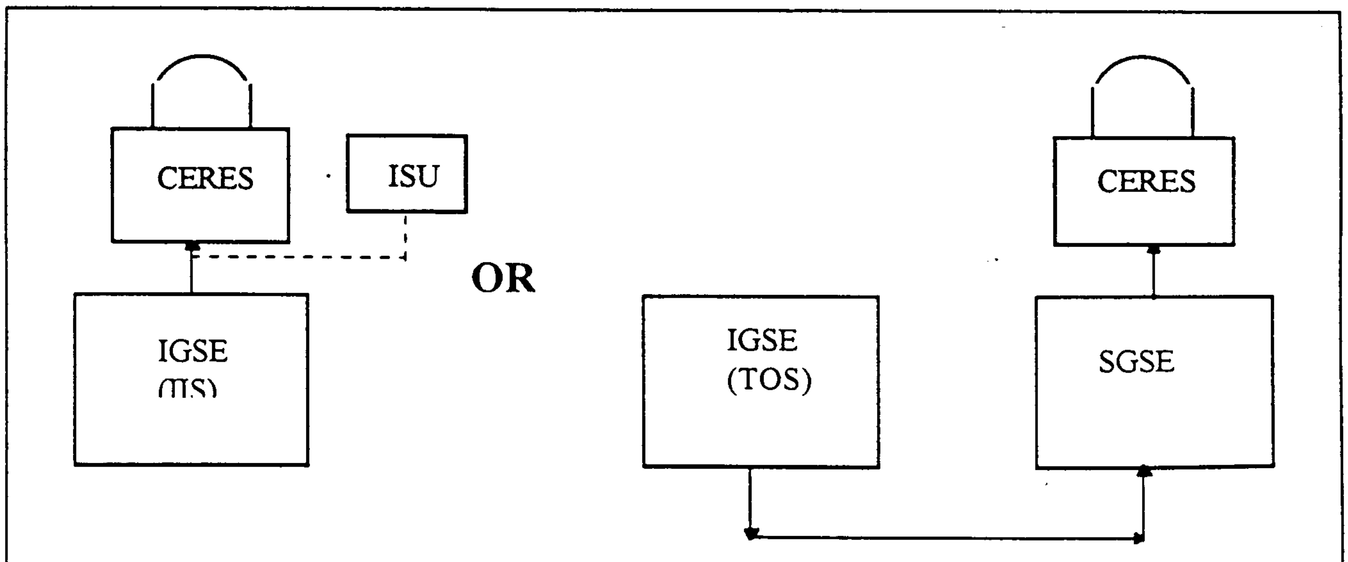


Figure 1: CERES PFM instrument GSE configurations

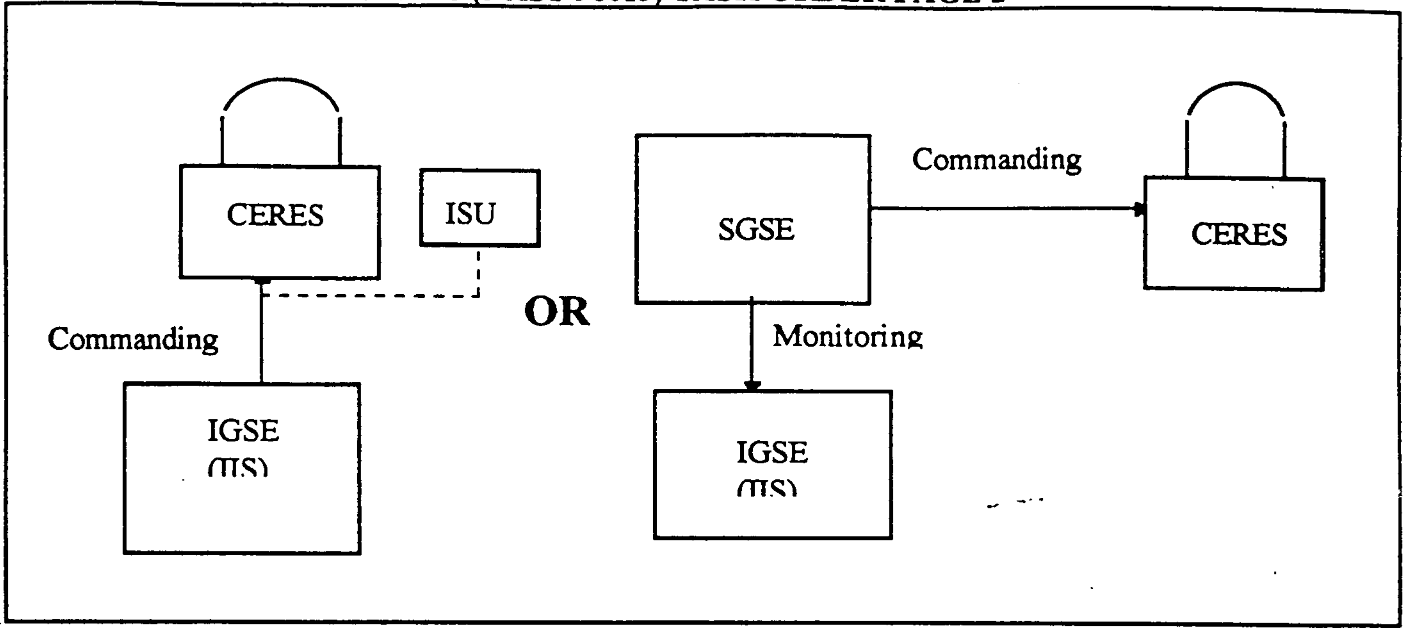


Figure 2: CERES FM1 & FM2 instruments GSE configurations

3. Task description:

The Contractor Shall perform BCU lifecycle configuration and maintenance under the task definition of the CERES software manager. This task shall include but not be limited to the following lifecycle support subtasks:

a. BCU documentation review.
b. BCU computer and software configuration maintenance .
c. Initiate and maintain a hardware and software configuration log indexed by BCU platform. This shall include all software and operating systems residing on the BCU platform.
d. BCU external interface configuration.
e. Investigate and resolve BCU computer or software anomalies.
f. Initiate and maintain a BCU Anomaly Log indexed by BCU platform and anomaly type.

Schedule time table:

See the attached schedules.

Deliverables:

Configuration log, anomaly log, documentation revisions and monthly reports.

Metrics:

1. Satisfactory effort:

Provide a monthly report by the first Monday of the month. The report shall include a summary of activity and operational status of all BCU workstations to include software releases and anomaly reports.

2. Exceeds effort:

Provide a monthly report described above earlier than the first Monday of the month. Include suggestions to better manage BCU configurations and provide user support.

4. **Other Information:**

1. Electro-Static Discharge (ESD) certification is required to handle the instrument and IGSE.

2. The IGSE is flight critical hardware and subject to established NASA and CERES Product Assurance Policies and Plans.
3. Adherence to contamination control policy and procedures is required to support space flight cleanroom CERES instrument operations.
4. All of the CERES operational test procedures will be approved by the CERES Project prior to execution.
5. All tests will be scheduled with and coordinated through the CERES Project for both GSFC/TRMM and LMMS/EOS-AM.

5. **Government Furnished items:**

1. Access to a 486 computer or better and software as required to develop and modify above mentioned logistics records and reports. The software will include DOS 3.1 or better, Windows 3.1 or better, Microsoft Office with Word 6.0 and Excel 5.0, Eudora and PC/TCP. This will be the minimum software provided; however, the CERES Project may provide other software as determined necessary by the Contractor to support this task.

2. Access to the CERES IGSE hardware and the TRW and CERES Project documentation as required for record keeping and to monitoring the scheduled of certification maintenance. This equipment may also be used on a non test interference basis for data analysis, operator training, evaluation of new procedures and troubleshooting of anomalies as they may occur. Use of the CERES IGSE and MGSE shall be scheduled and coordinated through the CERES Project.

6. **Security:** None Required.

7. **Travel:**

Periodic trips to GSFC, LMMS and Japan are expected to conduct this task. The attached schedule defines the dates and times of the operation. Note: These trips may be scheduled to coincide with instrument operation activities in order to control travel costs.

8. **Period of performance:**

1. Planned start date: May 1, 1997
2. Expected completion date: April 31, 1998

9. **NASA Technical Monitor**

Charles E. Jenkins Jr. M/S 431 Phone 804-864-7080

EOS-AM Schedule
FM1 FM2 CERES Instruments
5/27/97

1	EOS AM I&T	388	3/19/97	8/25/98		
2	Badging, SIS Training	1	3/19/97	3/19/97	2TC,2TO,2QA,TPE,2C.B.K.	
3	Delivery and Bat testing	3	3/20/97	3/22/97	2TC,2TO,2QA,TPE,2C.B.K.	
4	Pre-Integration az 0 ref test	1	3/22/97	3/22/97	TPE,C,QA,TC,OM	
5	AZ zero stop fix. test	1	3/26/97	3/26/97	TPE,C,TC,QA	
6	FM1 & 2 mech. Integ. to AM	2	3/26/97	3/27/97	2C,TPE,TO,TC,QA	
7	FM1 & FM2 elect. Integ. to AM	4	4/16/97	4/21/97	2C,TPE,QA,TC,TO	
8	Abbreviated Functional Test	4	4/21/97	4/24/97	C,2TC,2TO	
9	Abbreviated Functional Test	4	4/25/97	4/30/97	C,Vogler,Estes	
10	SC Compatability Test	10	7/8/97	7/19/97	C,2TC,4TO	
11	TDRSS Compatibility test 2-shifts	11	8/4/97	8/16/97	C,2TC,4TO	
12	SC Compatability test 2-shifts	11	9/2/97	9/16/97	2TC,C,4TO	
13	T/V Blancket Install. 2-shifts	8	9/16/97	9/25/97	C,2TC,4TO	
14	EMC test 2-shifts	7	9/26/97	10/5/97	C,2TC,4TO	
15	T/Vac prep. 2-shifts	18	10/5/97	10/25/97	C,2TC,4TO	
16	T/Vac & T/Bal test 3-shifts	32	10/26/97	12/8/97	C,3TC,6TO	
17	SC Functional test 2-shifts	6	12/15/97	12/22/97	C,2TC,4TO	
18	Alignment verification 2-shifts	6	12/31/97	1/7/98	C,2TC,4TO	
19	Acqustic test 2-shifts	7	1/15/98	1/23/98	C,2TC,4TO	
20	SC Functional test 2-shifts	8	1/20/98	1/29/98	C,2TC,4TO	
21	Alignment verification 2-shifts	2	1/30/98	1/31/98	C,2TC,4TO	
22	Pyro test 2-shifts	6	2/8/98	2/13/98	C,TC,2TO	
23	Alignment verification 2-shifts	6	2/19/98	2/25/98	C,2TC,4TO	
24	SC CPT 100 hrs. operation 3-shifts	11	3/1/98	3/13/98	C,3TC,6TO	
25	SC ground sys. test 2-shifts	2	3/14/98	3/16/98	C,2TC,4TO	
26	SC mass properties test 2-shifts	4	3/24/98	3/27/98	C,2TC,4TO	
27	Prep. for shipment 2-shifts	3	3/31/98	4/2/98	C,2TC,4TO	
28	SC pre-ship review	1	4/2/98	4/2/98	C	
29	Contingency	33	4/2/98	5/18/98		
30	SC ship to Vandenburg	2	4/3/98	4/6/98	C	
31	Launch Site Operations	57	5/4/98	7/21/98	2C,2TC,4TO	
32	Launch, Vandenburg, AFB	1	6/29/98	6/29/98	C,2TO,2TC	
33	Post launch ops./GSFC	7	6/29/98	7/7/98	C,TC	
34	Open doors	3	8/5/98	8/7/98	C,TC	
35	Deep space manuver	3	8/21/98	8/25/98	C,TC	

TRMM Schedule
CERES PFM Instrument
5/27/97

110	GSE Troubleshho & Repair	3	4/29/97	5/1/97	J. Donaldson
111	CPT #3, 3 Shifts; Sa, Su	6	4/28/97	5/3/97	QA,2TC,2TO,C-Hickman
112	CPT #3, 3 Shifts; Sa, Su	2	5/5/97	5/6/97	QA,C-Beatty,2TC,2TO
113	End to End Mission Sim #2; 3 Shifts	4	5/7/97	5/10/97	QA,C-Beatty,2TC,2TO
114	PFM Internal cleaning	1	5/13/97	5/13/97	TC,TO,B.Killough,C-Jenkins
115	PFM MLI repair	1	5/13/97	5/13/97	TC,TO,B.Killough,C-Jenkins
116	PFM alignment- 2nd shift	1	5/13/97	5/13/97	TC,TO,P.Brown,C-Jenkins
117	NASDA Training	1	5/23/97	5/23/97	I&T Suppport Team/Launch
118	CPT #4, 3 Shifts	7	6/2/97	6/8/97	3TC,3TO,C-Hickman
119	Mission Sim #3; 3 Shifts2..contigent	4	6/10/97	6/13/97	3TC,3TO,C-Beatty
120	I&T Schedule Contingency; 2 Holidays	54	6/14/97	8/9/97	As required
121	Pack EGSE for Shipment	5	6/16/97	6/20/97	C,TC,TO,QA
122	Pack MGSE for Shipment	5	6/15/97	6/19/97	
123	Ship GSE to Japan	42	6/26/97	8/9/97	
124	Transportation Meeting	1	7/8/97	7/8/97	
125	Launch Site I&T	90	8/1/97	10/29/97	
126	PSRR	2	8/6/97	8/7/97	
127	OBS Delivered to Launch Site	18	8/9/97	8/26/97	
128	GSE Shipm. Contingency	3	8/13/97	8/15/97	
129	Ship OBS to Japan	1	8/13/97	8/13/97	
130	Launch Site CPT IGSE set-up/Japan	5	9/5/97	9/9/97	C,TC,TO
131	Launch site CPT/Japan	11	9/10/97	9/20/97	C,2TC,2TO
132	Red/Grn tag, Alive test & launch/Japan	20	10/13/97	11/1/97	C,TC,TO
133	Aliveness test /GSFC	1	10/22/97	10/22/97	C,TC,TO
134	Launch Readiness Review/Japan	2	11/1/97	11/1/97	C,TC
135	Post Launch Support @GSFC	5	11/1/97	11/5/97	C,TC,TO
136	Main door open @ GSFC	3	12/1/97	12/3/97	C,TC,TO
137	Deep Space Manuver @ GSFC	3	12/8/97	12/10/97	C,TC,TO

SAERS (NAS1-96013) Task Order Page 1

1. **Task Order Number::** GK14 **Revision:** _____ **Date of Revision:**_
   Title: Deployable Lidar Telescope Test article.

2. **Purpose, Objective or Background of Work to be Performed:**
   Provide Engineering design and development of high precision mechanisms in support of Langley's precision deployment technology program currently funded under the Origins Product Integration Team (RTA 632-10-14-40). Origins PIT program is responsible for advancing high precision deployment technology for application to next generation space science missions such as the Next Generation Space Telescope (NGST). The specific objectives of the work to be performed under the present task are to: 1) develop a new high-precision latch mechanism for deployable structures; and 2) aide in the development of a preliminary design of a deployable lidar telescope.

3. **Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):**
   The contractor will design and develop a high precision prototype latch mechanism for application to a general class of precision deployable structures. Also, the contractor will aid in the development of a preliminary design for a deployable lidar telescope. All delivered items shall be readily useable by civil service personnel for testing or design modification of electronic developed drawings for design optimization. The designs shall be prepared with the Pro-Engineer CAD source code. Paper and electronic copies of engineering and assembly drawings representing 'as-built' condition of delivered hardware shall also be deliverables. All hardware will be purchased from vendors or manufactured by the U.S government per contractor specifications. The contractor will deliver final mechanism assemblies and aid in the integration of these assemblies into component test apparatus and/or structural testbeds.

3.1. ***PERFORMANCE:***
Performance will vary from "Minimally Acceptable (MA) to Substantially Exceeds (SE)" ratings based on the ability to meet the performance metric targets for deliverables 3.2.1, 3.2.2, 3.2.3, and the following criteria:

3.1.1. Ability to meet delivery schedules for all mechanism assemblies. Delivery within two weeks of stated milestones will constitute "MA" and delivery two weeks ahead of schedule will constitute "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control. Delivery schedule deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2. Manufacturability of designed components per contractor-generated engineering detail drawings.

3.1.3. Ability of final release engineering detailed drawings to describe accurately 'as-built-condition' of delivered components and assemblies. 40 hours of engineering drafting required to make final release drawing in full compliance with "as-built-condition" shall constitute "MA" and 6 hours of required changes shall constitute "SE" rating.

3.1.4. Ability to complete all test activities with delivered test setup. 70% completion of tests will constitute "MA" and 95% percent will constitute "SE".

3.2. ***DELIVERABLES:***

The listed items shall constitute the specific deliverables for this task.

DELIVERABLE	DATE
3.2.1. *Design and develop a zero-freeplay, micron-repeatable latch joint*	10/31/97

The contractor is to complete the design and development for an end-of-deployment latch joint for general application to precision deployable structures. The latch is to be axisymmetric in design and incorporate conical interfaces separated by an annular array of needle or ball bearings. The contractor is to generate three copies of the mechanism assemblies for component testing and retrofitting into existing truss hardware.

⟨ PERFORMANCE METRIC: The joint should exhibit no more than 3% hysteresis in response to quasi-static extensional load-cycling.

3.2.2. *Aid in development of a preliminary design of a deployable lidar telescope*	10/31/97

The contractor is to support the preliminary design of a deployable lidar telescope by: 1) adapting the design of existing precision hinge and latch mechanisms into a deployable metering truss assembly under development by an industry contractor, and 2) developing a prelimiary design for an adjustable flexure mount for interfacing reflector panels to the deployable telescope truss. The contractor shall develop drawings to detail the mechanism designs, and provide interface requirements for the incorporation of these mechanisms into the deployable telescope assembly.

PERFORMANCE METRICS:

⟨ The adjustable flexure should allow at least 1 mm of linear adjustment with a resolution of 1 micron.

⟨ The adapted mechanism designs should retain all salient features of existing proven designs and exhibit no more than 3% hysteresis in response to quasi-static extensional load-cycling.

4. Government Furnished Items:
Government Furnished Property and software will be furnished for the design, fabrication and testing of the deliverable items.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:
None.

7. Period of Performance	
Planned start date: 08/01/1997	Expected completion date: 10/31/1997

8. NASA Technical Monitor:	
.M/S: William M. Berrios	Phone: 757-864-7183

1. Task Order Number: ~~GL-001~~ 01 Revision:
Title: **LASE DPS and CDS/DRS Subsystem Maintenance and Deployment Operations**

2. Purpose, Objective or Background of Work to be Performed:
The Lidar Atmospheric Sensing Experiment (LASE) project is an aircraft-based active-sensor system which completed its field validation in September, 1995. Major upgrades are being completed to the Instrument Control Computer, Monitor and Command Computer and Data Processing Computer. LASE is now being utilized as an operational field experiment, participating in one to two field deployments per year. The present goal is to participate in the successful deployment of LASE aboard the P-3 aircraft from the WFF (Wallops Flight Facility) during the months of June and July, and subsequently return the equipment to LaRC in preparation for future deployments.

The instrument normally consists of four subsystems: laser, telescope, thermal control, and CDS/DRS aboard the ER-2, but on the P-3 the thermal control will be done using a NESLAB chillier. The CDS (Control and Data-Acquisition Subsystem) is the central computer (Intel 486 DX4) controlling the autonomous operation of the instrument, and includes a Data Recorder System (DRS). The CDS/DRS Ground Support Equipment (GSE) includes a Laptop Computer and several interface simulators. Also supporting instrument operations is a Data Processing Station (DPS), an Alpha powered VAX-based computer system which receives, processes, displays, and archives data from the instrument. The hardware involved in this task include the CDS/DRS (see attachment) and its associated support equipment, and the DPS. **Attachments:**
1. CDS/DRS Block Diagram
2. Test and Operations Schedule

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):
<u>Listing of Subtasks</u>:
1. Complete the assemble of and test of the PC-Based CDS computer subsystem and the connecting interfaces per the CDS/DRS Block Diagram.

2. Prepare the CDS/DRS, GSE, and DPS for shipment to WFF. After arrival at WFF; install/connect the electrical interfaces (power and data) of the LASE Instrument to the P-3 aircraft and ensure the LASE CDS/DRS is ready to support checkout testing for flight.

3, Maintain the LASE CDS/DRS flight and flight-backup hardware, its associated GSE, and the Data Processing Station such that they are ready/available to support each scheduled flight during the field deployment to Wallops Flight Facility and Oklahoma City in June and July 1997. Note: this includes hardware only; all software is maintained by NASA. Contractor shall monitor all system failures or anomalies, determine cause, and recommend corrective action for Government approval. Once aproved, contractor shall implement repairs. The contractor shall proceed if approval is not provided within three working days.

4. Ensure all hardware is functioning properly during flights and instrument tests, including monitor performance via the DPS, CDS, GSE display, or Laptop terminal during test and flight operations and identify, report, and repair failures and anomalous functioning. Contractor shall mintain system "ready" to support flight, including monitor all system failures or anomalies, determine cause, and recommend corrective action. Once aproved, contractor shall implement repairs. The contractor shall proceed if approval is not provided within two working days.

5. Operate hardware in support of scheduled lab test and flight operations schedules (refer to attachment).Specifically
   a. Operate the CDS/DRS through GSE control by government-provided procedures.
   b. Operate the DPS in support of instrument lab and flight operations by government-provided procedures.
      - During real-time lab and hangar operations (Network).
      - During real-time flight operations (Network).
      - During post-test and post-flight data processing activities.
   c. Download data from the DRS to the DPS by government-provided procedure following each test or flight.
   d. Process and archive all real-time and downloaded data by government-provided procedure immediately following acquisition of the data.

6. Maintain government-provided logbooks and related documentation in accordance with established NASA Product Assurance requirementsd detailing operational history, significant events, and failures and anomalous behavior and their dispositions

7. Prepare the CDS/DRS, GSE, and DPS for shipment back to LaRC. Unpack, reassemble and demonstrate fully operational in the lab within 3 weeks of receipt at LaRC.

Planned Schedule (1997):
Critical Milestones:

- June 9: All flight hardware ready to integrate the instrument onto the aircraft. GSE, DPS ready to support aircraft integration tests.
- June 17: CDS/DRS, GSE, and DPS ready for first deployment flight.
- June 18 - July 18: 20 flights of approximately 3 hours duration each. (Review of flight and test results between each flight.)
- July 25: All hardware ready for shipment back to LaRC.
- August 15: All hardware operational in lab and ready to support another deployment. All documentation completed and procedures/checklists updated.

Deliverable Documentation:
1. Complete and up-to-date logbooks for all flight and ground-support equipment.
2. Complete deployment procedures and checklists covering all aspects of this work.

Reports/Status Reviews:
1. Make available government-provided hardware logbooks for weekly review.
2. Report weekly at the LASE Project Status Meeting, presenting written status of flight and ground hardware, documentation, and procedures.
3. Report flight and ground hardware status at daily informal reviews during deployment.

Performance Standards and Evaluation Criteria:

Meets:
1. One complete set of CDS/DRS, GSE and DPS hardware available and fully functional to support each scheduled test and flight. For any hardware not available and fully functional, work-arounds are provided which prevent major schedule milestone delays or loss or compromising of flight data.
2. All hardware logbooks are maintained complete and up-to-date, within 48 hours, detailing all operations of and modifications to the hardware.
3.

Exceeds:
1. Improvements are made to the hardware or procedures which decrease the turn-around time of the instrument between flights, or significantly reduce the overall cost of a deployment. These improvements must in no way compromise the actual or perceived

health, safety, or performance of the instrument.
2. Performance of all task activities are consistently and reliably completed ahead of schedule, without increasing the of the deployment nor decreasing the government's confidence in the operational readiness of the hardware.
3. Expedite identification and resolution of problems or repairs.

4. Government Furnished Items:

- The following items are unique to the LASE Project and will be available for use:
  1. All flight hardware and GSE, and supporting documentation. This includes complete as-built mechanical and electrical drawings.
  2. All logbooks, which contain examples of entries from previous deployments.
  3. All operational procedures and checklists.
  4. All shipping containers.
  5. All existing special test equipment (e.g. LASE unique simulators and "breakout" boxes).
  6. Two Connex Containers, 1 for storage and 1 equipped/furnished as a Lab
- Access will be available to standard tools and lab test equipment (e.g. meters and o'scopes).
- All hardware and support equipment will be operational at WFF by June 16.
- Laboratory facilities are available in room 222 of building 1202.

5. Other information needed for performance of task.
Government to ship equipment from WFF to Langley within 7 days of completion of deployment activities.
Requirements:
All flight hardware repair and modification to be done by NASA flight wiring and soldering certified personnel.
Travel: One trip to NASA's Wallops Flight Facility for up to 10 days and One trip to Oklahoma City for up to 30 days.
Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC.
Test Procedures: All equipment checkout and test to be conducted following Project generated and approved procedures.
Product Assurance: All special tests, modifications, repairs and documentation to be done in accordance with established Project Product Assurance Plans and Procedures.
Equipment Handling: All disassembly, packing, unpacking and reassembly to follow Project generated and approved procedures.

6. Security clearance required for performance of work: None Required

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: Aug. 15, 1997

8. NASA Technical Monitor: A. S. Moore (LPO/SPO)
M/S: 472 Phone: 804-864-7094

SAERS Task Order

1. Task Order Number and Title Title: **Development of HydroStar Test-Bed**	Number: ~~GL002~~ GLC2	Revision:

2. Purpose, Objective or Background of Work to be Performed:
The objective of this task is to develop a functional hardware model ("test-bed") of a correlation radiometer receiver. This "test-bed" will include two channels of a synthetic aperture radiometer system. This system will provide I/Q demodulation and correlation of two nominally 20 MHz narrow band noise sources centered at 1.414 GHz. In addition, an IF output port will be provided to allow testing of alternative detection schemes. A subsystem block diagram is attached (TESTBED.DOC).

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements):

1. <u>Design, development and testing of RF/IF Down Converter Assembly</u>

The contractor shall complete development of an RF/IF Down Converter Assembly (DCA), more specifically, develop a detailed design and layout for the I/Q Detection Subsystem of an existing, but incomplete, RF/IF DCA. This shall include component selection, component layout, signal distribution and connector definition, and enclosure concept/design. The Contractor shall present the design to a Government team for review. Once design is approved by the Technical Monitor, the Contractor shall fabricate the I/Q Detection Subsystem, integrate it into the RF/IF DCA, and test the complete assembly.

There are at present six interfaces to the RF/IF DCA: RF input, Analog I/Q output, IF output, local oscillator input, digital control, and power input. The present definitions of these interfaces are included below. The RF/IF DCA and the above I/Q Detection Subsystem shall meet the following overall specifications:

System / Assembly Specifications:

RF center frequency 1.414 GHz
Input Bandwidth 20 MHz (3dB)
Image Rejection >40dB
IF center frequency 48 MHz
IF Bandwidth 20 MHz
Analog I/Q output: Bandwidth 10 MHz
Amplitude error +/- 1.0 dB max
Phase error +/- 2.0 deg max

Input Specification:

The input is a narrow band noise centered at 1.414 GHz with 25 MHz (nominal) bandwidth. The input noise power may vary from nominally 30 to 40 dB ENR. The input will be a 50Ω impedance coaxial line.

I/Q output Specification:

Impedance:	50 Ω
VSWR:	<2:1
Bandwidth:	dc to 10 MHz (3dB)
Power level:	8 dBm at 48 MHz for 0 dB ENR (300 K) input (nominal) TBR

connector: TBD
Amplitude error +/- 1.0 dB max
Phase error +/- 2.0 deg max

IF Output Specification:

Impedance: 50 Ω
IF Frequency: 48 MHz
Bandwidth: 20 MHz
VSWR: <2:1
Power level: -3 dBm at 48 MHz for 0 dB ENR (300 K) input (nominal) TBR

Local Oscillator Input:

Impedance: 50 Ω
VSWR: <2:1-
Frequency: 1462 MHz
Power level: 10 dBm

2. Design, development and testing of an analog correlator subsystem.
The contractor shall design a two channel analog correlator. This correlator shall be compatible with the Analog I/Q output of Subtask1 and will provide estimates of the "Cross Power" and "Quadrature Cross Power". That is, four output signals shall be provided which represent the following products $I_1 * I_2$, $Q_1 * Q_2$, $I_1 * Q_2$, and $Q_1 * I_2$. The analog correlator shall include a dc offset adjust prior to the multiplication to allow correction of system offsets. This offset adjust will provide ±1.0 V (TBR) adjustment range at least ± 10 mV adjustment range must be controlled by an externally applied voltage. The remaining offset adjustment range may be provided via a manual on board adjustment (TBR). The Contractor shall develop and present to the TM a subsystem functional test plan. The Contractor shall present the design and test plan to a Government team for review. Once the design is approved by the Technical Monitor, the contractor shall fabricate and test the Analog Correlator.

Output Specification: (four outputs $I_1 * I_2$, $Q_1 * Q_2$, $I_1 * Q_2$, and $Q_1 * I_2$)

Bandwidth: 100 Hz (3dB)
40dB attenuation at 1 KHz
Voltage Range ± 5.0 V
Output Impedance < 10 Ω
Resulting indicated phase error:
Phase Error = Differential Phase at IF - $\arctan\{(I_1 * Q_2 - Q_1 * I_2) / (I_1 * I_2 + Q_1 * Q_2)\}$
Maximum error (Peak to peak over +/- 180 deg): +/- 1 deg

3. System Integration, testing, and characterization.
The contractor shall perform system integration. The contractor shall develop and present to the TM a test plan to verify system meets all system requirements. Upon approval of the test plan the contractor shall complete all subsystem and system testing and document system performance

Deliverables:

Subtask 1.
1. Design and Test Plan review by 6/1/97.
2. Subsystem design report/documentation 30 days after approval to fab, including the following:
   - Subsystem Requirements
   - Design concept
   - Detailed subsystem specification
   - Detailed subsystem design - "as built" drawings
   - Subsystem parts list and hardware requirements
3. Working hardware at end of task

Subtask 2.
1. Design and Test Plan review by 6/1/97.
2. Preliminary design documentation by 6/1/97, including theory of operation, circuit drawing, interface requirements, connector definition, and parts list
3. Subsystem design report/documentation 30 days after approval to fab, including the following:
   - Subsystem Requirements
   - Design concept
   - Detailed subsystem specification
   - Detailed subsystem design - "as built" drawings
   - Subsystem parts list and hardware requirements
4. Working hardware at end of task

Subtask 3.
1. Proposed test plan for system level functional testing, including description of all test objectives, test setup, and any special test equipment or special considerations. by 7/15/97
2. Preliminary test report of functional testing 75 days after plan approval, including a description of all test completed along with any "red lines" or changes to the test plan, a description of the data set collect for each test, preliminary system test results and subsystem test results, i.e.
   - Test data verifying RF/IF DCA functional performance.
   - Test data verifying Analog Correlator functional performance.
3. Final Test report by 12/1/97, including the following:
   - System block diagram
   - "As tested" design drawings and documentation, including schematics, wiring diagrams, and parts lists
   - Test data verifying RF/IF DCA performance.
   - Test data verifying Analog Correlator performance
   - Test objects / goals and how they demonstrate system requirements

General
Monthly informal written or oral report of status to TM including major accomplishments or events of previous month and plans for following month by 5th day of month.

Metrics for Deliverables:

Subtask 1.
Meets:
Design review and report completed on schedule and working hardware meeting all specification as shown by results of Government approved testing or with minor Government approved variances which do not impact system performance.
Exceeds:
Design review and report completed on schedule and working hardware which exceeds specifications for I/Q balance as indicated below and meets all other specification as shown by results of Government approved testing or with minor Government approved

variances which do not impact system performance.
- Amplitude error <+/- 0.2 dB max
- Phase error +/- 1.0 deg max

Subtask 2.
Meets:
Design review and preliminary design documentation completed on schedule.
Design report completed on schedule and working hardware meeting all specification as shown by results of Government approved testing or with minor Government approved variances which do not impact system performance.
Exceeds:
Design report completed on schedule and working hardware which exceeds specification for maximum phase error (<+/- 0.5 deg max) as defined in Subtask 2 and meets all other specification as shown by results of Government approved testing or with minor Government approved variances which do not impact system performance.

Subtask 3.
Meets:
Test plan completed on schedule.
Preliminary test report completed on schedule.

Exceeds:
Test plan completed two weeks ahead of schedule.
Preliminary test report completed two weeks ahead of schedule.
Final test report completed two weeks ahead of schedule.

4. Government Furnished Items:
- Use of room and all test equipment located in 237 of building 1299, including local oscillator, Narrowband L-Band noise source, and data acquisition system.
- RF/IF Down Converter Assembly, including documentation

5. Other information needed for performance of task.
- All parts identified in subtask 1 and 3 may be provided by LaRC.
- All mechanical fabrication and assembly may be provided by LaRC.

6. Security clearance required for performance of work:
None

7. Period of Performance:	
Planned start date: 5/1/97	Expected completion date: 12/1/97

8. NASA Technical Monitor: Tom Shull
M/S: Phone: 804-864-1837

SAERS (NAS1-96013) Task Order

1. Task Order Number:: ~~GL003~~ GL03 Revision: ____ Date of Revision:

   Title: **CERES Interface Documentation Review**

2. Purpose, Objective, or Background of Work to be Performed:

The Clouds and Earth's Radiant Energy System (CERES) instrument is a broadband, scanning radiometer with three science channels for the measurement of both reflected and emitted energy from the Earth. CERES is part of NASA's Earth Observing System (EOS) program, an element of the Mission to Planet Earth Enterprize. The proto-flight model (PFM) of CERES was delivered to the Goddard Spaceflight Center (GSFC) in October of 1995, and mounted on the Tropical Rainfall Measurement Mission (TRMM) spacecraft in January of 1996. The CERES PFM is currently undergoing spacecraft-level testing.

Two more CERES units, known as Flight Model-1 (FM-1) and Flight Model-2 (FM-2), are currently being built for the upcoming EOS-AM mission, scheduled to launch in mid-1998. Flight Models -3 and -4 are planned for the flight on the EOS-PM mission. All of the Flight Models (-1 through -4) will be virtually identical to the PFM except for the power and instrument-to-spacecraft interface electronics. Spacecraft electrical interface requirements that all CERES units must meet are published by each respective spacecraft manufacturer. These interface requirements documents are revised from time to time (once a year on average) as the spacecraft design matures. The purpose of the work to be performed is to help ensure that the CERES instruments meet the electrical interface requirements for a given spacecraft. The goal of the work to be performed is to identify all discrepancies (i.e. "non-compliances") between the CERES instrument interface electronics and the electrical interface requirements for a given spacecraft, and to document and track these discrepancies until they are resolved by the Government Project Team.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements):

Task:
The contractor shall review all Government provided (see section 4.) spacecraft interface documentation that levies electrical interface requirements on the CERES instrument and review Government provided CERES electrical interface drawings or schematics (any of which are subject to revision approximately four times a year) and related CERES documentation, e.g. handouts or minutes of various meetings (up to one a month). The contractor shall subsequently identify, generate, and maintain a "status list" of all CERES electrical interface non-compliances and a list of all spacecraft electrical interface changes. Each non-compliance shall be listed, tracked, and the updated status reported (deliverable a.) until the non-compliance has been resolved by NASA and/or the spacecraft/instrument contractors, at which time it shall be clearly marked as "closed". In addition contractor shall attend (up to four) Government designated Interface TIMs (Technical Interchange Meetings) for the purpose of identifying, tracking, and supporting resolution of non-compliances.

Deliverables for the Task:
a. The status list of all the CERES electrical interface non-compliances found by the contractor, including those non-compliances which may be in dispute between the instrument and the spacecraft contractors. This list shall include the current status of and/or the final resolution of each non-compliance. There shall be one such list for each of the three spacecraft on which CERES will fly. (An example of such a status list for the TRMM and EOS-AM spacecraft is attached.)

b. A list of all electrical interface changes or differences (if any) found by the contractor between a previous spacecraft interface document revision and the current revision.

c. An ongoing "document review status" list for all spacecraft electrical interface documentation, which have been, are being, or will be reviewed. This list shall include the document name, the document review deadline to meet the spacecraft/CERES project schedules, and when the document review comments (i.e. deliverables a. and b. above) were actually delivered to the TM. (An example of such a list for the TRMM and EOS-AM spacecraft is attached.)

NOTE: All deliverables shall be available to the TM in both paper and electronic form (disk or email).

Schedule of Deliverables for the Task:

a. The updated status list of all current CERES electrical interface non-compliances shall be updated and delivered to the Task Manager (TM) by the end of each month. (One list per spacecraft)

b. The list of differences between the previous and the current revisions of a spacecraft interface document shall be delivered to the TM not less than 30 days after receipt (by the contractor) of the latest revision of a given document.

c. The document review status list shall be delivered to the TM by the end of each month. (One list for all spacecraft documentation reviewed.)

Performance Measurements for the Task:

Meets:

a. Deliverables received in accordance with the 'Schedule of Deliverables for the Task '.

b. Deliverables contain all the specified elements as given in the 'Deliverables for the Task'.

c. Deliverables complete and accurate (based on spot-checks and/or complete reviews of select documentation by the TM).

Exceeds:

a. More "subtle" or second order, i.e. requiring inference or analysis by the contractor, non-compliances found such as:

- In-rush currents will exceed specified limits based on an analysis of the instrument power supply.
- Digital interface signals will not operate reliably due to an inadequate voltage margin based on an analysis of the instrument interface electronics.

b. Suggest feasible solutions to electrical interface non-compliances.

4. Government Furnished Items:

a. Spacecraft electrical interface documentation as it becomes available. (Typical document listing for the TRMM and EOS-AM spacecraft is attached.)

b. Access to the latest CERES interface electronics drawings and all CERES contractor documentation available to NASA, pertaining to the instrument-to-spacecraft interface. Contractor may make copies.

c. Limited access to PC workstation, scheduled through Task Monitor.

5. Other information needed for performance of task.

Travel:
2 trips to TRW, Redondo Beach, CA for 4 days/trip and 2 trips to GSFC, Greenbelt, MD for 2 days/trip to attend spacecraft interface meetings (TIMs).

6. Security clearance needed for performance of task.

None required

7. Period of Performance:

Planned start date: April 1, 1997 Expected completion date: March 30, 1998

8. NASA Technical Monitor: Michael S. Grant
M/S: 488 Phone: 804-864-3707

Attachment to SAERS Task "**CERES Interface Documentation Review**"

STATUS UPDATE

3/13/96

TRMM ISSUES

ICD SCOOP PROOF INTERFACE CONNECTORS

REQUIRED ACTION: CCR to TRMM ICD.

STATUS: At the 9/19/94 EMC Telecon, Chuck Chidekel agreed to generate a CCR to remove the TRMM ICD requirement for "Scoop Proof Connectors" on the instrument to spacecraft interface. Fred Grena indicated that he would include this change to the update version of the ICD. The proposed change pages to the ICD (IN270 dated 3/18/95) shows that removal of the "scoop proof connector" requirement from the ICD is in progress.

STATUS UPDATE (3/13/96): Closed. TRMM ICD Rev A (6/14/95) documents that the requirement for Scoop Proof connectors has been removed from the ICD.

DOC TRMM CERES ELECTRICAL INTEGRATION PROCEDURE

STATUS: The TRMM CERES Electrical Integration Procedure (7/17/95) updated version (Draft #3) was completed and released to GSFC on 7/18/95. This version incorporates comments and suggestions from Chuck Chidekel (GSFC), experiences from the recent SIS to CERES Integration at TRW, and corrections for some clerical and typographical errors. GSFC will develop their first draft of the procedure from this updated LaRC version and provide review copies to LaRC and TRW before generating the final version of the procedure.
STATUS UPDATE (3/13/96): Closed. The GSFC Electrical Integration Procedure has been completed and the TRMM PFM has been electrically integrated with the TRMM spacecraft.

131 EMC TEST BW CHANGE

REQUIRED ACTION: Waiver to TRMM ICD, or Signed Update ICD

STATUS: Fred Grena at GSFC (Mcdonald Douglas) reported that a waiver to the TRMM ICD will be needed to officially change the EMC test bandwidths for CE01 and RE02. The required waiver request was submitted to the project office on 1/19/95. LaRC memo for ICD change request was submitted 3/29/95.
STATUS UPDATE (3/13/96): This change was not included in the TRMM ICD Rev A (6/14/95). After checking, I received a verbal response from Chris Savinell (via Leonard Kopia) on 9/11/95 that a later release of ICD Rev A has this change included. I have not yet received a copy of the updated ICD Rev A.

132 TRMM PWR CONVERTER SW FREQUENCY EXCEEDS THE 250KHZ ICD LIMIT

REQUIRED ACTION: ICD waiver/change to allow 550KHz switching

STATUS: The ICD states at 7.3.3.8 that the fundamental frequency of load current ripple shall not exceed 250KHz. The 500KHz converter switching frequency generates the load current ripple frequency. PSak memo (3/13/95) requested that the ripple frequency limit be changed to 550KHz. LaRC memo for ICD change request was submitted 3/29/95.
STATUS UPDATE (3/13/96): This change was not included in the TRMM ICD Rev A (6/14/95). After checking, I received a verbal response from Chris Savinell (via Leonard Kopia) on 9/11/95 that a later release of ICD Rev A has this change included. I have not yet received a copy of the updated ICD Rev A.

133 INSTRUMENT SURVIVAL HEATER POWER SWITCHING BY CONVERTERS

REQUIRED ACTION: ICD waiver or chg. to allow survival heater power switching by the instrument survival heater power converter.

STATUS: The ICD states at 7.3.3.3 that there shall be no instrument switching of heater power except for automatic thermostatic control. GSFC (Bill Browne) indicated that the power converter that was recently added to the survival heater circuit design constitutes switching of the survival heater power to CERES. LaRC memo for ICD change request was submitted 3/29/95 to request that survival heater power switching be allowed by the power converter.
STATUS UPDATE (3/13/96): This change was not included in the TRMM ICD Rev A (6/14/95). After checking, I received a verbal response from Chris Savinell (via Leonard Kopia) on 9/11/95 that the later release of ICD Rev A DOES NOT have this change included. Chris Savinell indicated that he and Bill Browne need to check with Brian Killough about this issue before making this change.

135 TRMM SURVIVAL PWR STATUS FOR TEST AND LAUNCH

STATUS: Gus initiated a request for info on the CERES (TRW) understanding as to the TRMM Survival Bus status for test and launch. Current plans are that the SURV bus will be ON for launch and for pump-down during TV test. SURV ON/OFF status for VIB test is still not decided.
STATUS UPDATE (3/13/96): After checking out this issue and reviewing with Gus, he realized he was thinking about the EOS CERES issue about launch/test with power ON. The EOS CERES concern is because of the high voltage (120 VDC) on the bus. TRW did not vib test TRMM CERES with power ON because of the lack of availability of a power source at the vib test facility and because there was no apparent need to have power ON while vib testing.

Attachment to SAERS Task "**CERES Interface Documentation Review**"

EOS ISSUES

215 EOS IFC CONNECTOR KEYING

REQUIRED ACTION: GIIS Waiver for IFC Connector Keying.

STATUS: The current TRMM IFC design does not use keyed connectors as specified in the GIIS. A Memo to Grant was completed on 9/23/94 to define all possible cross-connect configurations at the spacecraft to instrument IFC, the consequences of cross-connecting, and some options for prevention of un-detected cross-connects. Mike will provide a memo to GSFC to define the cross-connect issue before a GIIS waiver request is initiated.
STATUS UPDATE (3/13/96): No update info.

220 EOS AM EMC FUSE BLOW TEST REQUIREMENT

STATUS: The EMC Control Plan section 5.4(3) CONDUCTED SUSCEPTIBILITY requires a "Fuse Blow" test on a non-flight copy of the EOS AM CERES instrument flight hardware. At the 8/30/94 EOS IFC Review Meeting, Arpod agreed that TRW could do this test on the FTM after converting it to the EOS configuration. This discussion was documented in a memo to TRW on 10/6/94.
STATUS UPDATE (3/13/96): No update info.

221 EOS AM EMC GND STRAP BONDING REQUIREMENT

STATUS: The EMC Control Plan section 5.10(3) INSTRUMENT BONDING REQUIREMENTS requires that the instrument provide redundant ground straps between the instrument and the signal reference plane. TRW will comply and requests that GSFC select the GND strap instrument connection points and the routing path through the MLI blanket.
STATUS UPDATE (3/13/96): No update info.

223 EOS AM SIS TEST AND IFC HARNESS

STATUS: GSFC memo 1/30/95 requests a response by 2/17/95 on the status of development of the EOS AM SIS IFC test harness (Received memo 3/17/95). PSak has a copy of the memo. We need his response before we can provide an answer to GSFC. PSak stated (informally) during a visit to TRW (4/3/95 - 4/6/95) that this issue had been resolved by a recent phone conversation with GSFC. I have no record of this conclusion.
STATUS UPDATE (3/13/96): No update info.

Attachment to SAERS Task "**CERES Interface Documentation Review**"

DOCUMENT STATUS
7/24/95

TRMM

DOCUMENT NAME	VERSION DATE	COMMENTS DUE	COMMENTS COMPLETE
CERES Instr. Operations Concept	5//94	6/22/94	6/21/94
TRMM Electrical Subsys. Spec.	5/93	6/4/93	5/28/93
TRMM Low Pwr/Safe Hold Descript.	5/28/93	6/11/93	6/30/93
TRMM Observatory Modes of Opp.	5/28/93	6/16/93	7/07/93
TRMM Integ. & Func. Test Plan	4/18/94	6/20/94	6/16/94
TRMM CERES ICD	4/30/93	N/A (Final Ver.)	
TRMM CERES ICD CCR IN-270	2/2/94	6/13/94	6/15/94
TRMM IGSE to SGSE ICD	4/11/94	N/A (Final Ver.)	
TRMM Electrical Subsystem ICD	9/93	N/A (Final Ver.)	
ASSIST Work Station Users Guide	7/93	Reference Only	
Test/Verification Plan CERES DRL38	1/10/94	N/A	
Test/Verifi. Plan SWICS/BB DRL38	7/22/94	N/A	
Instrument Opp. Manual DRL87	11/9/93	1/14/94	No Comments
In-Flight Measurement Anal. DRL64	12/7/93	1/12/94	No Comments
Electronic Analysis DRL63 Rev B	12/13/93	(Reviewed by Will)	
TRMM Project Test Plan (Prelim)	3/94	5/13/94	5/19/94
TRMM ESD Control Imp.Plan (Prelim)	4/27/94	6/3/94	5/26/94
TRW ENG Design Handbook (Wiring)	6/28/85	Reference Only	
Problem/Critical Parts List DRL27	3/8/94	Reference Only	
Parts and Components List DRL20	5/25/94	Reference Only	
Spares Plan/Analysis DRL 35	12/8/93	Reference Only	
TRMM MOC to Instruments ICD	4/4/94	N/A	
TRMM IGSE to SGSE ICD CCR OB-0343	7/15/94	N/A	8/2/94
TRMM C&DH ICD CCR OB-0282	2/16/94	5/13/94	5/9/94
TRMM C&DH ICD RevA	10/17/94	N/A	
TRMM Flight Operations Plan	9/94	10/14/94	10/14/94
EGSE Acceptance Test Proc. Rev A	4/4/95	4/21/95	4/25/95
CERES Abbrev. Func. Test Proc.	7/5/95	7/28/95	7/11/95
CERES Compre. Func. Test Proc.	3/9/95	N/A	
CERES Perf. TP with Test Caps	4/14/95	5/10/95	5/5/95
TRMM Observ. EMI/EMC Test Plan	4/18/95	5/31/95	5/11/95
Passive Elec. Test Proc. DRL 38.3	4/25/95	5/12/95	5/10/95
Inst. Mag. Field TP (PFM/TRMM)	4/27/95	6/16/95	6/26/95
CERES EMC TP (PFM/TRMM) DRL 38.3	5/8/95	5/26/95	6/1/95
TRMM CERES I&T Plan	9/28/94	N/A	
GSE #2 Oppr. & Maint. Manual	5/22/95	N/A	

Attachment to SAERS Task "**CERES Interface Documentation Review**"

EOS-AM

DOCUMENT NAME | **VERSION DATE** | **COMMENTS DUE** | **COMMENTS COMPLETE**

EOS AM Electrical ICD	6/14/94	none	9/13/94
EOS AM EICD ECN-1	9/27/94	11/18/94	11/18/94
EOS AM EICD Rev A	1/13/95		2/1/95(OK)
EOS AM EMC Test Plan	3/01/93	none (Ref only)	
EOS AM S/C Baseline Descript. Doc.	6/10/93	?	11/4/93
EOS AM IFOU	8/26/93	?	
EOS AM GIIS 12/1/92 Rev A	4/11/94	None (Final Version)	
EOS AM Func. Intercon. Diag.(FID)	8/5/93	9/24/93	9/24/93
EOS AM Top Level Sig. Flow Diag.	7/23/93	none (Ref only)	
EOS AM C&T ICD	1/11/95	1/20/95	1/19/95
BDU I/O Allocation Tables	2/28/94	Rev B4/7/94	5/6/94
EOS AM I&T ICD	8/19/94	11/18/94	11/18/94
EOS AM I&T ICD Change Pages	11/21/95	ASAP	11/30/94
EOS AM I&T ICD	1/6/95	?	2/2/95(OK)
High Volt. Breakdown in Space Env.	REF DOC for EOS Launch PWR Issue		
EOS AM1 MOC	5/94	?	
EOS AM System Operation Modes	2/25/94	?	
EOS AM S/C FLT OPPS Concept (PDR)	9/30/93	N/A (Ref Only)	
GIIS Change 04	9/15/94	10/12/94	10/11/94
EOS AM UIID CH03	1/13/95	2/3/95	3/3/95
EOS AM UIID CH04	5/9/95	N/A	7/11/95
EOS AM Operations ICD (Draft)	5/19/95	N/A	

EOS-PM

DOCUMENT NAME | **VERSION DATE** | **COMMENTS DUE** | **COMMENTS COMPLETE**

EOS-PM GIRD	12/22/93	1/12/94	7/19/94
EOS-PM CERES UIID	6/93	7/20/93	7/22/93
EOS-PM CERES IDD	6/93	7/20/93	7/27/93
EOS PM CERES IDD (CH-01,6/94)	6/93	?	7/29/94
EOS PM IDD CCR422-12-13-004	6/94 RevA	?	9/09/94
EOS PM CERES UIID CCR422-12-13-003	6/94 RevA	?	9/13/94

SAERS (NAS1- 96013) Task Order

1. Task Order Number and Title Number: GL004 Revision:
Title: **Digital Fiber Optic Data Display Link Evaluation Testing**

2. Purpose, Objective or Background of Work to be Performed:
The Digital Fiber Optic Data Display Link (DFODL) project is an ongoing developmental effort of an electronic system to transfer digital display information from an aircraft computer to a remotely located flat-panel display for experimenter observations of flight measurements. The design is complete and uses digital logic, TTL to ECL conversion and fiber optic transmitter/receiver link technology. The basic design uses a high-speed serial communication link (504 Mbaud) to transmit standard IBM compatible video card (Super VGA) output via VESA feature connector (TTL) and converts to ECL, then transmits through fiber optical cable to a receiver that decodes the signal back to TTL and to a remote multi-color VGA flat display panel. The DFODL consists of a Transmitter Assembly, Receiver Assembly, high performance electro-luminescent flat-panel display, and approximately 200 feet of fiber optic cable. The Receiver and Transmitter Assemblies are mounted on a standard PC/104 8-Bit Module and are designed for operation with 3 additional PC/104 modules in a standard stack configuration. The Transmitter Assembly is designed for interface with an IBM Compatible video card via VESA Feature Connector as is the Receiver Assembly on the flat panel display.

The purpose of this task is to complete the breadboard integration, perform test and evaluation of the breadboarded system, then develop a detailed design for a flight qualifiable system (see section 5 below). The objective is to demonstrate proof of concept, and evaluate for use on research aircraft flight instrumentation data systems

3. Description of the Work to be Performed:

Sub-task 1

1.1 The contractor shall integrate the completed individual assemblies and evaluate the performance of the complete breadboard Digital Fiber Optic Data Display Link (DFODL) system.

1.2 Deliverables:

1.2.1 Demonstration of operating DFODL system using government-furnished software test pattern.

1. 1.2.2 Complete Test and Evaluation Report by June 30, 1997, that contains as a minimum :

1.2.2.1 Description of test setup.

1.2.2.2 Test parameters and how they demonstrated proof of concept.

1.2.2.3 Test results indicating power consumption and projected cooling requirem ents for a four stack PC/104 configuration for future 120° Fahrenheit operation with supporting analysis.

1.2.2.4 Test results indicating video output quality for the government-furnished flat-panel display over at least 200 feet of fiber optical cable.

1.2.2.5 Identify all significant events, anomalies, or failures during testing.

1.2.2.6 Recommendations for possible improvements for a flight qualifiable version of DFODL.

1.2.3 Completed DFODL breadboard system and all spare parts at end of task.

1.2.4 Monthly Status Reports (written or verbal) by last working day of month, summarizing work done the previous month, including significant events, anomalies, or failures, and the work planned for the next month

Sub-task 2

2.1 The contractor shall design a flight qualifiable version of the Digital Fiber Optic Data Display Link (DFODL) system . Contractor shall document design and conduct design reviews before a Government review board.

2.2 Deliverables

2.2.1 Design for a flight qualifiable version of the Digital Fiber Optic Data Display Link (DFODL) system that includes the following:

2.2.1.1 System Block diagram

2.2.1.2 Narrative description of design and analysis performed

2.2.1.3 Electronic drawings and printed circuit layouts ready for fabrication. Note: Layouts not required for PDR.

2.2.1.4 Parts list

2.2.1.5 Power Requirements

2.2.1.6 Recommendations for packaging (Enclosure Design)

2.2.2 Design concept, approach, and preliminary design documentation five working days before scheduled preliminary design review (PDR) for review by government design review board.

2.2.3 Baseline design documentation five working days before for critical design review (CDR) for review by government design review board.

2.3 Schedule:

2.3.1 Preliminary Design Review - by July 31, 1997.

2.3.2 Critical Design Review - by September 12, 1997.

2.3.3 Final submittal of all documentation detailed above as deliverables, including all changes as result of CDR action items - by September 30, 1997.

2.4 Performance Standards and Evaluation Criteria:

2.4.1 Meets:

2.4.1.1 All deliverables on time.

2.4.1.2 Breadboard Test and Evaluation Report is clear, concise, accurate (having no major errors and few minor discrepancies or typos) as determined by TM random check and contains the information listed above.

2.4.1.3 Flight qualifiable Digital Fiber Optic Data Display Link (DFODL) system design documentation clear, accurate (having no major errors and few minor discrepancies or typos), as determined by TM random check, contains the information listed above, and qualifiable as determined by Government review board.

2.4.2 Exceeds:

2.4.2.1 Breadboard Test and Evaluation Report delivered at least 2 weeks ahead of schedule.

2.4.2.2 Final design documentation delivered 30 days ahead of schedule.

2.4.2.3 Contractor provides solutions to unforeseen problems or modifications while meeting "meets" criteria .

4. Government Furnished Items:

1. Complete Breadboarded DFODL System which includes the Transmitter Assembly, Receiver Assembly, 200 feet of fiber optic cable with connectors, electro-luminescent flat-panel display, and video cables for connection to flat panel and IBM video card.
2. Complete set of spare parts for the DFODL system.
3. Access to lab bench in buiulding 1202, room 150.
4. Access to IBM compatible personal computer (PC) with a VGA video card.
5. Access to standard laboratory equipment (voltage supplies, RF meter, multi-meter, etc.).
6. Specifications, drawings, operating manuals and other required documentation for government furnished items.
7. Test pattern Software for test.

5. Other Information Needed for Performance of Task.

5.1. All drawings must meet NASA Flight Instrumentation Guidelines for generation, modification, release.(reference LHB 7910.1 "Flight Research Program Management")

5.2. For the purpose of this task flight qualified hardware (design) must conform to

5.2.1. NHB 5300.4 (1A-1) Reliablity Program Requirements for Aeronautical and Space Contractors

5.2.2. NHB 5300.4 (3A-2) Requirements for Soldered Electrical Connections, January 1992

5.2.3. NHB 5300.4(3G) Requirements for interconnecting Cables, Harnesses, and Wiring, April 1985

5.2.4. Memorandum dated June 5, 1996 from Project Manager, 757 Transport Research Facility Project to Chairperson of Environmental Test Team, Subject: "Test Procedures and Test Conditions for the Environmental Testing of Airborne Research Equipment

6. Security Clearance Required for Performance of Work:

None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: September 30, 1997

8. NASA Technical Monitor: David Terry
M/S: 471 Phone: 757-864-4795

SAERS (NAS1-96013) Task Order

1. Task Order Number: **GLO05** Revision: Date of Revision
   Title: **B737 Flight Instrumentation Data Acquisition**

2. Purpose, Objective or Background of Work to be Performed:

The objective of this task is to acquire experimental flight data on a B737 research aircraft utilizing a proven NASA programmable, configurable, pulse-code modulation (PCM) digital Data Acquisition System (DAS) installed on the LaRC 737 research aircraft. The DAS is backed up by a complete set of spare parts and an inventory of research sensors. System elements include: signal conditioning, time code generator, optical disk & magnetic tape recorders; flight computers for combining PCM system data with data from a serial avionics data bus; radio frequency (RF) transmitters, C-band radar beacon transmitter, smart decom/display, and strip chart data recorders. The existing B737 DAS generates digital PCM data and media compatible with the Aerospace Data Acquisition and Processing Station (ADAPS). An identical flight data system (excluding most PCM sensors) and a smart decom/display are also utilized to support a ground-based avionics "hot-bench" test facility.

Typically 150 primary experimental data channels and an additional 290 secondary channels are required per flight (out of a total 560 recordable channels). Each different "experimenter defined" flight telemetry request typically requires selected sets of data channels from the 150 primary channels for display. Transmitted data is received and displayed by other organizations in ground facilities. Telemetry of B737 flight data is generally used on less than 5 percent of the total flights. The C-band beacon data is required only for ground radar trackers to identify the B737 aircraft. The B737 aircraft is typically utilized to support a variety of experiments including aero, runway friction, terminal area research, etc. During periods of active research, weekly project meetings are held in Bldg. 1244 where schedule requirements for near-term and future flight and hot-bench tests are given. A measurement list and display requirements are received from experimenters in writing for each flight and hot-bench tests, including requirements for providing telemetry data and C-band beacon data. This task will require support for up to 20 research flight tests per month for a five calendar month period.

3. Description of work to be performed:

Sub-Task 1 DAS Prep / Aircraft Modifications

1.1 Contractor shall select sensors from NASA inventory and integrate sensors into data systems as deemed necessary by the contractor to meet research flight / experiment requirements during the 5-month period. The Contractor shall be responsible for initiating aircraft work orders for any instrumentation modifications such as sensor changes to meet measurement requirements of each flight or series of flights. Historical data of the numbers of modifications during the past 12 months is available from the monitor. The Contractor shall provide modification drawings and schedule instrumentation modifications and installation through approved and certified aircraft installation personnel.

1.1.1 Deliverables:

1.1.1.1 Aircraft work orders and modified drawings.

1.1.1.2 DAS configured and operational at the time of scheduled flight experiments.

Sub-Task 2 Acquire Flight Research Data

2.1 Acquire experimental data from B737 research aircraft and ground-based avionics hot-bench facility (located in bldg. 1244), using the existing government developed data acquisition systems (DAS) currently installed on the aircraft and in the ground facility.

specification ambient stability to no more than 0.5 percent of active channel or better with out-of-specification ambient stability.

5.2.3 Flight data system which is configured and operational at the time of scheduled flight experiments 98 to 100% of the time.

5.2.4 Post-flight data deliverables met within requested times between 90 and 100% of the flights.

Note: "Unscheduled Changes": Contractor will not be held accountable for data system being not ready on the appointed schedule time if flight schedule is accelerated without reasonable notice to the contractor.

4. Government Furnished Items:

Hardware (complete GSE listing available from task monitor):

1. PCM Data Systems, Signal Conditioning Units, Signal Condition Modules
2. Smart Decommutator/Display Systems
3. Flight Computer Data Combiner
4. Personal Ground Computers for post-flight quick-look produced for experimenters.
5. Use of NASA ground station is available for post flight quick-looks on a scheduled basis.
6. Assorted collection of Sensors
7. Recorders: Magnetic Tape, Optical Disk, Strip Charts
8. Time Code Generators/Readers/Receivers
9. RF Transmitters and Antennas installed on the aircraft
10. C-band Radar Beacon and Antenna installed on the aircraft
11. Power Subsystems; Control Units, and Power Supplies

Documentation (available from task monitor):

1. Data System Specifications/Operation/Maintenance/Troubleshooting information.
2. Calibration database information/software.
3. Smart Decommutator/Real-time Display System Applications Software Manual.
4. List of sensor inventory.

Software for computer data combiner.

NASA Flight Instrumentation Drawing Procedure.

List of equipment that contractor may elect to have NASA service due to availability of expertise and facilities already existing at NASA.

5. Other information needed for performance of task.

1. Flight tests out of Langley Research Center hanger
2. Contractors are allowed to fly onboard the B737 aircraft if Contractor deems necessary to perform critical tasks onboard during a research flight.
3. Travel to remote sites infrequently may be required to support flight tests, typically two remote deployments of 1.5 to 2 week duration. Travel by contractors on the NASA B737 aircraft to the remote test site (airport) is normally permitted based on available seats.
4. NASA Quality Assurance Inspection required for all flight data systems/subsystems/sensors, etc., which are installed on the B737 aircraft. No exception are allowed in flight hardware inspection. Inspection must be scheduled.
5. All flight data systems soldering, crimping, etc., must be performed to NASA Standards
6. NHB 5300.4 Series.
7. Wiring, crimping, installation, etc., of aircraft hardware must be performed
8. by certified personnel.
9. All instrumentation must meet NASA Standard NHB 7910.1 requirements.
10. New or modified instrumentation drawing must meet NASA Flight Instrumentation Drawing

Procedure for generation, approval, and release.

6. Security clearance required for performance of work: None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: September 30, 1997

8. NASA Technical Monitor: Mark Hutchinson M/S: 471 Phone: 804-864- 4642

SAERS (NAS1-96013) Task Order

1. Task Order Number: **GL006** Revision:
Title: **B-757 Research Instrumentation System**

2. Purpose, Objective or Background of Work to be Performed:

The Government is developing a new Advanced Data Acquisition System (DAS) for flight research instrumentation on the B-757 aircraft. The heart of the DAS is a rugged Government owned, programmable commercial Advanced Airborne Test Instrumentation System (AATIS). The DAS accepts data from a variety of aircraft sensors such as accelerometers, control position transmitters (CPT), hot-film anemometers, synchros, etc., using a proven family of programmable signal conditioning modules. The DAS can operate from 100 Kbytes to 5 Mbytes per second and accept up to 1,000 data channels at a wide variety of selectable sample rates. The new DAS will also accept digital data from experimental avionics via a SCRAMNet experimental aircraft data bus. In order to accept data from the aircraft bus, development of a flight harden Interface Subsystem that will allow transfer of parallel digital flight research data from the B757 SCRAMNet Bus to the DAS is required.

By the time of task start all hardware component development, with the exception of the flight SCRAMNet and the Quick Look Valadation System, will have been complete and integration on to the government owned B-757 aircraft (a/c) will have started. The overall objective of this task is to complete the SCRAMNet development; develop and integrate softwarefor the Quick Look Valadation System; assemble, integrate, and test the complete DAS system on the a/c, configured for the Low Visibility and Landing Service Operation (LVLSO) mission; and then to support LVLSO deployment to Altanta, Georgia. An additional requirement is to incorporate, via serial PCM interface, a Government owned commercial display and processing system (Loral 550) to provide the aircraft experimenters/ researchers with on-board capability to process and display limited subsets of the data in near real-time.

3. Description of the Work to be Performed:

Sub-Task 1 SCRAMNet to AATIS Interface Subsystem.

1.1 Design, fabricate, flight harden (see 5. below), test, and deliver a SCRAMNet to Advanced Airborne Test Instrumentation System (AATIS) Digital Parallel/Serial Interface Subsystem . This includes preparing for and presenting design before a Government review panel. The interface system shall meet the following minimum design requirements.

1. Shall conform to NASA B757 DAS SCRAMNet Interface Specification 1.0.
   a). Contractor shall design a custom Host Interface Card as described in Specification 1.0.
   b). Contractor shall design a custom Output Interface Card as described in Specification 1.0.
2. Contractor shall design a flight harden package to conform to the volume constraints identified in Specification 1.0.
3. Contractor design shall meet Flight requirements as per memorandum dated June 5, 1996 "Test Procedures and Test Conditions for the environmental Testing of Airborne Research Equipment" and meet flight requirements as per NASA LHB-7910.1

Once design is approved by the Technical Monitor, the Contractor shall fabricate flight printed circuit boards, integrate the circuit boards in a flight harden package, and perform flight qualification tests to NASA B757 flight environmental and EMI specifications. The contractor shall proceed if approval is not provided within 5 working days.

Deliverables:
1. One SCRAMNet to Advanced Airborne Test Instrumentation System (AATIS) Digital Parallel/Serial Interface flight harden sub-system by June 26, 1997.

2. Test and Evaluation Report by July 30, 1997.
3. Identify all significant events or failures to technical monitor within 24 hours.
4. "As built" design documentation and Operations / Instruction Manual by August 30, 1997.
5. Monthly status reports, either written or presentation, by the last working day of the month.
6. Design review material

Performance, Standards, and Evaluation Criteria:
Meets:
1. Deliverables provided on time.
2. The SCRAMNet Interface conforms to NASA B757 DAS SCRAMNet Interface Specification 1.0, memorandum dated June 5, 1996 "Test Procedures and Test Conditions for the environmental Testing of Airborne Research Equipment", and meets flight requirements as per NASA LHB-7910.1
3. Test and Evaluation Report clear, accurate, and comprehensive, as determined by the TM, and contains as a minimum:
   a) Description of test setup
   b) Listing of test parameters and how they demonstrated system design and operating performance
   c) Test results demonstrating system performance
   d) Test results demonstrating meets 2. above.
4. All significant events or failures identified to technical monitor within 24 hours
5. "As built" Design documentation includes detailed "fabrication ready" electronic drawings (circuit schematic and layout), system level block diagrams, other engineering drawings (parts lists, wiring diagrams, housing design, etc.) needed to assemble subsystem, conforms to Mil STD 100 and LHB 7910.1, and is clear, accurate, and comprehensive, as determined by the TM.
6. Operations / Instruction Manual clear, accurate, and comprehensive, as determined by the TM
7. Monthly status reports include the following minimum information:
   a) Schedule status
   b) Design/development progress
   c) Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.
8. Design review material delivered two working days prior to review and clear and accurate as determined by the TM.

Exceeds:
Delivers system 30 days ahead of schedule

Sub-task 2 "Quicklook System".

The contractor shall develop and integrate software for existing Government Furnished "Quicklook" System (PC based system with a Berg model 4422 PCM card and an A/D card) for remote site flight data validation (spikes, scaled correctly, data integrity checks) and provide data for experimenters to determine go/no-go situation for next flight. Software package shall provide the following operator selectable options:
1. Engineering Units (EU) conversions based on polynomial curve fitting (up to 5th order)
2. EU conversions based on linear table interpolation (raw data will use sensor calibration data base for conversion)
3. View flight data file based on time of flight.
4. Run time summary
5. Output flight data files with pcfile stream (interfacing with government sdf file format which allows for channel selection, and engineering unit conversion option on a per channel basis).
6. Real time output of files (charts, analog or digital data).

Deliverables:

1. Operational quicklook system capable of processing the PCM data stream file from the 757 DAS by July 31,1997.
2. Software (source and executable) code for the "quicklook" system
3. Operational Instructions for software to include
   a. Display options
   b. Configuration requirements
   c. Output options
   d. Setup requirements

Performance, Standards, and Evaluation Criteria:
Meets:
Provides operation system on time with all documentation detail as deliverables above.
Exceeds:
Delivers system 15 days ahead of schedule

Sub-Task 3 Integrate and validate the DAS.

3.1 The contractor shall install, integrate and validate the DAS (excluding Loral 550) on the government owned B757 in support of LVLSO Program measurements requirements list (available from the Technical Monitor). The measurements requirement list will also define the test channels needed for post-test quick-look deliverables. Validation shall include demonstration, i.e. data acquisition during scheduled flight tests (up to three) at LARC during July.

Deliverables:

1. Recorded data media delivered to NASA Aerospace Data Acquisition and Processing Station (ADAPS)
2. Post-test limited time duration quick-look of government selected test channels in plots or strip-chart format.
3. Post-test limited time duration quick-look of government selected test channels in Engineering Unit (EU) ASCII.
4. Short abbreviated report after each validation test.

3.2 Using Government provided LVLSO data requirements, provide measurement calibration database in standard compatible NASA ground station data processing format for flight experiments / projects. Contractor shall perform calibration on aircraft flight instrumentsat 6-month intervals and other supporting instruments, such as meters, oscilloscopes, hot-bench instruments, etc., at less than or equal to 12-month intervals. Calibration interval for onboard flight instruments may be extended for up to 2 months upon written approval of B757 Operations Manager when critical flight schedules conflict with accomplishing these calibrations.

Deliverables: Calibration flight database .

Performance Standards and Evaluation Criteria
Meets:

1. DAS ground baesed validation testing completed (all functions tested, meets LVLSO measurments list, and recorded data meets 8. below) June 12,1997
2. DAS initial (LVLSO) calibration completed June 30,1997
3. Recorded data media delivered to NASA Aerospace Data Acquisition and Processing Station (ADAPS) located in bldg 1244 within 24 hours after each validation tests for processing and Government review.
4. Post-test quick-look of government selected test channels in plots or strip-chart format delivered to TM within 12 hours after each validation test for Government review.
5. Post-test quick-look of government selected test channels in Engineering Unit (EU) ASCII delivered to TM within 24 hours after each validation test for Government review.
6. Short abbreviated report after each validation test estimating the percent of test data acquired

and any significant problems requiring resolution/scheduling changes delivered to TM within 12 hours after each validation test.
7. Calibration flight database containing calibration information for each active data channel delivered in standard NASA- ground data processing station format prior to each validation and flight test (LVLSO deployment).
8. LVLSO Recorded data with no more than 1 percent data dropouts averaged across all active data channels during validation test and flights.
9. All significant events or failures identifiedto technical monitor within 24 hours

Exceeds:
1. LVLSO Recorded data with no more than 0.2 percent data dropouts averaged across all active data channels during validation test and flights.
2. DAS ground based validation testing complete (recorded data meets 8. above) 2 weeks ahead of project schedule
3. DAS initial (LVLSO) calibration complete (batabase meets 7. above) 2 weeks ahead of project schedule
4. Contractor suggested improvements are accepted (government reviewed and approved) to design or operating procedures which increase reliabilty (as determined by TM) or decrease turn around time of project processed data.

Subtask 4 LVLSO Operations.

Acquire experimental aircraft flight data as per LVLSO measurements list during each scheduled flight or ground test while on deployment. Current schedule calls for two deployments to Atlanta of one week each (may change) and up to two flights a day.

Deliverables:
1. Recorded flight data media.
2. RF transmitted data.
3. C-band beacon transmitted data.
4. Data log or logs.

Performance Standards and Evaluation Criteria

Meets:
1. Recorded flight data media in standard NASA ground station format submitted to NASA ground data processing station facility or ground playback system after each flight.
2. LVLSO Recorded data with no more than 1 percent data dropouts averaged across all active data channels during research LVLSO deployment to Altanta.
3. RF Data transmitted in standard NASA telemetry format on required flights.
4. C-band beacon data transmitted on required flights
5. All significant events or failures identifiedto technical monitor within 24 hours
6. Data log or logs contain number and duration of flight data runs, start and stop times, total record time, and a listing of any significant flight events, as determined by the contractor, which will aid post-flight ground data handling and processing.

Exceeds:
1. LVLSO Recorded data with no more than 0.2 percent data dropouts averaged across all active data channels during research LVLSO deployment to Altanta.
2. Contractor suggested improvements are accepted (government reviewed and approved) to design or operating procedures which increase reliabilty (as determined by TM) or decrease turn around time of project processed data.

Subtask 5 Data display and Processing System

Contractor shall ruggidize (modify such that meets environmental requirements of memorandum dated June 5, 1996 "Test Procedures and Test Conditions for the environmental Testing of Airborne Research Equipment", and NASA LHB-7910.1) and test a Government owned commercial processing unit (Loral 550). Contractor shall test and ruggidize a Government owned display (X terminal). Contractor shall integrate display and processor into standard 757 pallet so as to link to DAS pallet via serial PCM interface to provide the aircraft experimenters / researchers with on-board capability to process and display limited subsets of the data in near real-time. Contractor shall generate functional and environmental acceptance test procedures and deliver to TM, who will review and provide approval of these procedures. The contractor shall proceed if approval is not provided within 5 working days. The contractor shall use these procudures to verify proper operation and performance of the system. Contractor shall generate Operations / Instruction Manual.

Deliverables

1. Functional and environmental acceptance test procedures.
2. Operations / Instruction Manual by September 30.
3. Hardened / ruggidized system installed in pallet by September 30, 1997.
4. Pallet assembly documentation, including wiring schematic / diagram and connector / cable specification.
5. Test and Evaluation Report by October 15, 1997
6. Monthly status reports, either written or presentation, by the last working day of the month.

Performance, Standards, and Evaluation Criteria:

Meets:

1. Deliverables provided on time.
2. The Data display and Processing System conforms to memorandum dated June 5, 1996 "Test Procedures and Test Conditions for the environmental Testing of Airborne Research Equipment", and meets flight requirements as per NASA LHB-7910.1
3. Test and Evaluation Report clear, accurate, and comprehensive, and contains as a minimum:
   a) Description of test setup
   b) Listing of test parameters and how they demonstrated system design and operating performance
   c) Test results demonstrating system performance
   d) Test results demonstrating meets 2. above.
4. All significant events or failures identifiedto technical monitor within 24 hours
5. Pallet assembly documentation conforms to Mil STD 100 and LHB 7910.1, and is clear, accurate, and comprehensive, as determined by the TM.
6. Operations / Instruction Manual clear, accurate, and comprehensive, as determined by the TM
7. Monthly status reports include the following minimum information:
   a) Schedule status
   b) Design/development progress
   c) Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.

Exceeds:

Delivers system 30 days ahead of schedule

Subtask 6 Failures or anomalies

Document all data system, including AATIS, Loral 550, and sensors, failures or anomalies, determine cause, and recommend corrective action.

Deliverables: Failure report: Notification of failure within 24 hours of completion of test or flight; failure analysis within 1 week following completion of flight.

Performance Standards and Evaluation Criteria
Meets:
Failure reports complete and on-time.
Exceeds:
Contractor provides practical, as determined by TM, preventative recommendations.

4. Government Furnished Items:

1. Memorandum dated June 5, 1996 from Project Manager, 757 Transport Research Facility Project to Chairperson of Environmental Test Team, Subject: "Test Procedures and Test Conditions for the Environmental Testing of Airborne Research Equipment".
2. NASA DAS SCRAMNet Interface Specification 1.0
3. NASA Transport Research Facilities Requirements Document
4. DAS Development Schedule - update weekly, and released monthly.
5. AATIS system setup documentation
6. LVLSO Measurements List

Access to the following:

7. AATIS data system with documentation
8. AATIS compatible recording media
9. Loral system with documentation
10. Ruggidized X Terminal
11. Standard 757 Pallet
12. Government data base for the 757
13. Sensors
14. Sensor calibration data
15. PC-104 Computer system as described in Spec. 1.0
16. Experimental Aircraft Systems Integration Laboratory (EASILY) for testing SCRAMNet sub-system.
17. SCRAMNet Laboratory Simulator to test Subsystems.
18. Standard laboratory support equipment (power supplies, multi-meters, oscilloscopes, etc.
19. PC based "quick-look" system

5. Other information needed for performance of task.

1. Major system buildup, installation and validation will occur at Langley Research Center (LaRC) Aircraft Hanger B1244.
2. Component environmental testing will occur at Environmental Test Facility, bldg. 1250
3. All wiring soldering, crimping, etc., shall be performed to NASA Handbook NHB 5300.4 Series.
4. All drawings must meet NASA Flight Instrumentation Guidelines for generation, modification, release.(reference LHB 7910.1 "Flight Research Program Management")
5. Repair of Government furnished items may be scheduled through NASA funded equipment repair facilities.
6. Calibration of equipment shall comply with LMI-5330.9.B and may be scheduled through NASA funded calibration facilities traceable to National Calibration Standards.
7. Contractor may use NASA environmental and EMI test facilities to qualify flight hardware.
8. Contractor may utilize NASA furnished parts and components.

9. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards.
10. Contractor may utilize NASA furnished fabrication facilities/resources to complete breadboard and flight hardware, including mechanical hardware and wiring.

6. Security clearance required for performance of work:

None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: October 15, 1997

8. NASA Technical Monitor: Mike Koch
M/S: 257 Phone: 757-864- 7685

1. Task Order Number and Title Number: GL08 Revision:

Title: **Millimeter Wave Beacon Experiment**

2. Purpose, Objective or Background of Work to be Performed:

LaRC, TRW, McDonald Douglas, and the USAF are participating in a flight experiment to demonstrate the performance of a Passive Millimeter Wave (PMMW) Camera. This system will be used to augment landing of aircraft in low visibility situations. One portion of the flight experiment will include the investigation of active and passive beacons to enhance the performance of the camera system. LaRC will develop the beacon/reflector system, support the development of the Flight Plan and experiment definition, and support the deployment and operation of the beacons during the flight experiment.

This task covers the preparation and check out of the Beacon/reflector system prior to shipment to Edwards AFB; verification of beacon operation at Edwards AFB; deployment and operation of the beacons/reflectors during the flight operations; maintenance and repair of the beacons at Edwards and Point Magu; and preparation of the beacons for shipment to LaRC.

3. Description of the Work to be Performed:

Subtask 1.0: Develop familiarity of the Beacon design and operation. Participate in the weekly design update meetings. Review and comment on the beacon operations/test procedure. Operate beacons during electromagnetic boresighting and antenna pattern measurement testing at LaRC.

Deliverables

1. Beacon successfully operated during testing.
2. Review comments on the operations/test procedure.

Performance Standards and Evaluation Criteria

Meets:

1. Contractor develops and demonstrates sufficient understanding of beacon to independently operate beacon system.

Exceeds:

1. Contractor develops sufficient understanding of beacon operation and design to independently operate and maintain beacon system as demonstrated by successful beacon operation during the pre-flight acceptance testing.

Subtask 2.0: Prepare, check out and pack Beacons/reflectors and support equipment for shipment to Edwards AFB. The contractor shall use LaRC provided testing procedures to prepare and check out the Beacon/reflectors for shipment. The contractor shall make any required adjustments or repairs to the beacons.

Deliverables

1. Operational Beacon and support equipment, packed and ready to ship.
2. Log entries summarizing test results of the beacons (according to above procedures), including anomalous behavior and/or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.
4. List of instrument calibration status.
5. Packing list

Performance Standards and Evaluation Criteria

Meets:
1. Testing to verify beacon performance via Government procedures completed one week after receipt of beacons from LaRC.
2. Calibration and shipping list complete and up to date prior to shipment.

Exceeds:
1. Boresight variance {will be part of the test procedure}and required adjustment data prepared prior to shipment.

Subtask 3.0: Operation and maintenance of beacons at experiment sites. The Contractor shall unpack and test the beacon system at Edwards AFB. The contractor shall verify the Beacon performance and document any anomalous behavior and/or failures. The contractor shall deploy and operate the beacon/reflector system during the flight experiment as specified in Test Procedure provided by LaRC (under subtask 1.0) including any redlines or changes specified by the LaRC on site representative.

Deliverables

1. Beacon operated successfully during deployment.
   Log entries summarizing procedural verification of operation and performance of the Beacons (according to above procedures), including anomalous behavior and / or failures during check out.
2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed at check out.
   Log entries summarizing procedural verification of operation and performance of the Beacons (according to above procedures) prior to and during each flight, including anomalous behavior and / or failures.

Performance Standards and Evaluation Criteria

Meets:
1. Beacons are ready, i.e. verified operational and deployed as specified in the Test Procedure to meet scheduled aircraft flights.
2. Delivery of Beacon deployment status Log entries (output power, alignment, location, and mode) to the LaRC on site representative within 4 hours of the completion of each flight.

Exceeds:
1. Delivery of Beacon deployment status Log entries (output power, alignment, location, and mode) to the LaRC on site representative within 2 hours of the completion of each flight.

Subtask 4.0: Coordinate packaging of the Beacons and support equipment for shipment to LaRC.

Deliverables

1. Beacon and support equipment, packed and ready to ship.
2. Log entries of handling or work performed on subsystems.
3. Provide LaRC On Site representative with shipping lists at time of shipment.

Performance Standards and Evaluation Criteria

Meets:
1. Equipment packed and shipping list complete (ready for shipment) within two days of experiment conclusion.

Exceeds:
1. Equipment packed and shipping list complete (ready for shipment) within one day of experiment conclusion.

General Performance Standards and Evaluation Criteria (apply to all subtasks)

Meets:
1. Log books are maintained complete and up-to-date within 24 hours

Exceeds:
Contractor suggested improvements are accepted (government reviewed and approved) to operating procedures which decrease the turn-around time of the instruments between flights or significantly reduce the over-all cost of preparation and deployment. These improvements shall in no way compromise the health, safety, or performance of the instruments.

4. Government Furnished Items:

- Access to standard laboratory equipment (voltage supplies, RF meter, multi-meter, etc.).
- Access to governmental environmental test facilities
- Beacon and support equipment needed for testing.
- Access to specifications, drawings, operating manuals and other required documentation for government furnished items.
- Government to ship equipment to Edwards from LaRC and return.
- Government to furnish existing documentation, including notebooks, schematics, etc.

5. Other information needed for performance of task.

The contractor shall be responsible for maintenance and operation, such as changing the beacon mode, alignment, or location of the beacons throughout the experiment, but will not be responsible for any modifications of the Test Procedure or Flight Test Plan. All coordination with the Test Director and flight crew will be provided by the LaRC on site representative. Any modification to the beacon / reflector portion of the Flight Test Plan will be provided by the LaRC on site representative.

Travel: Task will require contractor to support deployment at Edwards AFB. The duration of the flight experiment is expected to be two weeks and the nominal start date is September 1, 1997. Deployment schedule calendars for the Test Aircraft operations are subject to change. Current schedules are available from the Task Monitor but may be modified if conditions out of the government control occur (weather, aircraft failures, etc.).

6. Security clearance required for performance of work:

None

7. Period of Performance:

Planned start date: 7/15/96	Expected completion date: 9/30/96

8. NASA Technical Monitor: Tom Shull
MS 471 / Phone x4-1837

1. Task Order Number and Title Number: GL09 Revision: 1 Date: 06/27/97
Title: **AIR Measurements Instruments Support**

2. Purpose, Objective or Background of Work to be Performed:

The NASA High Speed Research Program Office is sponsoring an airborne Atmospheric Ionizing Radiation Measurement mission to be flown out of Ames Research Center , Moffit Field, CA on a government owned ER-2 aircraft This measurement mission named AIR Measurements will involve the deployment of instrumentation system developed and fabricated at Langley Research Center and is scheduled to be packaged and shipped to Ames in May 1997. The objective of the AIR Measurements Mission is to record ionizing radiation in the upper atmosphere.

The Flight Instrumentation Branch (FIB) in the Aerospace Electronics Systems Division (AESD) will have an important role in AIR by providing the power systems, data acquisition system, and flight harden of principle investigators (PI) instruments on to instrumentation pallets to be used on the ER-2 aircraft. Personnel are required to support the deployment by preflight testing, post flight data processing, and installation of instrumentation on and off the ER-2 aircraft at AMES.

This tasks covers the preparation, check out, and shipment of the AIR Instrumentation pallets to AMES from LaRC; subsequent integration of the instrumentation pallets and preflight testing of the instruments; post flight data processing of the instruments; and prepare the instruments for the return to LaRC.

3. Description of the Work to be Performed:

Subtask 1.0: Prepare, check out and pack AIR instruments for shipment to AMES. The contractor follow developed testing procedures to prepare, check out and ship AIR instruments to the integration site. The task monitor will provide procedures to contractor. The contractor shall use these procedures to verify proper operation and performance of the instruments and prepare the instruments for shipment to AMES.).

Deliverables

1. Log entries summarizing tests of AIR Instrustments subsystems (according to above procedures), including anomalous behavior and / or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

4. Test data files and/or strip charts generated during check out tests.

5. List of instrument calibration status

6. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. AIR Instruments verified operational via Government procedures, and packed, to meet scheduled ship date of May 11, 1997.

2. Delivery of AIR Instrument data files and/or strip charts to Task Monitor within 24 hours of each test.
3. Calibration and shipping list complete and up to date prior to shipment.

Exceeds:

AIR Instruments are ready three days prior to scheduled ship date.

Subtask 2.0: Integrate and preflight test AIR Instrumentation on the ER-2. This requires the contractor to unpack, assemble and install the AIR Instrumentation on the ER-2. The contractor shall verify the AIR Instruments operational using the procedures under subtask 1.0 above.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of AIR Instruments subsystems (according to above procedures), including anomalous behavior and / or failures.

2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

3. AIR Instruments test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. AIR Instruments are ready, i.e. verified operational via Government procedures to meet scheduled science flights barring optics failure
2. Delivery of AIR Instruments data files to PI within 24 hours of each test.

Exceeds:

1. AIR Instruments are ready one week prior to first scheduled science.

Subtask 3.0: Operate, according to Subtask 1.0 procedures, and maintain AIR Instruments subsystems during the AIR mission, i.e. test and science flights.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of AIR Instruments (according to above procedures) prior to each flight, including anomalous behavior and / or failures.

2. Log entries summarizing procedural operation and performance of AIR Instrustments subsystems (according to above procedures) during each flight, including anomalous behavior and / or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

4. AIR Instruments test data files and/or strip charts.

Performance Standards anc. ⌐valuation Criteria

Meets:
Delivery of AIR Instruments data files to PI within 4 hours of each flight

Exceeds:
Delivery of AIR Instruments data files to PI within 2 hours of each flight

Subtask 4.0: Coordinate off-loading of AIR Instruments with ER-2 support personnel and packaging of instruments for shipment of equipment to Langley AIR project personnel.

Deliverables

1. Log entries of handling or work performed on subsystems.
2. Provide PI with shipping lists at time of shipment.

Performance Standards and Evaluation Criteria

Meets:
1. Equipment packed and shipping list complete and up to date prior to shipment.

Exceeds:
1. Equipment packed and shipping list complete and up to date 2 days prior to shipment.

Subtask 5.0: After return from deployment, unpack AIR instruments and supporting equipment, reorganize laboratory, conduct equipment inventory, and send instruments in need of calibration to LaRC Calibration Laboratory.

Deliverable
1. Log entries of handling or work performed on subsystems.
2. Results of equipment inventory.
3. List of instrument calibration status

Performance Standards and Evaluation Criteria

Meets:
1. Equipment unpacked and laboratory reorganized within one month of receipt at LARC.

Exceeds:
1. Equipment unpacked and laboratory reorganized within 2 weeks of receipt at LARC.

General Performance Standards and Evaluation Criteria (apply to all subtasks)

Meets:

1. Log books are maintained complete and up-to-date within 24 hours

Exceeds:
Contractor suggested improvements are accepted (government reviewed and approved) to

operating procedures whic... ...crease the turn-around time of the inst... ...nents between flights or significantly reduce the over-all cost of preparation and deployment. These improvements shall in no way compromise the health, safety, or performance of the instruments.

4. Government Furnished Items:

- Access to standard laboratory equipment (voltage supplies, RF meter, multi-meter, etc.).
- Access to governmental environmental test facilities
- DAS subsystem hardware needed for testing.

Access to specifications, drawings, operating manuals and other required documentation for government furnished items.

- Government to ship equipment to ARC from LaRC and return.
- Government to furnish existing documentation, including notebooks, schematics, etc.

5. Other information needed for performance of task.

. Other information needed for performance of task.

<u>Travel</u>: Task will require contractor to support deployment at AMES. Deployment schedule calendars for the ER-2 operations are very changeable. Current schedules are available from the Task Monitor but may be modified if conditions out of the government control occur (weather, aircraft failures, etc.).

6. Security clearance required for performance of work:

None

7. Period of Performance:

Planned start date: 5/1/97	Expected completion date: 7/31/97

8. NASA Technical Monitor: Mark Hutchinson/Kieth Harris
M/S: 471 Phone: 804-864- 4642

SAERS (NAS1-96013) Task Order

1. Task Order Number and Title — Number: GL10 — Revision:
   Title: **Free-Flight Drop Model Instrumentation**

2. Purpose, Objective or Background of Work to be Performed:

NASA Langley has been developing and flying research models for many years. The most recent is the F/A-18E/F. Unfortunately, this model was lost recently in a mishap. A replacement model is being built under the "Return to Flight" program. The plan is to resume flight experiments (drops) at Wallops Island in September 1997. Within the scope of this task there are two program elements, the Free Flight Drop Model itself and the ground electronic systems. The ground electronic systems include telemetry equipment, the flight control computer and associated equipment, radar tracking equipment, video and data recording equipment, smart decom/displays, strip chart recorders, antenna systems, and recovery command electronics in the instrumentation trailer, command trailer and tracker trailer. These three trailers make up what is called the Free-flight Drop Model Ground Instrumentation or just Ground Instrumentation.

The Free Flight Drop Models are developed by NASA and include (see attached block diagram) sensors, flight servos to control the model during flight, telemetry pulse code modulation (PCM) encoders and decoders, video cameras, radio frequency (RF) receivers (uplinks) and transmitters (down-links), recovery parachute deployed by RF command and electro-pyrotechnic actuation, and model flotation aids deployed by water activated sensors and pyrotechnic actuation. The model's flight and data acquisition are controlled by the Ground Instrumentation. These are drop model and flight dependent and programmable.

The Free Flight Drop Models are lifted by a helicopter to a height ranging to approximately 12,000 feet at Wallops Island, Virginia for research flight drop tests, and recovered from the water off Wallops Island via NASA recovery boat after the flight tests. The Free-flight Drop Model Ground Instrumentation is prepared and tested at the NASA Langley Research Center Facility (B-720B) located in the east area of Langley Air Force Base. The Ground Instrumentation is moved between NASA Langley and Wallops Island as required to support a series of flight tests of a particular research aircraft model. The Ground Instrumentation has been designed to generate NASA Ground Station compatible tapes.

The purpose of this task is to provide the Electro-pyrotechnic and RF Communications subsystem components for the replacement Model, integrate them into the Model and operate and maintain the Ground Instrumentation during Model integration and test, thereby controlling the model and acquiring and storing the ground test data.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements):

<u>Subtask 1</u>: Electro-pyrotechnic and RF Communications subsystems

The Contractor shall fabricate, assemble and test the replacement Electro-pyrotechnic and RF Communications subsystems for the F-18E/F drop model. The Contractor shall build to existing drawings. NASA will provide all parts and COTS (commercial off the shelf) hardware units. Note: Design and procedure changes may be necessary if previously-used COTS hardware unavailable. Recommended changes shall be submitted to the Technical Monitor (TM). The TM will review and provide approval of these changes. The contractor shall proceed if approval is not provided within 5 working days. The Contractor shall maintain (redline and modify as approved) drawings and all assembly and test documentation. The Contractor shall characterize, using existing procedures, antennas provided by NASA. The Contractor shall integrate the components into the Model and perform functional tests. A Contractor representative shall attend weekly Project status/planning meetings in NASA Langley Research Center B720B and be prepared to present/discuss progress, plans, and problems associated with the subtask. The Contractor shall participate in (prepare material for) the Return-to-Flight design review.

Deliverables:
1. All Boxes & wiring harnesses for the Electro-pyrotechnic and RF Systems ready (operational and tested) for integration by August 31, 1997.
2. Subsystems integrated into Model and ready (operational) for system-level test by September 15, 1997.
3. Assembly-history and test-result documentation at completion of integration.
4. Updated system drawings / documentation (incorporating any approved changes necessary due to design changes, unavailability of parts, etc.) at completion of integration.
5. Test and Evaluation Report by September 26, 1997.
6. Monthly status reports, either written or presentation.
7. Design review material.

Performance Standards and Evaluation Criteria
Meets:
1. Deliverables provided on time.
2. Electro-pyrotechnic and RF Communications subsystem conforms to existing drawings or approved modified drawings.
3. Updated "as built" design documentation includes detailed "fabrication ready" electronic drawings (circuit schematic and layout), system level block diagrams, other engineering drawings (parts lists, wiring diagrams, housing design, etc.) needed to assemble subsystem, conforms to Mil STD 100 and LHB 7910.1, and is clear, accurate, and comprehensive, as determined by the TM.
4. Test and Evaluation Report clear, accurate, and comprehensive, as determined by the TM, and contains as a minimum:
   a). Description of test setup
   b). Listing of test parameters and how they demonstrated system design and operating performance
   c).Test results demonstrating system performance
5. All significant events or failures identified to technical monitor within 24 hours
6. Monthly status reports by the last working day of the month include the following minimum information:
   a). Schedule status
   b). Design/development progress
   c). Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.
7. Design review material delivered two working days prior to review and clear and accurate as determined by the TM.

Exceeds:
1. Delivers system at least 15 days ahead of schedule.
2. Contractor suggested improvements are accepted (government reviewed and approved) to design or test procedures which increase reliability (as determined by TM) or decrease test time.

Subtask 2: Ground Instrumentation

2.1 The Contractor shall setup, operate, and maintain, using Government provided procedures, proven ground electronic equipment and systems in the instrumentation trailer, command trailer and tracker trailer, making up the Ground Instrumentation. The Ground Instrumentation shall support all scheduled ground tests at Langley Research Center, and ground and flight tests at Wallops Flight Facility. The Contractor shall monitor all system failures or anomalies, determine cause, and recommend corrective action for Government approval. Once approved, contractor shall implement repairs. The contractor shall proceed if approval is not provided within three working days. (Note: salt corrosion has been a problem.) Design, configuration, and procedure changes may be necessary to support testing. Contractor shall determine and recommend changes to the Technical Monitor (TM). The TM will review and provide approval of these changes. The contractor shall proceed if approval is not provided within three working days. The Contractor shall maintain (redline and modify as approved) drawings and all assembly, test and operations procedures/documentation to provide up-to-date configuration. The Contractor shall record data from each drop model system-level test on magnetic tape recorders, included as part of the Ground Instrumentation, and provide to the Government for review and processing. The Contractor shall validate recorded data (verify recorded, recoverable and channel operating) within 4 hours after each drop model test is completed.

Deliverables:
1. Ground Instrumentation ready to support scheduled ground and flight tests at Langley Research Center and at Wallops Island.
2. Up-to-date logbooks of system configuration and equipment status
3. Up-to-date drawings and documentation of system configuration and components.
4. Tapes of test data.
5. Monthly status reports, either written or presentation.
6. Display and hardcopy of 24 Government designated calibrated stripchart recorder channels for each ground test.
7. Recorded data from each ground test.
8. Validated quick-look data records for each ground test.

2.2 The contractor shall also maintain the Government provided Drop Model battery packs using a government supplied "pre-flight procedure" (reference document available on request from Technical Monitor). Government owned, automated charging equipment is available for Contractor use.

Deliverables:
1. Charged battery packs ready for each ground and flight test for the following systems:
   a. Instrumentation System
   b. Pyrotechnic System
   c. Servo System
   d. Salt-water sensor system
   e. Zero Impulse Bolt System
   f. Ground Support Equipment System
   g. Helicopter Power System
2. Data sheets for each pack
3. Monthly status reports, either written or presentation.

2.3 The Contractor shall calibrate or have calibrated all ground equipment used to acquire the test data and defined in the Instrumentation Trailer Pre-flight Procedure (reference document available upon request from Technical Monitor) at intervals of 12 months or less in accordance with LHB5330.9 Metrology and Calibration Program.

Deliverables:
1. Monthly equipment calibration status.
2. Calibration data sheets on contractor-calibrated Ground Instrumentation equipment.

Performance Standards and Evaluation Criteria

Meets:

1. Ground Instrumentation (instrumentation, command and tracker trailer electronic systems) ready (pre-flight procedures completed prior to the scheduled test and all equipment necessary for test operating properly) as needed/scheduled 90% of the time.
2. Recorded data 90% recoverable (based on Contractor validation) 90% of the time.
3. Recorded data from each ground test delivered to NASA within 24 hours after completion of test, on media compatible with NASA ground station data processing systems.
4. Validated quick-look data records for all active channels from the ground data tape recorders used to record the data during ground tests delivered the day following the test.
5. At least 95% of the ground electronic systems calibrations (reference NMI -5330.9B) maintained by the calibration due date.
6. No equipment failure due to mishandling as determined by Government review.
7. Updated documentation includes detailed "fabrication ready" electronic drawings (circuit schematic and layout), system level block diagrams, other engineering drawings (parts lists, wiring diagrams, housing design, etc.) needed to assemble subsystem/trailers, conforms to Mil STD 100 and LHB 7910.1, and is clear, accurate, and comprehensive, as determined by the TM.
8. All significant events or failures identified to technical monitor within 24 hours.
9. Monthly report on documentation status including documentation changes due to ground electronic modifications / upgrades / reconfiguration, changes to trailer setup procedures, and equipment anomalies requiring repair or delay of scheduled tests. Monthly status reports by the last working day of the month include the following minimum information:
   a. Schedule status
   b. Design/development progress
   c. Significant problems with design, procedures, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.

Exceeds:

1. Ground Instrumentation ready as needed/scheduled 98% of the time.
2. Recorded data 100% recoverable (based on Contractor validation) tape recorder data 95% of the time. All (100%) of the ground electronic systems calibrations maintained by the calibration due date.
3. Post-flight quick-look records delivered within 2 hours after the flight.

4. Government Furnished Items: The following items are unique to the Drop Model Project and will be available for use:

1. Complete set of Model design documentation.
2. Ground equipment and spares for the instrumentation trailer, command trailer and tracker trailer. A complete list is available from the Technical Monitor.
3. Battery packs and spare batteries.
4. NASA battery maintenance procedure.
5. All equipment manuals, specifications, ground and flight test procedures.
6. Day of Flight Procedures.
7. Instrument Trailer Pre-flight Procedures.
8. Model Development Schedule - update weekly, and released monthly..
9. Laboratory facilities for test and assembly.
10. Access to general laboratory equipment and electronic assembly hand tools.
11. Access to a computer aided design workstation with access to the CAEDE facility.

5. Other information needed for performance of task

- Major system modifications and checkouts will occur at Langley Research Center (LaRC) B720B.
- All wiring, soldering, crimping, etc., shall be performed to NASA Handbook NHB 5300.4 Series.
- All drawings must meet NASA Flight Instrumentation Guidelines for generation, modification, release (reference LHB 7910.1 "Flight Research Program Management").
- Repair of Government furnished items may be scheduled through NASA-funded equipment repair facilities.
- Calibration of equipment may be scheduled through NASA-funded calibration facilities traceable to National Calibration Standards.

6. Security clearance required for performance of work:

None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: September 30, 1997

8. NASA Technical Monitor: Kevin E. Brown
M/S: 488 Phone: 804-864-1856

SAERS (NAS1-96013) Task Order

1. Task Order Number:: GL011 Revision: ____ Date of Revision:_
   Title: AEROSPACE DATA ACQUISITION & PROCESSING STATION (ADAPS).

2. Purpose, Objective or Background of Work to be Performed:

The government is currently enhancing and operating an advanced data acquisition and processing station (ADAPS). The station is located in building 1244 in room 121B. ADAPS is a combination of several systems and includes a backup system. The core processing system (CPS) involves an acquisition system, a realtime data processing system, and an output processing system (see attached CPS block diagram). The heart of the processing system is a realtime multi-processing computer that takes serial raw digital data and converts the output to engineering units. This Realtime Multi-Processing System (RMPS) utilizes a unix based front end which in turn is run and monitored by a Vax computer system. Processing programs are written in C, Fortran and 68000 assembler code. The acquisition system is a mixture of computers and external hardware that inputs a variety of data media such as optical, magnetic, and RF and converts this either into an analog format for stripcharts or into pulse code modulation (PCM) digital stream format. This format is established by the mission/flight database. The output processing system is composed of several computers and peripherals linked to the realtime data processing system data via electronic storage files. This system delivers displays, run summaries, status reports, plots, and archives data for both long and short term storage. Data storage involves both long term and short term storage long term is data storage via network at the information systems and services division (ISSD), Bldg.1268A /Masstor. Short term is data storage maintained at ADAPS. The Government has developed standard operating procedures for the existing CPS.

The "backup" system replicates the core processing system using PC based hardware and in house software programs. The input uses the same CPS digital format and the output format is identical to RMPS Engineering Units (EU) files. However, the backup system has a much slower processing rate.

Typical data processing for a project consists up to 1500 channels. PCM words can be up to 16 bits in length. A typical data channel frequency is less than 50 Hertz. Flight recorded data can be up to 8 hour lengths. Data playback can be played back at higher rates to reduce post-processing time. "Processing requests" include EU processing, re-processing of stored or recorded data, archiving, and simulation (generation and processing of simulated data). Average annual flight load is 100 - 200 flights or data events.

The purpose of this task is to operate, via procedure, ADAPS, as described above, to process data according to request, complete development and integrate a RMPS Quicklook program and RMPS Derived Parameter Editor into the core processing system, and test the feasibility of bringing a RMPS II online.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements):

3.1 CPS Data Processing / Operations

The Contractor shall, in response to user "processing requests", operate the acquisition, RMPS, and output processing systems, keep operation logs, maintain system, database, backups, and update ADAPS webpage. This includes providing mission / flight process scheduling / schedules, and attend mission / project planning meetings . Data processing operations shall be performed using standard flight project database furnished by LaRC.

Deliverables:

3.1.1. ADAPS Processing Schedules, updated at least weekly.
3.1.2. Setup, tested, and verified RMPS project databases.
3.1.3. RMPS Project Scenarios.
3.1.4. Processed real-time displays, recorded EU files, plots, run summaries, and status reports.
3.1.5. Archived ADAPS Project Data.
3.1.6. ADAPS Project, Diagnostics, And Problem Logs.
3.1.7. RMPS Database Backups.
3.1.8. ADAPS Project Data Web Page Updates.
3.1.9. Attend regular and "called" meetings designated by TM and provide consultation for new ADAPS projects.
NOTE: "Called" project meetings are flight load dependent, approximately one hour long up to five times a week, two per week on average.

PERFORMANCE STANDARDS AND EVALUATION CRITERIA

Meets:
1. Deliverables 3.1.1-3.1.5 are complete and accurate as determined by task monitor and instrumentation engineer.
2. Processed real-time displays, recorded EU files, plots, run summaries, and
3. status reports within 12 working hours 90% of the time with no more than 2 days average delay the remaining 10% of the time.
4. ADAPS data processed and stored at ISSD Masstor within 12 working hours 90% of the time with no more than 2 days average delay the remaining 10% of the time.
   NOTE: New project scenarios / databases are allowed 2 weeks for setup, testing, and verification.
5. Log books are maintained complete, as determined by task monitor review, and up-to-date within 48 hours.
6. RMPS Database Incremental backups weekly.
7. ADAPS Project Data Web Page updated daily.
8. Contractor available for meetings 90% of the time.
9. All significant events or failures identified to technical monitor within 24 hours.

Exceeds:
1. Exceeds criteria if deliverables 3.1.4. and 3.1.5. are completed within 6 working hours 90% of the time with no more than 1 day average delay the remaining 10% of the time.
2. Contractor suggested improvements are accepted (government reviewed and approved) to operating procedures which decrease turn around time of project processed data.
3. Exceeds criteria if task monitor receives weekly email summary / status reports.
4. Exceeds criteria if a complete incremental image (as opposed to file) backup of the RMPS operating system hard drive is also performed monthly.
5. Exceeds criteria if meeting summaries are emailed to task monitor within 48 hours.

3.2. CPS Maintenance
The Contractor shall maintain the acquisition, data processing, and output processing systems, including the "backup" system. Contractor may schedule ADAPS equipment repair and calibration through NASA funded services / facilities.

Deliverables:

3.2.1. Operational CPS.
3.2.2. ADAPS Equipment Calibrations.
3.2.3. ADAPS Maintenance Logs.

PERFORMANCE STANDARDS AND EVALUATION CRITERIA

Meets:
1. CPS operational to meet project processing schedules 95% of the time.
2. Remaining 5% of the time no more than one week delay.
3. ADAPS Equipment Calibrations comply with LMI 5330.9 standards (performed every 6 months).
4. Log books are maintained complete, as determined by task monitor review, and updated monthly.

Exceeds:

1. Exceeds criteria if CPS available as scheduled 100% of the time.
2. Exceeds criteria if a daily operations log is maintained.

3.3. RMPS II Investigation

The Contractor shall conduct an investigation and development of an existing RMPS II single chassis system. Contractor shall use existing RMPS I software diagnostic routines to investigate RMPS II firmware and hardware. Contractor shall interface one Vax terminal and one Fuji 2361 disk drive to the RMPS II chassis. Contractor may use RMPS I peripherals, but shall schedule use to not interfere with ADAPS processing.

Deliverables:

3.3.1. RMPS II Power On Diagnostics Report.
3.3.2. Peripheral Interface Diagnostics Report.
3.3.3. Feasibility Report, to include as a minimum, the condition of the firmware and backplane of the versabus cage, condition of the VMEbus cage, and possible solutions to the above identified and other problems encountered.
3.3.4. Monthly status reports.

PERFORMANCE STANDARDS AND EVALUATION CRITERIA

Meets:
1. Monthly status reports by last working day of month include the following minimum information:
   a). Schedule status
   b). Development and test progress
   c). Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.
2. Diagnostic Reports 60 days after contract is implemented and are clear, accurate, and comprehensive, as determined by the TM, and contains as a minimum:
   a). Description of test setup
   b). Listing of test parameters and how they demonstrate system operating performance
   c). Test results demonstrating system performance or non performance
3. Feasibility Report 30 days after contract is implemented and is clear, accurate, and comprehensive, as determined by the TM
4. All significant events or failures identified to technical monitor within 24 hours

Exceeds:
1. SUBTASK 3.3.1-3.3.2. Exceeds criteria if deliverables do not use RMPS I perpherals.

3.4. RMPS Quicklook

Contractor shall complete the RMPS Quicklook program. Quicklooks shall use the RMPS flight test data analysis system (FTDAS) software. All quicklooks shall playback RMPS EU files. Quicklooks shall process parameters from EU run files based on pre-determined start and stop times. Quicklook development shall use the current B757 baseline database as an initial reference. Quicklook algorithms shall use Teledyne Controls handbook on parameter processing algorithms. Contractor shall use quicklooks to identify dead channels, dropouts, limits exceeded, discrete events, and detect spikes in flight processed data. Quicklooks shall use RMPS displays to display EU data of selected playback start and stop times. Quicklooks shall print out summaries of the above and associated times events occurred, totals, project and file names, and date. The contractor shall develop test procedures. All tests procedures shall be delivered to the TM for review and approval. They will be reviewed and verified by the ADAPS TM and flight instrumentation engineer. The contractor shall proceed if approval is not provided within 5 working days. The contractor shall use these approved procedures to verify proper operation and performance.

NOTE: Quicklooks are used to determine quality assurance of flight data.

<u>Deliverables:</u>

3.4.1. RMPS Quicklook Program.
3.4.2. RMPS Quicklook Displays.
3.4.3. Operating Manual.
3.4.4. Monthly status reports.
3.4.5. Test procedures.
3.4.6. Test and Evaluation Report.

PERFORMANCE STANDARDS AND EVALUATION CRITERIA

<u>Meets:</u>

1. RMPS Quicklook Program developed, tested, and verified (by the ADAPS TM and flight instrumentation engineer) 120 days after contract is implemented.
2. Operations Manual clear, accurate, and comprehensive, as determined by the TM
3. Monthly status reports by last working day of month include the following minimum information:
   a). Schedule status
   b). Development and test progress
   c). Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.
4. Test and Evaluation Report clear, accurate, and comprehensive, as determined by the TM, and contains as a minimum:
   a). Description of test setup
   b). Listing of test parameters and how they demonstrated system design and operating performance
   c). Test results demonstrating system performance
5. All significant events or failures identified to technical monitor within 24 hours

<u>Exceeds:</u>

1. Exceeds criteria if deliverable is completed in 90 days after contract is implemented.
2. Contractor suggested improvements to operating procedure are accepted (government reviewed and approved) which decrease turn-around time of processing flight data or provides project compatible Quicklook running on PC / backup computers.

3.5. RMPS Derived Parameter Editor

Contractor shall complete the RMPS Derived Parameter Editor development, including test and verification. Editor shall be able to manipulate RMPS acquisition words into temporary RMPS scratch memory. Manipulation shall be able to concatenate unused areas of previously used acquisition words to form parameters. Concatenated parameters shall be made available for RMPS EU processing outputs. Editor shall interface with Teledyne Controls RMPS software. The contractor shall develop test procedures. All tests procedures shall be delivered to the TM for review and approval. They will be reviewed and verified by the ADAPS TM and flight instrumentation engineer. The contractor shall proceed if approval is not provided within 5 working days. The contractor shall use these approved procedures to verify proper operation and performance.

Deliverables:

3.5.1. RMPS Derived Parameter Editor.
3.5.2. Operating Manual.
3.5.3. Monthly status reports.
3.5.4. Test procedures.
3.5.5. Test and Evaluation Report.

PERFORMANCE STANDARDS AND EVALUATION CRITERIA

Meets:
1. RMPS Derived Parameter Editor developed, tested, and verified (by the ADAPS TM and flight instrumentation engineer) 90 days after contract is implemented.
2. Operations Manual clear, accurate, and comprehensive, as determined by the TM
3. Monthly status reports by last working day of month include the following minimum information:
   a). Schedule status
   b). Development and test progress
   c). Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.
4. Test and Evaluation Report clear, accurate, and comprehensive, as determined by the TM, and contains as a minimum:
   a). Description of test setup
   b). Listing of test parameters and how they demonstrated system design and operating performance
   c). Test results demonstrating system performance
5. All significant events or failures identified to technical monitor within 24 hours

Exceeds:
1. Exceeds criteria if deliverable is completed in 60 days after contract is implemented.
2. Contractor suggested improvements to operating procedure are accepted (government reviewed and approved) which decrease turn-around time in editing derived parameters for RMPS.

4. Government Furnished Items:

4.1. CPS Hardware/Software:
(Summary Of Core Processing System (CPS)).
- RMPS I and RMPS II, Vax computer, PC computers, IBM 591 RISC 6000, operating software, and all necessary documentation.
- Data acquisition hardware.
- Simulators

- Strip chart recorders and DAC'S.
- Time code readers/generators/receivers.
- Recorders, magnetic tape, optical, CD, DLT
- Network system
- Printers, plotters
- Teledyne Controls RMPS and flight test data analysis system (FTDAS) software.
- Other acquisition software, (TMATE, BSW 1001, RAGS) for ADAPS backup purposes.
- PCFILE and Microsoft access database software.

NOTE: Complete, detailed current list to be provided.

4.2. Access, via network connection, to ISSD Masstore Computers

5. Other information needed for performance of task.

1. Data plots may/should be generated using standard proven software.
2. Run summaries may/should be generated using standard proven software.
3. All PCM data will conform to the inter-range instrumentation group (IRIG) Standard 106-93.
4. All current RMPS operations are based on Teledyne Controls documentation located in ADAPS.

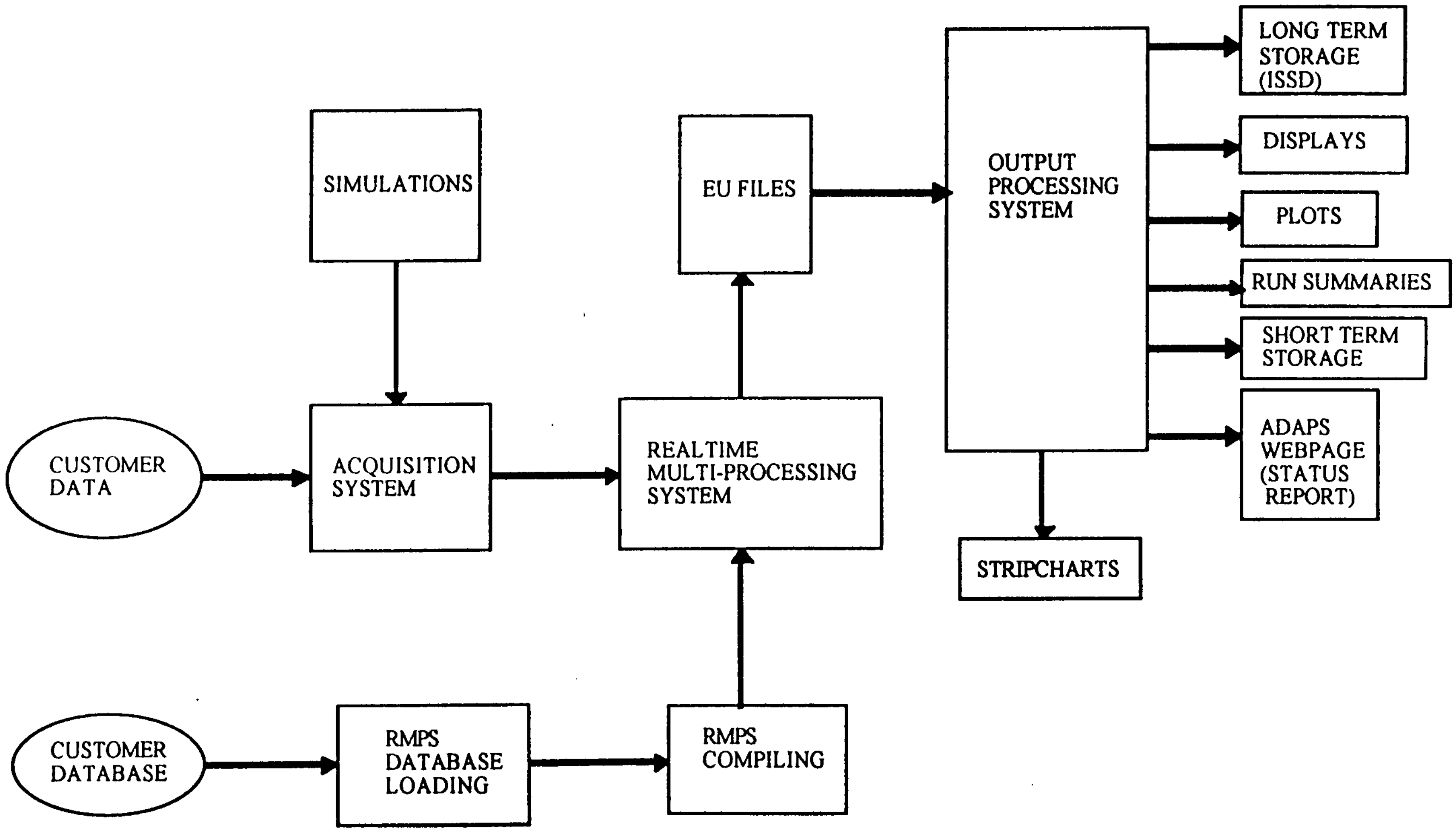
6. Security clearance required for performance of work:

None

7. Period of Performance:	
Planned start date: 5/1/1997	Expected completion date: 4/30/1998

8. NASA Technical Monitor: KEVIN VIPAVETZ
M/S: 257 Phone: 757-864- 3806

CORE PROCESSING SYSTEM (CPS)



GOVERNMENT FURNISHED ITEM LIST
for
ADAPS / SAERS GL011

ITEM	MODEL	ECN
Digital Microvax III expansion chassis		062025
Digital Microvax II		144345
Kennedy Magnetic Tape Drive	9401	144351
Emulex Hard Drive	SD893	1083904
Emulex Hard Drive	SD893	1083903
Emulex Hard Drive	SD893	1083905
Digital RA90 Hard Drives (8)	SA600	1424202
Digital Line Printer	LP26	220076
Hewlett-Packard Laser Jet Printer	5SiMX	1428804
IBM Network Printer	24	
Digital Color Monitor	VT340	1262213
Digital Color Monitor	VT340	1424204
Digital Color Monitor	VT340	1262214
Digital Printer/Terminal	Decwriter III	144346
Digital Printer/Terminal	Decwriter III	220075
Digital Color Monitor (Rags 2)	VT340	
Systron-Donner Tape Search Unit	8140	530416
Systron-Donner Time Code Reader	8130	178274
General Data Products PCM Simulator	233	848955
Gateway 2000 Personal Computer	P5-166	1430927
NEC Multi-Sync Color Monitor	4Fge	1257352
EMR PCM Bit Synchronizer	720	847333
Cherokee Data Systems Optical Disk Drive		1092324
Digital Color Monitor	VT340	1424203
Okidata 24 Pin Printer	Microline 590	
Ampex 3025 Tape Recorder	FR3025	189374
Ampex 3030 Tape Recorder	FR3030	144412
Gould Strip Chart Recorde	TA4000	848582
EMR Digital/Analog Converter	8350	259706
EMR Programmable Word Selector	713	180059
Data Check Scan/Scope	1880	778007
Tektronix Oscilloscope	465	777896
Monitor Systems Frame Synchronizer	430	550764
Ampex Tape Degausser	SE-10	530793
Datum Time Code Generator/Translator	9310	471865
EMR PCM Bit Synchronizer	720	532488
Teledyne Controls RMPS-2		1254833
Digital RMPS-2	4200	1424205
Fujitsu Drive RMPS-2	M2361A	052529
Fujitsu Drive RMPS-2	M2361A	141075
Fujitsu Drive RMPS-2	M2361A	1086338
Fujitsu Drive RMPS-2	M2361A	1086337
Trimm Industries Hard Drive	DA40-DIR	1426002
Datatape MARS-II Electronics Module		1428799
Datatape MARS-II Storage Module		1428801
EMR PCM Bit Synchronizer	720	847334
Fujitsu RMPS-1 & MARS-II Rack		144340
RMPS-1 Rack		138486
Teledyne Controls RMPS-1		144342

Digital RMPS-1	3200	848106
Digital Color Monitor (RMPS-1)	VT340	
Datum Time Code Generator/Translator	9310	533188
Datum Tape Search & Control Unit	9241	282792
EMR PCM Simulator	2795	531165
EMR PCM Bit Synchronizer	720	187356
Monitor PCM Frame Synchronizer	430	155453
IBM Color Monitor	6091-19I	1431215
IBM RISC System/6000 (BORG)	591	1431097
NEC Multi-Sync Color Monitor	4Fge	1344610
Gateway 2000 Personal Computer	G6-200	

1. Task Order Number:: GL 012 Revision: ____ Date of Revision:_
   Title: **DACOM and DLH Instrument Support for SONEX**

2. Purpose, Objective or Background of Work to be Performed:

The NASA Atmospheric Effects of Aviation Project (AEAP) is sponsoring an airborne atmospheric science mission to the North Atlantic region during the summer and fall 1997. This measurement campaign named the SASS Ozone and NO_x Experiment (SONEX) Mission will involve the deployment of the NASA Ames DC-8 that will be instrumented by principal investigator (PI) groups from several universities and government agencies. The primary objective of the SONEX Mission is to investigate the impact of air traffic emissions on the atmosphere.

The Aerospace Electronics Systems Division (AESD) will have an important role in SONEX by providing measurements of key gas species on the DC-8 aircraft made by the diode-laser-based DACOM (Differential Absorption CO Measurement) and DLH (Diode Laser Hygrometer) instruments. High accuracy, fast response, in situ measurements of CO, CH_4 and N_2O will be provided by DACOM while high quality $H_2O(v)$ measurements will be provided by the DLH. The DACOM and DLH instrument systems are scheduled to be in the field at either the DC-8 integration site (NASA Ames) or based from operations sites at Bangor, Maine or Shannon, Ireland during the period July 11, 1997 to approximately September 30, 1997. Personnel are required to support deployment by preflight testing, inflight operation, and post flight data handling.

The DACOM instrument has the following subsystems: air sampling, calibration, optics, cryogenics, electronics (control and detection)and data acquisition. The DLH includes the following subsystems: laser transceiver, electronics (control and detection) and data acquisition.

This task covers the preparation, check out and shipment of the DACOM and DLH instruments for reflight on the DC-8; subsequent integration of DACOM and DLH onto the DC-8 and preflight test of the instruments; the operation and maintenance of the instruments during the SONEX deployment; the return of these instruments and supporting hardware/software to Langley; and the consolidation of the equipment back into the laboratory. The SAERS task responsibilities during the aircraft integration and operations of the DACOM and DLH are to ensure operation of the above subsystems except for the DACOM optics. The NASA PI will be responsible for the DACOM optics. He will also interpret the mission objectives and requirements of the SONEX project office and will determine measurement strategy.

Description of the Work to be Performed

Subtask 1.0: Prepare, check out and ship DACOM and DLH to integration site. The contractor shall develop procedures to prepare, check out and ship DACOM and DLH to the integration site. The Task monitor will review and provide approval of these procedures. The contractor shall proceed if approval is not provided within 5 working days. The contractor shall use these procudures to verify proper operation and performance of the instruments. The contractor shall ship the DACOM and DLH to the integration site. Attachment A lists the details (dates location, and durations of field operation).

Deliverables

1. Written procedures to operate and maintain DACOM and DLH subsystems.

2. Log entries summarizing tests of DACOM and DLH subsystems (according to above procedures), including anomalous behavior and / or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

4. DACOM and DLH test data files and/or strip charts generated during check out tests.

5. List of instrument calibration status

6. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DACOM and DLH verified operational via Government approved procedures, and packed, to meet scheduled ship date of July 11, 1997, barring optics failure.
2. Delivery of DACOM and DLH data files and/or strip charts to PI within 24 hours of each test. Details of tests are listed in Attachment A.
3. Calibration and shipping list complete and up to date prior to shippment.

Exceeds:

1. DACOM and DLH are ready three weeks prior to scheduled ship date, barring optics failure

Subtask 2.0: Integrate and preflight test DACOM and DLH on the NASA DC-8 (detailed in Attachment A). This requires the contractor to unpack, assemble and install the DACOM and DLH on the NASA DC-8. The contractor shall verify the DACOM and DLH operational using the procudures developed under subtask 1.0 above.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM and DLH subsystems (according to above procedures), including anomalous

behavior and / or failures.

2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

3. DACOM and DLH test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM and DLH are ready, i.e. verified operational via Govemement approved procedures to meet scheduled science flights (detailed in Attachment A) barring optics failure
2. Delivery of DACOM and DLH data files to PI within 24 hours of each test.

Exceeds:

1. DACOM and DLH are ready one week prior to first scheduled science flight (detailed in Attachment A), barring optics failure

Subtask 3.0: Operate, according to Subtask 1.0 developed procedures, and maintain DACOM and DLH subsystems during the SONEX mission, i.e. test and science flights.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM and DLH instruments (according to above procedures) prior to each flight, including anomalous behavior and / or failures.

2. Log entries summarizing procedural operation and performance of DACOM and DLH subsystems (according to above procedures) during each flight, including anomalous behavior and / or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

4. DACOM and DLH test data files and/or stripcharts.

Performance Standards and Evaluation Criteria

Meets:

1. CO data for each flight barring laser, optics or detector failures.
2. CH_4 data for at least 50% of the flights barring laser, optics or detector failures.
3. N_2O data for at least 25% of the flights barring laser , optics or detector failures.
4. $H_2O(v)$ data for at least 50% of the flights barring laser, optics or detector failures.
5. Delivery of DACOM and DLH data files to PI within 24 hours of each flight (detailed in Attachment A)

Exceeds:

1. CH_4 data for at least 75% of the flights barring laser, optics or detector failures.
2. N_2O data for at least 50% of the flights barring laser, optics or detector failures.
3. $H_2O(v)$ data for at least 75% of the flights barring laser, optics or detector failures.

Subtask 4.0: Coordinate off-loading of DACOM and DLH with DC-8 support personnel and shipment of equipment to Langley with SONEX project personnel.

Deliverables

1. Log entries of handling or work performed on subsystems.
2. Provide PI with shipping lists at time of shipment.

Performance Standards and Evaluation Criteria

Meets:
1. Equipment packed and shipping list complete and up to date prior to shipment.

Exceeds:
1. Equipment packed and shipping list complete and up to date one week prior to shippment.

Subtask 5.0: After return from deployment, unpack DACOM, DLH, and supporting equipment, reorganize laboratory, conduct equipment inventory, and send instruments in need of calibration to LaRC Calibration Laboratory.

Deliverable
1. Log entries of handling or work performed on subsystems.
2. Results of equipment inventory.
3. List of instrument calibration status

Performance Standards and Evaluation Criteria

Meets:
1. Equipment unpacked and laboratory reorganized within two months of receipt at LARC.

Exceeds:
1. Equipment unpacked and laboratory reorganized within one months of receipt at LARC.

General Performance Standards and Evaluation Criteria (apply to all subtasks)

Meets:

1. Log books are maintained complete and up-to-date within 48 hours

Exceeds:
Contractor suggested improvements are accepted (government reviewed and approved) to operating procedures which decrease the turn-around time of the instruments between flights or significantly reduce the over-all cost of preparation and deployment. These improvements shall in no way compromise the health, safety, or performance of the instruments.

4. Government Furnished Items:

1. The DACOM and DLH instruments as well as supporting instrumentation, flight racks, shipping containers, hardware, software, and manuals. Lists of GFI will be provided by May 1, 1997
2. Access will be available to standard tools and lab test equipment (e.g. meters and 'scopes).
3. Laboratory facilities for instrument checkout are available in rooms 123 and 124 of Building 1202.
4. Government to ship equipment to ARC from LaRC and return.
5. Government to furnish existing documentation, including notebooks, AutoCAD schematics, etc.

5. Other information needed for performance of task.

Travel: Deployment schedule calendars for the DC-8 operations are very changeable. They can be accessed on the web at the SONEX site URL:
http://telsci.arc.nasa.gov/~sonex
There must be 2 operators with the DACOM and DLH throughout the mission. (Note: the PI or his designee will count as one operator of these instruments) Typically, more personnel are used at the initial stages when the equipment is configured for the aircraft and characterized during the "shakedown flights" at the beginning of the deployment.

Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC

6. Security clearance required for performance of work:
None required

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: November 30, 1997

8. NASA Technical Monitor: Glen W. Sachse
M/S: 472 Phone: 757-864-1566

High Level Sonex Schedule

This is based on the latest information provided at the SONEX Web Site
http://telsci.arc.nasa.gov/~sonex

SONEX Integration and Upload: July 7- August 1 at Ames Research Center
Aircraft Rollout, inspection, weight and balance, power checks August 4-August 8 (ARC)
Pilot Proficiency, Engineering/Test Flighta August 9-August 19
Transit Prep at ARC 8/20-8/21
Transit to Bangor ME August 22-23
Transit to Shannon, Irelend August 24th
Science flights off Irish Coats/Shannon - August 25th-Sept 5th
Prep and Transit to Azores - 9/6 - 9/8
Azores Science Flights - 9/9 -9/10
Transit to Bangor, ME 9/11
Bangor Deployments - 9/12 - 9/24
Transit to Ames - 9/25
Download and Deintegration at Ames - 9-26-10/1

1. Task Order Number:: GL14 Revision: 1 Date of Revision: 6/10/97

Title: **Wake Vortex Lidar Data Acquisition System**

2. Purpose, Objective or Background of Work to be Performed:

The Wake Vortex Lidar (WVL) project is to define and implement lidar and optical measurement techniques for locating, tracking, and quantifying trailing vortices created by aircraft during takeoff and landings. The system will provide wake vortex detection and tracking for an Aircraft Vortex Spacing System (AVOSS) which is part of a future air traffic control system. The data acquisition will be carried out in the Wake Vortex Lidar Mobile Test Facility taken to various airports described below. The data acquisition system includes a digitizer, analog electronics for matching signals to the digitizer, real-time digital signal processors for computing wind velocity versus range, video systems for recording images for landing aircraft, and computer and computer networks for operation and data storage. This equipment is already in place in the Mobile Test Facility, and an enhanced system for a high pulse repetition frequency, 1.56 micron lidar will be installed at a later date.

A coherent lidar transceiver, having a pulse repetition frequency of 1000 Hz, is under development at NASA LaRC. A data acquisition system is required to capture the atmospheric return signals at this high rate and process the signal for real-time computation of wind velocity versus range. The complete lidar system will be used for detection of aircraft wake vortices in support of the Wake Vortex Lidar project. This task will include design, development, and testing of the data acquisition system at LaRC. The system will be integrated into the existing system housed in a NASA trailer described above. Once integration is complete, the proven system will be taken on field tests.

This task covers maintenance and upgrades to the existing data acquisition system and installation of the new, upgraded system.

3. Description of the Work to be Performed

Existing System

1.0 The contractor shall maintain the data acquisition system, including archival and storage of data, housekeeping of computers, identification of any anomalies or failures, and execution of repairs. Maintenance shall be judged successful if the data acquisition system is fully operational one week prior to deployments. Approximate dates of deployments are listed below, and written notification of exact dates will be given three weeks prior to deployment. Maintenance shall also include a training period of up to two weeks to occur at the beginning of each deployment, so that government personnel will be able to operate the data acquisition system. This training will occur at the field test site during the deployment's phase of setup and system check-out.

Deliverables:

- Lidar data acquisition system functional (passed all check-out procedures) and ready to support field deployments to occur a the following dates and locations:
    - JFK International Airport in May 1997.
    - DFW International Airport in July 1997.
    - ORF International Airport in February 1998.

- Instruction manual a... operational procedures for the data acq...ition system one week prior to each deployment.
- Written reports of equipment failures and recommended repairs.

2.0 The contractor shall upgrade the existing data acquisition system as listed below.

2.1 Integration of a fiber optic SCRAMNET interface between a PC-based digitizer located in Room 300, B1202 and data acquisition system located in the Mobile Test Facility when parked behind B1202. Routing of the fiber optic cable between the two locations will be provided by NASA.

2.2 Implement PC-based code to enable real-time vortex tracking. Algorithms for real-time processing will be provided by Research Triangle Institute (RTI) before June 16, 1997 in the form of equations, block diagrams, and pseudocode. Fully functional code shall be demonstrated before 45 days after receipt from RTI.

2.3 Implement PC-based code for enhanced display resolution based on Lagrange estimation. Algorithm for this estimation technique will be provided by Research Triangle Institute before May 12, 1997. Fully functional code shall be provided demonstrated before 45 days after receipt from RTI.

<u>Deliverables</u>:
- Instruction manual for use of SCRAMNET interface.
- Instruction manual and print-out of code source listing for real-time vortex tracking.
- Instruction manual and print-out of code source listing for enhanced display resolution.

3.0 <u>Reports/Status Reviews:</u>
- Monthly written report, submitted electronically, on the work done the previous month and the work planned for the next month.
- Quarterly written reports on the work performed the past quarter and the work planned for the next quarter.
- Informal oral reports at the weekly team meeting.

Performance Standards and Evaluation Criteria:

<u>Meets:</u>
- Lidar data acquisition system functional (passed all check-out procedures) and ready to support field deployments one week prior to beginning of deployment..
- Contractor delivered code and lidar data acquisition system provides acceptable recording and processing of lidar returns, as verified by post-processed comparison by the Government with data recorded from deployment of Wake Vortex Lidar at Norfolk International Airport during March 1997.
- Laboratory equipment calibrated at least annually, traceable to National Calibration Standards.
- Documentation (log books, manuals, reports, etc.) clear, concise and accurate as determined by TM random check.

<u>Exceeds:</u>

- Data Acquisition system fully functional (passed all check-out procedures) and ready to support field deployments two week prior to beginning of deployment.
- Practical Contractor suggested system modifications or procedure change that improve operational readiness while not increasing cost. Note: If approved by Government review boards, modifications may lead to task modification for implementation.

- Codes described in ɔ-task 2.0 fully functional 15 days ahe. ɔf schedule (i.e.before 30 days).

3A. Description of the Work to be Performed

<u>New / upgraded system</u>

1.0 Data acquisition system design

The contractor shall complete design and provide specification for all components for the data acquisition system. The design shall be presented before a Government review panel for approval. This design shall include analog front end, digitizer, and real-time signal processing hardware. To the fullest extent possible, the design shall include existing data processing hardware currently in use by the Wake Vortex Project. Design requirements and performance specifications will be provided in a government-prepared document "Data Acquisition and Processing Requirements for a 1.5 micron Wavelength, 1000 Hz Pulse Repetition Frequency Coherent Lidar."

1.1 <u>Deliverables</u>:

a) Design review before Government review board before June 30, 1997.
b) Documentation of design including all block diagrams and schematics before July 15, 1997.
c) Identification of all parts, to the level of recommended vendor and part number, before July 15 1997.

2.0 Data acquisition system implementation

Upon approval by the Government, the contractor shall implement hardware and software designed in previous subtask. Algorithms for real-time processing will be provided by Research Triangle Institute and Clemson University in the form of equations, block diagrams and pseudocode. Coding of the algorithms is included in this task. The first phase of development, shown as the first deliverable below will be carried out in Room 300, B1202. All systems will then be moved to the Wake Vortex Lidar Mobile Test Facility parked behind B1202 where the second phase, shown as the second deliverable below, will be completed. Performance of the three deliverables will be tested and verified by the Government as described in the Government-prepared document "Data Acquisition and Processing Requirements for a 1.5 micron Wavelength, 1000 Hz Pulse Repetition Frequency Coherent Lidar."

2.1 <u>Deliverables:</u>

a) Hardware implemented with the capability to digitize lidar returns and analyze under post processing before September 30, 1997.
b) Fully functional hardware and software system with capability to process lidar returns in real-time before January 15, 1998.
c) "As built" Design documentation and Test and Evaluation Report of performance, Operations / Instruction Manuals, and print-outs of source code for previous two deliverables before January 15, 1998.

3.0 Data acquisition system integration and atmospheric testing

The Contractor shall interface the data acquisition system with the electronic output of the Government-provided lidar transceiver. This shall be done in two phases 1) integration of analog front end and digitizer, 2) integration of real-time signal processing hardware. The Contractor shall also operate and monitor the data acquisition system during atmospheric tests of the lidar system. Performance of the integrated data acquisition system will be tested and verified as described in the Government-prepared document "Data Acquisition and Processing Requirements for a 1.5 micron Wavelength, 1000 Hz Pulse Repetition Frequency Coherent Lidar." The lidar transceiver is due to be completed by Government personnel before August 30, 1997.

3.1 Deliverables:

a) Digitizer integrated (documented test results indicating meets performance delivered to Government for review and acceptance) with lidar transceiver by one month after completion of lidar transceiver.

b) Fully functional data acquisition system with real-time processing integrated (documented test results indicating meets performance delivered to Government for review and acceptance) with lidar transceiver by 4.5 months after completion of lidar transceiver.

c) Test and Evaluation Report of data acquisition performance of the above two deliverables by five months after completion of lidar transceiver.

4.0 Reports/Status Reviews:

a) Monthly written report by the last working day of the month, submitted electronically, on the work done the previous month and the work planned for the next month.

b) Oral reports at weekly team meeting.

5.0 Performance Standards and Evaluation Criteria:

5.1 Meets:

A. Design, implementation, and integration completed on time.

B. Design review material delivered two working days prior to review.

C. Test and Evaluation Report contains as a minimum:
   1. Description of test setup
   2. Listing of test parameters and how they demonstrated system design and operating performance
   3. Test results demonstrating system performance

D. All significant events or failures identified to technical monitor within 48 hours

E. "As built" Design documentation includes detailed "fabrication ready" electronic drawings (circuit schematic and layout), system level block diagrams, other engineering drawings (parts lists, wiring diagrams, housing design, etc.) needed to assemble subsystem, conforms to Mil STD 100 and LHB 7910.1.

F. Operations / Instruction Manual completed on time.

G. Monthly status reports include the following minimum information:
   1. Schedule status
   2. Design/development progress
   3. Significant problems with design, availability of government furnished equipment, acquisition of components or other issues, including anomalies and failures, that would effect completion of task.

H. Data acquisition system performance meets specifications described in the Government-prepared document "Data Acquisition and Processing Requirements for a 1.5 micron Wavelength, 1000 Hz Pulse Repetition Frequency Coherent Lidar."

5.2 Exceeds:

a) Practical Contractor suggested system modifications accepted, that improve operational readiness, while not increasing cost. If approved by Government review boards, modifications may lead to task modification for implementation.

b) Integration of data acquisition system completed two or more weeks ahead of schedule.

c) All documentation found by the Government to be clear, accurate and comprehensive.

4. Government Furnished Items:

a) Analog signal processing radio frequency/intermediate frequency (RF/IF) systems and components

b) Data system components

c) Real-time data process...g and storage components

Lidar and scanner system:

d) Coherent Technologies Inc. (CTI) 2 micron lidar transceiver

e) NASA developed 1.56 micron lidar transceiver.

f) Ancillary time, video, weather and environment data sensors

g) Lidar data system computers, peripherals and network facilities

h) Oscilloscopes, power sources and other standard laboratory equipment

i) PC based digitizer with SCRAMNET interface.

j) Algorithms for vortex tracking and enhanced displays.

k) Current data processing software code, manuals and specifications of GFI.

l) Operational procudures for lidar transceivers and scanner systems.

m) Parts and components specified in Contractor's design

n) "Data Aquisition and Processing Requirements for a 1.5 micron Wavelegnth, 1000 Hz Pulse Repetition Frequency Coherent Lidar"

o) Computers and software for operation and programming of data aquisition system.

p) Laboratoty facility in building 1202.

q) Current data processing software code, manuals and specifications of GFI.

5. Other information needed for performance of task.

Equipment Repair
- Equipment repair may be scheduled through NASA funded equipment repair facilities.

Equipment Calibration
- Equipment calibration may be scheduled through NASA funded calibration facilities traceable to National Calibration Standards.

6. Security clearance required for performance of work: None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Grady Koch
M/S: 468 Phone: 804-864-3850

National Aeronautics and
Space Administration
Langley Research Center
Hampton, VA 23681-0001

Reply to Attn of:

105 7/8/97

To: 126/Contracting Officer, NAS1-96013

From: COTR, NAS1-96013

Subject: Request for Task Modification under NAS1-96013

Please issue the attached task GL14R1 Modification under NAS1-96013.

Please contact the undersigned if you have any questions or require additional information.

Fred L. Staggs

Fred L. Staggs
864-1743

SAERS (NAS1-96013)Task Order

1. Task Order Number and Title Number: GL014 Revision:
   Title: **Wake Vortex Lidar Data Acquisition System**

2. Purpose, Objective or Background of Work to be Performed:

The Wake Vortex Lidar (WVL) project is to define and implement lidar and optical measurement techniques for locating, tracking, and quantifying trailing vortices created by aircraft during takeoff and landings. The system will provide wake vortex detection and tracking for an Aircraft Vortex Spacing System (AVOSS) which is part of a future air traffic control system. The data acquisition will be carried out in the Wake Vortex Lidar Mobile Test Facility taken to various airports described below. The data acquisition system includes a digitzer, analog electronics for matching signals to the digitizer, real-time digital signal processors for computing wind velocity versus range, video systems for recording images for landing aircraft, and computer and computer networks for operation and data storage. This equipment is already in place in the Mobile Test Facility, and an enhanced system for a high pulse repetition frequency, 1.56 micron lidar will be installed as part of a different task order (GL017). This task covers maintenance and upgrades to the data acquisition system.

3. Description of the Work to be Performed

1.0 The contractor shall maintain the data acquisition system, including archival and storage of data, housekeeping of computers, identification of any anomalies or failures, and execution of repairs. Maintenance shall be judged successful if the data acquisition system is fully operational one week prior to deployments. Approximate dates of deployments are listed below, and written notification of exact dates will be given three weeks prior to deployment. Maintenance shall also include a training period of up to two weeks to occur at the beginning of each deployment, so that government personnel will be able to operate the data acquisition system. This training will occur at the field test site during the deployment's phase of setup and system check-out.

<u>Deliverables</u>:

- Lidar data acquisition system functional (passed all check-out procedures) and ready to support field deployments to occur a the following dates and locations:
  - JFK International Airport in May 1997.
  - DFW International Airport in July 1997.
  - ORF International Airport in February 1998.
- Instruction manual and operational procedures for the data acquisition system one week prior to each deployment.
- Written reports of equipment failures and recommended repairs.

2.0 The contractor shall upgrade the existing data acquisition system as listed below.

2.1 Integration of a fiber optic SCRAMNET interface between a PC-based digitizer located in Room 300, B1202 and data acquisition system located in the Mobile Test Facility when parked behind B1202. Routing of the fiber optic cable between the two locations will be provided by NASA.

2.2 Implement PC-based code to enable real-time vortex tracking. Algorithms for real-time processing will be provided by Research Triangle Institute (RTI) before June 16, 1997 in the form of equations, block diagrams, and pseudocode. Fully functional code shall be demonstrated before 45 days after receipt from RTI.

2.3 Implement PC-based code for enhanced display resolution based on Lagrange estimation. Algorithm for this estimation technique will be provided by Research Triangle Institute before May 12, 1997. Fully functional code shall be provided demonstrated before 45 days after receipt from RTI.

Deliverables:

- Instruction manual for use of SCRAMNET interface.
- Instruction manual and print-out of code source listing for real-time vortex tracking.
- Instruction manual and print-out of code source listing for enhanced display resolution.

3.0 Reports/Status Reviews:

- Monthly written report, submitted electronically, on the work done the previous month and the work planned for the next month.
- Quarterly written reports on the work performed the past quarter and the work planned for the next quarter.
- Informal oral reports at the weekly team meeting.

Performance Standards and Evaluation Criteria:

Meets:

- Lidar data acquisition system functional (passed all check-out procedures) and ready to support field deployments one week prior to beginning of deployment..
- Contractor delivered code and lidar data acquisition system provides acceptable recording and processing of lidar returns, as verified by post-processed comparison by the Government with data recorded from deployment of Wake Vortex Lidar at Norfolk International Airport during March 1997.
- Laboratory equipment calibrated at least annually, traceable to National Calibration Standards.
- Documentation (log books, manuals, reports, etc.) clear, concise and accurate as determined by TM random check.

Exceeds:

- Data Acquisition system fully functional (passed all check-out procedures) and ready to support field deployments two week prior to beginning of deployment.
- Practical Contractor suggested system modifications or procedure change that improve operational readiness while not increasing cost. Note: If approved by Government review boards, modifications may lead to task modification for implementation.
- Codes described in sub-task 2.0 fully functional 15 days ahead of schedule (i.e.before 30 days).

4. Government Furnished Items:

- Analog signal processing radio frequency/intermediate frequency (RF/IF) systems and components
- Data system components
- Real-time data processing and storage components
- Lidar and scanner systems
- Ancillary time, video, weather and environment data sensors

- Lidar data system computers, peripherals and network facilities
- Oscilloscopes, power sources and other standard laboratory equipment
- Coherent Technologies Inc. (CTI) 2 micron lidar transceiver
- 1.56 micron lidar transceiver.
- PC based digitizer with SCRAMNET interface.
- Algorithms for vortex tracking and enhanced displays.
- Current data processing software code, manuals and specifications of GFI.
- Operational procudures for lidar transceivers and scanner systems.

5. Other information needed for performance of task.

<u>Equipment Repair</u>
- Equipment repair may be scheduled through NASA funded equipment repair facilities.

<u>Equipment Calibration</u>
- Equipment calibration may be scheduled through NASA funded calibration facilities traceable to National Calibration Standards.

6. Security clearance required for performance of work: None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Grady Koch
M/S: 468 Phone: 804-864-3850

SAERS Task Order Page 1

1. Task Order Number and Title Number: GL015 Revision:

CERES Command Load Simulator Support

2. Purpose, Objective or Background of Work to be Performed:

The CERES Upload Command / Instrument Simulator consists of a dublicate flight electronics set of TRW designed circuit cards, fabricated by Cirtech, that have been populated with components, sockets and SMT chips. The assembly, packaging and cabling was done by the LaRC Electronics Development~~.~~ Section of the Fabrication~~-~~Divsion.~~. (You might want to spell out instead of abbreviating.)~~ This combination of TRW cards linked to CERES Elevation and Azimuth virtual instrument Matlab models already developed and running on two fast host PCs will allow the validation of CERES instrument long and short command uploads. The TRW developed Bench Checkout Unit (BCU) software and Flight Code for TRMM & EOS-AM-1 are compatible with the hardware procured for the simulator. Commercial plastic packaged integrated circuits, pin for pin equivalent to the flight hardware have been procured for the simulator. Daughter boards for the SRAM and CMOS EPROM allow the substitution of inexpensive (laboratory compatible) integrated circuits for these parts {which make up the "twin buffers"}. A bi-directional, bit sliced bus (Metrobyte PIO-12 card) will provide handshaking between the Instrument Control Processor (ICP) and the PC based Matlab models for Elevation and Azimuth scanners. A 1553 bus (DDC VLSI implementation) PC card is used for uplink (bus transfer) to the Central Processor Unit (CPU) shared memory from a control PC.

~~>>>>>> add block diagram~~

The purpose of this task is to complete integration and test of the government owned circuit cards and digital integrated circuits at the card and component through system level.

3. Description of the Work to be Performed:

The contractor shall complete integration of the completed individual circuit cards, power supplies, software, host PCs and I/O cards into a fully functional CERES Command Upload Simulator / Instrument simulation system. The contractor shall complete construction of the twin buffered Spacecraft I/F card and integrate it into the system. The contractor shall determine test plans, procedures, and success criteria, and present them to the Government for review and approval. After approval, the contractor shall complete testing and troubleshooting of the system elements and conduct a laboratory test and demonstration of the CERES Command Upload Simulator system, i.e. complete hardware and software.

Deliverables:

1. Demonstration of a fully functional hardware portion of the TRW flight cards including following attributes and functions:
   - 1.1. Support spacecraft I/F card with 1553 link to twin CPU shared memory to accomplish Command uploads from host PC ICP with Digital I/O card linked to host PC.
   - 1.2. Support Metrabyte PIO-12 card for virtual Azimuth. Matlab/Simulink interface to accomplish bi-directional bus rate & position status & data.
   - 1.3. Support Data Acquisition Processor (DAP) with Digital Interface card linked to host PC.
   - 1.4. Support Metrabyte PIO-12 card for virtual Elevation. Matlab/Simulink interface to accomplish bi-directional bus rate and position status and data.
2. Test and Evaluation Report containing as a minimum:
   - 2.1. Description of test setup
   - 2.2. Test parameters and results
   - 2.3. Significant events or failures
   - 2.4. Recommendations for possible improvements

2.5. Revised design drawings, parts lists and assembly drawings
3. Notification of significant events, anomalies or failures to Technical Monitor.
4. Monthly oral or written status reports on the work done the previous month and the work planned for the next month.

Schedule:
CERES Command Upload Simulator integration and test Milestones:

	No later than
1. Matlab Elevation model test, ICP to PC bus	May 30, 1997
2. Emulator assisted DAP boot-up	May 30, 1997
3. Matlab Azimuth model test, ICP to PC bus	May 30, 1997
4. 1553 PC to Spacecraft Interface Card hardware check	May 30, 1997
5. 1553 shared memory with ICP card check	May 30, 1997
6. TRW / BCU Software mod to make 1553 link perform	June 30, 1997
7. Long/Short Command functional check	June 30, 1997
8. Install / run EPROM as Housekeeper steady state signal source	July 31, 1997
9. Install / run Radiometer Servo Corp. Matlab models	Aug. 30, 1997
10. Build EOS AM-1 twin buffered Spacecraft I/F card	Aug. 30, 1997
11. Install EOS AM-1 Spacecraft I/F card as 1553 link	Aug. 30, 1997
12. Complete demonstration of working system	Sept. 30, 1997
13. Test and Evaluation Report	Sept. 30, 1997

Performance, Standards, and Evaluation Criteria

Meets:
1. Monthly reports by end of month - last working day of month
2. Events, anomalies, and failure notifications within two working days.
3. Delivery / demonstration of fully operational system in accordance with the schedule above.
4. The Test and Evaluation Report must be clear and accurate (having no major errors and few minor discrepancies or typos) as determined by TM and complete (having minimum contents listed under deliverables) in accordance with the schedule above.

Exceeds:
Demonstrates / deliverssystem 30 calendar days ahead of schedule.

4. Government Furnished Items:

- Access to Laboratory for setup and testing.
- Access to standard laboratory test equipment:
- All parts, systems equipment housings, computers, and software.
- CERES Simulator Design documentation and Electronic Drawings.
- Equipment Documentation, Operations Manuals, Drawings, and Parts Lists
- Consultation for troubleshooting

5. Other information needed for performance of task.

Benefitial experience: testing and troubleshooting using bus analyzers, signal tracing, logic probes, and familiarity with digital electronics, microprocessor systems, Pcs and the IEEE 1553 bus.

6. Security clearance required for performance of work:
None

7. Period of Performance	
Planned start date:	Expected completion date:

May 1, 1997	September 30, 1997

8. NASA Technical Monitor: Mark Hutchinson
.M/S: 471 Phone: 757-864-4642

SAERS (NAS1-96013) Task Order

1. Task Order Number: ~~GL018~~ GL19 Revision:
   Title: **Data Acquisition and Control System for GFCR**

2. Purpose, Objective or Background of Work to be Performed:

The Gas Filter Correlation Radiometer (GFCR) is a fast-response, nonmechanical remote gas sensor being developed by NASA for measurement of trace gas species. NASA applications include measurement from spacecraft of tropospheric or stratospheric constituents. A number of potential commercial applications for GFCR have also been identified.

Two working model GFCR sensors have been developed. One operates in the near infrared, measuring species such as methane (CH_4). The second operates in the 5μm region of the infrared, measuring species such as nitric oxide (NO).

Commercial electronic equipment has been used for data acquisition and control of GFCR devices. The equipment includes a unit to control the operation of a polarization modulator contained within the GFCR, a lock-in amplifier to process data from the GFCR, these two make up the DACS (data acquisition and control system), and an IBM compatible PC.

3. Description of the Work to be Performed:

The objective of this task is to develop and demonstrate a prototype of a miniaturized DACS for the GFCR, including operating software for the PC, which produces GFCR system/sensor performance that meets or exceeds the performance achieved when the GFCR is controlled by the commercial instrumentation.

The contractor shall design, construct, and demonstrate the performance of the prototype DACS when interfaced to a GFCR sensor. (See Attachment 1 for Specifications)

Deliverables

1. The prototype DACS.
2. Operating software for the prototype DACS.
3. A demonstration of the performance of the DACS when interfaced to a GFCR sensor.
4. Engineering documentation including schematic drawings, parts lists, and operating manual for DACS hardware and software.
5. An informal written report which presents the results of the performance demonstration, including comparisons made with the performance of the commercial data acquisition and control system.

Schedule

1. DACS design documentation shall be submitted no later than 3 months after date of task start.

2. The performance demonstration shall be complete no later than 11 months after date of task start.

3. All other deliverables are required no later than 12 months after date of task start.

Performance Criteria

MEETS

1. The DACS is designed and operates (as verified by demonstration) according to the requirements specified by attachment 1,

AND,

2. A demonstration that the performance of the GFCR (measurement signal-to-noise ratio) when controlled by the DACS, is at least equivalent to the GFCR performance when controlled by the commercial data acquisition system. [For this demonstration, the 5μm GFCR sensor shall be used, and "noise" tests conducted under ambient laboratory conditions using existing standard GFCR test procedures.]

AND,

3. The overall size (volume) of the prototype DACS, including enclosure but not cables, does not exceed .0052m^3 (320 in^3).

EXCEEDS

1. Meets above criteria 1. and 2. AND the overall size (volume) of the prototype DACS, including enclosure, does not exceed .0026m^3 (160 in^3).

4. Government Furnished Items:

o For the purpose of developmental tests and performance demonstration, access to the following, in Room 262 of Building 1202:

- A 5um GFCR sensor
- IBM Compatible PC, 486 or better with operating system software
- Commercial data acquisition and control system, including operating software (Lab Windows)
- Commercial data analysis and display software (SigmaPlot)
- Laboratory power supply

o The BOARDMASTER machine and TANGO software located in Building 1202, Room 153, may be used, as available, for the purpose of design and fabrication of prototype printed circuit boards for DACS.

5. Other information needed for performance of task.
None

6. Security clearance required for performance of work:
None

7. Period of Performance:	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: P. J. LeBel
M/S: 472 Phone: 804-864-1568
fax: 804-864-8818 e-mail: p.j.lebel@larc.nasa.gov

Attachment 1
Summary of Functional Requirements
Data Acquisition and Control System for GFCR

1. Polarization Modulator Control

   - o Operating frequency, 20 - 90 kHz
   - o Adjustable retardation, 0 - $\lambda/2$ for 5 micron operation
   - o Retardation stability, 0.5%
   - o Harmonic suppression, >25 dB

2. Data Acquisition

   - o Lock-in, 20 - 90 kHz, 1f operation
   - o 5 Hz and 100 Hz electronic low pass filters for V and ΔV signals
   - o Output of lock-in should provide amplitude & phase information for V and ΔV signals

3. Computer Interface and Software

   - o DACS shall interface with PC, 486 or better
   - o PC interface through either IEEE bus or RS422
   - o Lab Windows - based data acquisition and control software
   - o Control of instrument operating parameters via software (Lab Windows)
   - o Data acquisition software shall include, as a minimum, Setting, Status, Test and Data Acquisition menus
   - o Data processing software shall convert raw, binary data files to scaled ASCII data files for Government use/analysis with commercially available data analysis software (SigmaPlot)

4. Power Requirements

   - o DACS shall operate from 12 ±2 vdc

SAERS (NAS1-96013) Task Order

1. Task Order Number:: GL019 Revision: ____ Date of Revision:_
   Title: Gas and Aerosol Monitoring Sensorcraft (GAMS) Technical Support

2. Purpose, Objective or Background of Work to be Performed:
The purpose of the work to be performed under this contract is to align and characterize the GAMS prototype and flight spectrometers.
The GAMS spectrometer design and fabrication is performed by civil servants who are responsible for its performance. The objective of this task is to perform the critical alignment tasks during the integration of the spectrometer and to measure the performance of the resulting spectrometer.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements):

Opto-mechanical alignment and characterization of the GAMS prototype and flight spectrometer.

Subtask 1 (Prototype unit)--
Description: The contractor shall integrate and align the GAMS prototype spectrometer and characterize its operation in a sun-looking mode. Characterization includes measurement of spectral resolution and radiometric throughput.

Schedule: This task shall be complete by 9/30/97 and is contingent upon the delivery of all necessary components, which are the responsibility of civil servants, two months prior to this date.

Deliverables: Report containing alignment procedures and characterization data that demonstrates the prototype spectrometer spectral resolution and throughput have been determined. The contractor is not responsible for the spectrometer meeting the GAMS requirements but is responsible for demonstrating by measurement what the performance of the spectrometer is as built.

Performance criteria: The contractor meets the minimum criteria for success with alignment procedures produced in bullet format and characterization data that is acquired by a single measurement technique. The contractor exceeds with alignment procedures produced with comments and explanations of the rationale behind each step that would enable someone else to perform the procedure. Characterization data that is acquired by two or more techniques that all give similar results exceeds the minimum success criteria.

Subtask 2 (Flight unit)--
Description: The contractor shall integrate and align the GAMS flight spectrometer and characterize its operation in a sun looking mode. Characterization includes measurement of spectral resolution and radiometric throughput. This task shall be complete when the GAMS spectrometer delivers solar spectra in agreement with corresponding known solar spectra.
Schedule: This task shall be complete by 6/30/98 and is contingent upon the delivery of all necessary components, which are the responsibility of civil servants, three months prior to this date.

Deliverables: Report containing alignment procedures and characterization data that Demonstrates the prototype spectrometer spectral resolution and throughput have been determined. The contractor is not responsible for the spectrometer meeting the GAMS requirements but is responsible for demonstrating by measurement what the performance of the spectrometer is as built.

Performance criteria: The contractor meets the minimum criteria for success with alignment procedures produced in bullet format and characterization data that is acquired by a single measurement technique. The contractor exceeds with alignment procedures produced with comments and explanations of the rationale behind each step that would enable someone else to perform the procedure. Characterization data that is acquired by two or more techniques that all give similar results exceeds the minimum success criteria.

4. Government Furnished Items:

(Use of room and all test equipment located in 242 of building 1202, including Tektronix oscilloscope, optical measurement instrumentation and data acquisition system.

5. Other information needed for performance of task.
N/A

6. Security clearance required for performance of work: none

7. Period of Performance:	
Planned start date: **5/1/97**	Expected completion date: **06/01/98**

8. NASA Technical Monitor: **Don M. Robinson**
M/S: **468** Phone: **757-864-1625**

1. Task Order Number: GL21 Revision: 08/11/97

Title: **LASE DPS and CDS/DRS Subsystem Anomaly Analysis, Repairs, Changes and Maintenance with Documentation**

2. Purpose, Objective or Background of Work to be Performed:

The Lidar Atmospheric Sensing Experiment (LASE) project is an aircraft-based active-sensor system which completed its field validation in September 1995. Major upgrades have been made to the Instrument Control Computer, Monitor and Command Computer and Data Processing Computer. Checkout of these systems were performed during a field mission onboard a P-3 aircraft. During the checkout, a list of anomalies and recommended changes to the hardware has been itemized. The present goal is to correct the anomalies and to make changes that will enhance the overall operation of the instrument that would be applicable to P-3, ER-2 and DC-8 aircraft operations.

The instrument normally consists of four subsystems: laser, telescope, thermal control, and CDS/DRS aboard the ER-2, but on the P-3 the thermal control was a NESLAB chillier. The Control and Data-Acquisition Subsystem (CDS) is the central computer (Intel 486 DX4) controlling the operation of the instrument, and includes a Data Recorder System (DRS). The CDS/DRS Ground Support Equipment (GSE) includes a Laptop Computer and several interface simulators. Also supporting instrument operations is a Data Processing Station (DPS), an Alpha powered VAX-based computer system which receives, processes, displays, and archives data from the instrument. The hardware involved in this task includes the CDS/DRS and it's associated support equipment, and the DPS.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Listing of Subtasks:

Subtask 1.

Analysis/trouble-shoot, determine cause, and recommend corrective action for Government approval of anomalies from the July 1997 deployment. Once approved, contractor shall implement repairs related to the hardware. In the case of NASA maintained software, contractor shall check all operating modes per Government provided procedures after necessary revisions. The contractor shall proceed with the recommended corrective action if approval is not provided within five working days.

Performance Standards and Evaluation Criteria:

Meets:

1. One complete set of CDS/DRS, GSE and DPS hardware anomalies corrected, and tested software, fully functional to support future missions.

Exceeds:

1. Identify additional anomalies during the course of correcting the July deployment anomalies.
2. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs nor decreasing the government's confidence in the operational readiness of the hardware.

Subtask 2.

Recommend changes, for Government approval, to interface cables and/or boxes to prevent disconnecting connectors when raising Upper Rack for laser access. Once approved, contractor shall implement repairs related to the hardware. The contractor shall proceed with the recommended corrective action if approval is not provided within five working days.

Performance Standards and Evaluation Criteria:

Meets:

1. One complete set of cables for CDS/DRS, GSE and DPS hardware that will fully support future missions.

Exceeds:

1. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs nor decreasing the government's confidence in the operational readiness of the hardware.

Subtask 3.

Incorporate data handling hardware to the flight instrument for recording real-time data to an optical drive system and a universal network box to the DPS to allow for multi-user interface.

Performance Standards and Evaluation Criteria:

Meets:

1. Improved recording and archival means in areas of reliability and safety/permanence of data.
2. Incorporate a network interface, which will adapt to the standards likely to be encountered in use at the various locations.

Exceeds:

1. Improvements made to the hardware, with government approval, which will decrease the set-up and archival time by 75%. These improvements must in no way compromise the actual or perceived safety, or permanence of the data.
2. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs or changes nor decreasing the government's confidence in the operational readiness of the hardware.

Subtask 4.

Identify a Semi-Autonomous Mode for operating LASE when on P-3 and DC-8 aircraft, identify additional housekeeping data to be displayed and identify an electrical interface required for adding a zenith science channel to LASE.

Performance Standards and Evaluation Criteria:

Meets:

1. Devise the method of selecting Semi-Autonomous Mode and which operations are to be automatic and which are to be performed manually by the operator.
2. Determine and incorporate data to be displayed on the CDS display.
3. Recommend printed circuit cards (compatible with existing card cage) for controlling and importing data from a zenith science channel

Exceeds:

1. Improvements made to the hardware or software, with government approval, which will reduce the Instrument operational instructions and data display screens by 50% of the existing instructions. These improvements must in no way compromise the actual or perceived health, safety, or performance of the instrument.
2. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs or changes nor decreasing the government's confidence in the operational readiness of the hardware.

Subtask 5.

Identify a 6 week time period for laser testing that will not impact the completion of this contract and identify related GSE hardware that is no longer needed to support the LASE Instrument.

Performance Standards and Evaluation Criteria:

Meets:

1. Have hardware available and fully functional to support a 6 week testing of the laser under simulator control. For any hardware not available and fully functional, work-arounds are provided.
2. Archive all data by government-provided procedure following any tests.
3. Identify hardware no longer needed to support LASE and excess that equipment, after government approval.

Exceeds:

1. Improvements made to the hardware or procedures, with government approval. These improvements must in no way compromise the actual or perceived health, safety, or performance of the instrument.
2. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs or changes nor decreasing the government's confidence in the operational readiness of the hardware.

Subtask 6.

Generate new/update, check lists, procedures and drawings as needed to support changes.

Performance Standards and Evaluation Criteria:

Meets:

1. Generate new checklists, procedures and drawings for all added or revised equipment to insure accurate and rapid operations.
2. Update checklists, procedures and drawings to support the physically revised LASE instrument and/or new operational modes aboard aircraft during accompanied flights.

Exceeds:

1. Improvements made to the documentation, with government approval, which significantly improve operational efficiency and instrument safety. These improvements must in no way compromise the actual or perceived health, safety, or performance of the instrument.
2. Performance of all task activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost of the repairs or changes nor decreasing the government's confidence in the operational readiness of the hardware.
3. Expedite documentation changes for use during transition period.

Subtask 7.

Maintain government-provided logbooks and related documentation in accordance with established NASA Product Assurance requirements detailing operational history, significant events, and failures and anomalous behavior and their dispositions.

Performance Standards and Evaluation Criteria:

Meets:

1. All hardware logbooks are maintained complete and up-to-date, within 48 hours, detailing all operations of and modifications to the hardware.

Exceeds:

1. Documentation of all activities are consistently and reliably completed before 2-28-98, without increasing the negotiated cost or decreasing the government's confidence in the accuracy of entries.

Planned Schedule (1997-98):

Critical Milestone:

- Completed above task by Feb. 28, 1998.

Deliverable Documentation:

1. Complete and up-to-date logbooks for all flight and ground-support equipment.
2. Complete and up-to-date procedures, checklists and drawings covering all aspects of this work.
3. Archive all data by government-provided procedure.
4. Complete and up-to-date hardware description documents.

Reports/Status Reviews:

1. Make available government-provided hardware logbooks for weekly review.
2. Report weekly at the LASE Project Status Meeting, presenting written status of flight and ground hardware, documentation, and procedures.

4. Government Furnished Items:

- The following items are unique to the LASE Project and will be available for use:
    1. All flight hardware and GSE, and supporting documentation.
    2. All logbooks.
    3. All operational procedures and checklists.
    4. Electronic copies of existing documentation at beginning of task period.
    5. All shipping containers.
    6. All existing special test equipment
    7. Two Connex Containers, 1 for storage and 1 equipped/furnished as a Lab
- Access will be available to standard tools and lab test equipment (e.g. meters and o'scopes).
- Laboratory facilities are available in room 222 of building 1202.
- Revisions to Government furnished software in a timely manner.
- Consultation in specialty areas as necessary.

5. Other information needed for performance of task.
Requirements:
All flight hardware repair and modification to be done by NASA flight wiring and soldering certified personnel.
Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC.
Test Procedures: All equipment checkout and test to be conducted following Project generated and approved procedures and checklist.
Product Assurance: All special tests, modifications, repairs and documentation to be done in accordance with established Project Product Assurance Plans and Procedures.
Equipment Handling: All disassembly, packing, unpacking and reassemble to follow Project generated and approved procedures.

6. Security clearance required for performance of work: None Required

7. Period of Performance	
Planned start date: Aug. 16, 1997	Expected completion date: Feb. 28, 1998

8. NASA Technical Monitor: A. S. Moore (LOP/SPO)
M/S: 472 Phone: 804-864-7094

SAERS Task Order

1.	Task Order Number and Title Number: GN01 Revision: Title: Aircraft Documentation and Standards

2. Background of Work to be Performed:
The contractor shall maintain NASA LaRC aircraft historical records, log sheets, and status boards that form the basis of the Quality Assurance library. In addition, the Contractor shall locate and retrieve specific information and documents. The contractor shall maintain technical files and USMF files (microfiche) for LaRC aircraft/standards.

3. Task Description:

a. The contractor shall review aircraft records daily, checking for accuracy and proper documentation. Changes and revisions to military and commercial aircraft publications will be posted.

Microfilm Library - 2 each month
Hot Specification Library - biweekly
Vendor Information - every 3 months
FAA - every 2 months
Commercial Aircraft (micro/hard copy) - every 3 months
Military (hard copy) - monthly

Deliverables:
A current, updated QAO aircraft records library.

b. The QAO Technical Library shall be maintained and updated. Updates and revisions to support aircraft will be minimal (3 per year) while more complex aircraft, like the Boeing 737 and 757, will require more maintenance (documentation updates monthly).

Deliverables:
All publications must be ordered within 10 days after the receipt of request.

c. The contractor shall post aircraft status boards (7) for each aircraft flown at the conclusion of each flight day to display current aircraft time, engine time, time remaining until next inspection, and type of inspection due. The QAO computer data base will be updated daily with current aircraft status information and inspection requirements. The computer data base will be expanded/developed to incorporate records and inspection requirements for newly acquired aircraft.

GN01

Deliverables:
Accurate, updated aircraft record with computer access to status information.

d. All aircraft test equipment records will be monitored for calibration due dates and repair notices and equipment will be submitted for recalibration/repair as required. The contractor will be responsible for tracking approximately 220 pieces of equipment.

Minimum acceptable performance:
Records and documentation must be maintained at 97% accuracy and all changes must be filed within 5 days of receipt.

Posting and updating must be accomplished on a daily basis to a 97% accuracy level. New aircraft must be incorporated into QAO data base within 10 days of data input from new aircraft records search.

Equipment records must be reviewed and updated and appropriate submittals made every 7 days.

Exceeds minimum acceptable performance:
Records, documentation, and updating will be accomplished at a greater than 97% accuracy level.

4. Government Furnished Items:
Computer (Gateway 2000 4 DX 3V), monitor (Gateway 2000 Crystal Scan 1024 NI) and printers (NEC Pinwriter P7 and P6) will be provided for contractor use, with repair scheduled through NASA repair contract.

5. Other information needed for performance of task:
Contractor location is Building 1244, Rooms 127 and 128. There is no requirement for remote travel

6. Security clearance required for performance of work:
Due to the nature of information contained in the QAO Technical Library a Secret level is required.

7. Period of Performance
Planned state date: 05-01-97 Expected completion date: 04-30-98

8. NASA Technical Monitor: Michael A. Klebitz
M/S 255 Phone: (804) 864-3995

SAERS Task Order

1. Task Order Number and Title Number: GN02 Revision:
   Title: Aircraft Support Branch Operations

2. Background and General Requirements Overview: NASA Langley Research Center (LaRC) aircraft are used to provide support to research programs as required.

It is the purpose of this contract to support the operation and maintenance of Government-provided aircraft to include:

Beech T-34C, NASA 509	Beech King Air 200, NASA 529
Northrop T-38A, NASA 511	Bell UH-1H, NASA 535

and any additional aircraft assigned to the LaRC inventory during the contract period. The avionics task order covers both research and support aircraft. The King Air 200 shall maintain an Federal Aviation Administration (FAA) airworthiness certificate per applicable FAA directives.

The contractor shall complete all work requirements in accordance with manufacturers applicable directives and/or NASA specific directives.

The contractor may be required to make configuration changes and minor/major modifications to support the Langley programs. The assigned personnel shall be required to complete such work in accordance with the NASA GAMM and Langley Handbook (LHB) 7910.1.

The contractor shall meet the requirements for maintenance as directed in NHB 7900.3 and the GAMM with the FAA, Federal Aviation Regulations (FAR) 43 being the default document for minimum standards for acceptable maintenance practices.

3. Subtask Description:
A. Aircraft Maintenance
The contractor shall submit specific maintenance data as required by the contracting officer or his authorized representative. The contractor shall conduct daily maintenance meetings with NASA maintenance and Quality Assurance personnel to report aircraft status and contractor maintenance actions. Normally the aircraft

status will be reported at 0900 and 1400 daily to NASA maintenance contact. Flight schedules will be generated by NASA following the status reports.

The contractor shall provide maintenance support that covers all activities associated with routine and scheduled maintenance and servicing of assigned aircraft. They shall have the ability to perform aircraft maintenance at the levels defined as organizational and intermediate with occasional depot level maintenance. They may be required to fly in support of various missions and to support troubleshooting of aircraft systems. Duties involve all associated maintenance and repair of fixed- and rotary-wing aircraft systems. Major aircraft systems to be maintained are such as, but not limited to, airframe, engine, hydraulic, propeller, rotor, instrument, electrical, oxygen, fuel, lubrication, and flight control. Duties also require the care and maintenance of all aircraft support equipment; routine line duty, which includes parking and servicing of transient aircraft, and maintaining a safe, clean working environment.

Major tasks address the following activities:

a. Troubleshoot and make adjustments to aircraft and engine systems.
b. Locate defects; determine the extent, type, and material (parts) required to repair or replace and take appropriate action.
c. Install, align, and adjust new systems, assemblies, and flight control surfaces, intermeshing related systems.
d. Rig and adjust control systems (cable and torque-tube type).
e. Adjust temperature-measuring systems (thermocouple or bridge-type).
f. Remove and replace engines, making proper adjustments to systems for pressures, flows, and timing.
g. Remove and install rotor systems and propellers and makes adjustments.
h Make repairs and adjustments to the aircraft basic electrical system.
i. Remove, replace and rig components in landing gear systems.
j. Remove and replace and service components in oxygen systems.
k. Perform prescribed LaRC inspections including preflight, post-flight, and periodical/phase inspections.
l. Comply with Airworthiness Directives, Service Bulletins, and Technical Orders.
m. Maintain documentation in accordance with NHB 7900.3 and NASA Langley GAMM.
n. Serve as aircraft crew chief on assignment.

The contractor shall provide aircraft as scheduled for flight to meet the goals and missions of Langley Research Center. The aircraft shall be available for flight normally between the hours of 7:00 a.m. to 3:30 p.m., Monday through Friday.

The annual flight utilization rate will be as follows:

T-34C	NASA 509	100 Hours
T-38A	NASA 511	100 Hours
King Air 200	NASA 529	200 Hours
UH-1H	NASA 535	100 Hours

Minimum acceptable performance:
- Mission Capable, ready to fly 75-80% of the performance period, including maintenance down time.
- Completed flights effectiveness, 95% flown (not canceled due to maintenance.)
- Shall pass 90% of FCF's following maintenance actions.
- Scheduled ETIC's 75%
- Unscheduled ETIC's 75%.

Exceeds minimum acceptable performance:
- Mission capable >80%

Subtask Description:
B. Ground Support Equipment Maintenance
The contractor shall provide maintenance/management for all aircraft Ground Support Equipment (GSE) used for flight operations by the Aircraft Support Branch (ASB). Langley regulations will provide guidance on technical aspects of contractors responsibility on such items as load testing, heavy maintenance, etc.

The contractor shall provide all GSE scheduled and non-scheduled preventative maintenance, servicing, troubleshooting, and repairing. The contractor shall also provide expert guidance and recommendations in the maintenance and acquisition of GSE and conduct acceptance inspections on newly acquired and/or repaired equipment, to include but not limited to the following:

a. Aircraft refueling trucks (vehicle maintenance performed by NASA)
b. Aircraft hydraulic jacks
c. Portable maintenance check stands (personnel)

d. Electric generator and hydraulic carts (servicing)
e. Aircraft towbar
f. Aircraft tow-truck (tugs) (vehicle maintenance performed by NASA)
g. Portable maintenance equipment
h. Oil servicing carts
i. Hydraulic test stands
j. Compact lifts

The contractor shall maintain the recall checklist for scheduling/servicing of the various equipment. Inspections/servicing shall be completed prior to the due date expiring unless given permission to put item on hold status and tagging the equipment "DO NOT USE."

Contractor shall transfer aviation fuel from transport trucks to refueling trucks and shall transport the LOX tank to the Air Force filling station and assure that the LOX tank is serviced, ready for use.

Minimum acceptable performance:
- Equipment maintained per maintenance/inspection schedule 95% of performance period.
- Schedule accuracy 98%

Exceeds minimum acceptable performance:
- Equipment maintained > 95%
- Schedule accuracy > 98%

Subtask Description:
C. Personal Survival Equipment Maintenance
The contractor shall operate a flight survival equipment maintenance and issuance operation in support of numerous LaRC flight vehicles.

The contractor is required to maintain personnel equipment such as flight helmets, oxygen masks, life rafts, life preservers, and parachutes; use industrial sewing machines for fabrication and repair; fit crews with parachutes and life preservers; support water survival and egress training; perform 30-day tests and inspections on parachute safety systems; pack non-personnel aircraft parachutes; maintain the stock of flight safety equipment; and compile computerized inventories, training requirements, time change items, and other essential data.

Minimum acceptable performance:
- Equipment maintained per maintenance/inspection plans 95% of performance period.
- Schedule accuracy 98%.

Exceeds minimum acceptable performance:
- Equipment maintained > 95%.
- Schedule accuracy > 98%.

Subtask Description:
D. Avionics
The contractor shall provide maintenance on aircraft avionics and electrical equipment as required by both program support aircraft and research aircraft, to include:

Boeing 757, Boeing 737, and OV-10A

The contractor shall conduct routine and scheduled maintenance on aircraft avionics equipment including component calibrations, repair, modifications, and installation. Aircraft electrical and navigation systems, video and communication systems, plus specialized controls such as fly-by-wire systems are types of systems to be maintained but not limited to only these. Major tasks address activities as the following:

a. Resolve inflight avionics troubleshooting problems and provide video equipment and data recording support on local and deployed missions.
b. Develop and generate drawings and schematics for new and modified equipment installations.
c. Perform preflight, post-flight, and periodical checks; provide system check-out for operation and accuracy.
d. Remove, inspect, repair, and reinstall equipment and conduct system check-out.
e. Maintain the battery shop operations: provide scheduled maintenance, repair, recharging, and inspections of nickel-cadmium batteries; maintain files and documentation for aircraft and GSE equipment. Lead-acid facilities may be developed later.
f. Maintain avionics shop, maintenance, and electronics calibration equipment.
g. Wire and rewire aircraft electrical systems.
h. Study and recommend avionics updates.

i. Maintain avionics spare parts inventory.
j. Maintain individual certifications required by NASA handbooks and directives.

Minimum acceptable performance:

- Calibrations complied with per schedule 98% of the performance period.
- Preflight, post-flight and periodical checks provided when scheduled 100% of the performance period.
- Batteries maintained and ready per schedule 95% of the performance period.
- Maintain 95% accuracy of avionics spares inventory.

Exceeds minimum acceptable performance:

- Calibrations complied with at >98%.
- Avionics spares inventory maintained at >95% accuracy.

Subtask Description:

E. Procurement/Stockroom

During the normal 8-hour shift, the contractor shall be responsible for and perform procurement, property control, receipt and inspection, storage, packing, shipping, delivery, redistribution, and disposal functions that are necessary to meet the requirements of all NASA Langley aircraft. Applicable Federal Acquisition Regulations (FAR's) shall be used as a guide along with applicable NASA Handbooks. The responsibilities of the contractor are to be in accordance with the following property management directives and installation supplements to these directives:

NHB 4200.1, NASA Equipment Management Manual
NHB 4300.1, NASA Personal Property Disposal Manual
NHB 4100.1, NASA Materials Inventory Management Manual

The contractor shall maintain stockroom/storage area for the receipt, storage, issuance and accountability of spare parts and supplies for assigned aircraft and maintain a system for perpetual inventory, cataloging and reorder, environmental storage and shelf-life replacement/rework cycles in accordance with NASA standards.

The contractor shall be responsible for locating parts directly from MIL/FEDSTRIP supply and commercial sources. The contractor shall be provided existing spares inventory for all aircraft and stockroom and shall have responsibility for preparing and notifying NASA of will be given to the contractor through the authorized representative.

The contractor shall be responsible for the following activities:

a. Locate and order high priority grounding items, spares support, and hardware.
b. Determine the source for procurement (DOD, GSA, or commercial sources).
c. Initiate and route the proper forms for procurement.
d. Follow up on overdue and lead-time items and furnish status reports.
e. Receive items and pick up parts as necessary.
f. Sign for receipt and distribute materials.
g. Review invoices for orders received to assure costs are correct and recommend to the Branch Head proper payment actions.
h. Prepare shipping documents and assure proper shipping methods are utilized.
i. Determine the proper method and initiate actions to dispose of materials and parts. Track disposal of all hazardous materials/waste.
j. Assign identifying numbers to track the transactions on ongoing maintenance contracts, such as Oil Analysts, Inc.
k. Maintain files for all procurement transaction, and maintain a running balance of funds expended from Depot Level Contract as required.
l. Operate PCs to manage program stock including updating, querying, and printing reports accurately and using established procedures to reconcile the inventory with LaRC Accounting and Supply.
m. Issue aircraft general hardware and special tools to technicians assigned to the Branch.
n. Maintain aircraft general hardware stock levels.
o. Determine the appropriate level and change levels as rate of usage changes.
p. Rearrange stock bins and shelving in aircraft general hardware stockroom to accommodate fluctuating stock levels.
q. Working with the Quality Assurance Office and the Head, of ASB, monitor and control the quality of hardware received in the stockroom to prevent the acceptance of inferior materials.
r. Assure stockroom is managed as a controlled area.
s. Assist in the inventory of program stock.
t. Maintain the data base of all MSDS sheets received by ASB.
u. Perform procurement as requested by ASB.

Minimum acceptable performance:

- Timeliness of material location and ordering within acceptable limits.

- Tracking to within 98% accuracy w/periodic updates on long lead items.
- Maintain 90-95% accuracy on stockroom and aircraft spare parts inventory.
- Stockroom and aircraft parts storage maintained as a controlled area.

Exceeds minimum acceptable performance:
- Stockroom and aircraft inventory maintained at >95% accuracy.
- Tracking at >98% accuracy.

Subtask Description:
F. Quality Assurance
The contractor shall be responsible for a quality control system that assures quality of maintenance, products produced, and general services provided. The contractor shall complete all work in accordance with applicable NASA, FAA and/or DOD directives. The quality assurance function shall be separate and distinct from the maintenance function and shall satisfy the requirements of NASA Handbook (NHB) 7900.3 and the NASA General Aircraft Maintenance Manual (GAMM) in all respects.

NASA (Quality Assurance Office, FOSD) reserves the right to conduct full surveys and audits at any time during the contract period (FAR 52.246-5). These surveys/audits shall include, but are not limited to inspection of facilities, equipment, and conformance to required specifications and procedures. The contractor shall support these surveys/audits with necessary documentation and personnel. Audits will be announced 5 working days in advance. Surveys, Quality Verification Inspections (QVI's), may be conducted at any time for the purpose of assuring compliance with NHB 7900.3 and NASA GAMM.

For surveys/audits that contain recommended actions, the contractor shall respond no later than 30 days after notification. Action items that remain open more than 30 days shall have a status report submitted every 30 days until the action is closed. Follow-up surveys/audits will insure compliance.

Minimum acceptable performance:
- Maintain the assigned aircraft complete historical record and documentation to an accuracy level of 97%.

- Review airworthiness directives, manufacturer service bulletins, modifications, etc., to determine their applicability to the aircraft/accessories and document the same to an accuracy level of 95%.
- Maintain weight and balance records for the assigned aircraft, which includes actual weighing of the aircraft, calculating changes, and making proper form entries to an accuracy level of 98%.
- Perform Phase, Annual, Periodic, and Special inspections on assigned aircraft meeting predicted schedules to a 90% degree of accuracy.
- Perform final inspections of all major maintenance items (parts, fab, electrical, etc.) on assigned aircraft, to insure the aircraft is maintained according to airworthiness standards and work practices to an accuracy level of 97%.

Exceeds minimum acceptable performance:
- Minimum acceptable performance is exceeded in each of the foregoing elements when the accuracy level exceeds the stated acceptable threshold.

4. Critical definitions and terms:

a. Support Aircraft - Program support aircraft required for the conduct of flight research. Aircraft are so determined by NASA Headquarters, Code JP, utilized to carry personnel and equipment or provide other support functions to NASA programs and projects. They may have modifications provided the primary structure, control system, or engines are not affected.

b. Research Aircraft - Aircraft whose primary use is for research purposes. They may have modifications to primary structure, control systems, engines and/or basic aerodynamics.

c. Depot Level Maintenance - Maintenance activities requiring more extensive shop facilities and equipment and personnel of higher technical skill than are normally available at the lower levels of maintenance. Normally consists of repairing, modifying, overhauling, reclaiming, or rebuilding parts, assemblies, sub-assemblies, components, and end items.

d. Intermediate Level Maintenance - Maintenance activities for direct support of using organizations normally consisting of calibrating, repairing, or replacing damaged or unserviceable parts, and providing technical assistance.

e. Organizational Level Maintenance - Maintenance activities normally consisting of inspecting, servicing, lubricating, adjusting, and replacing parts, minor assemblies and subassemblies.

f. Functional Check Flight (FCF) - Flight flown on the aircraft after major maintenance or modification to perform an operational check of the affected aircraft system and aircraft handling characteristics.

g. Functional or Operational Check - Testing and checking of function and operation of the component either on the aircraft or in shops, using equipment, procedures, and limits in the applicable technical directives.

h. Mission Capable - Available and ready to fly to meet the intended mission.

i. Completed Flight Effectiveness - Percentage of scheduled flights flown and not canceled due to maintenance.

j. Estimated Time in Commission (ETIC) - Maintenance action completed on or before the estimated time.

5. Government provided property and facilities while on-site at the NASA LaRC facility:
Access to hangar/ramp space, office and work area space.
Special purpose equipment to be made available to the contractor for use in performance of this contract on-site and at other locations as approved by the contracting officer to include:

a. All support aircraft assigned to NASA LaRC in accordance with the task order listing.
b. Fuel, oil, and lubricants for aircraft and ground support equipment at LaRC and at other locations. At other locations, fuel, oil, and lubricants will be obtained when available, through Government procurement agreements for which payment will be made directly by NASA to the appropriate Government agency.
c. Ground Support Equipment, such as start units, generators, fuel servicing vehicles, jacks, towbars, ladders and special tooling used in performance of task under this contract.
d. Liquid and gaseous aviators breathing oxygen.
e. Special flight clothing and survival equipment for flight personnel as required by the Government to meet NASA safety standards.
f. Avionics test equipment as required to perform the task under this contract.

g. Aircraft spare parts and supplies.

Supplies from LaRC stockroom, publications, and forms stocked by LaRC. Safety and fire protection for contractor personnel and facilities.

6. Other information needed for performance of task:
The contractor shall manage the total work effort associated with the task order to assure fully adequate and timely completion of services to include any and all after hours, holiday, or weekend requirements, responding to unforeseen contingencies and/or emergencies at LaRC or off-site.

Contractor may be required to participate in day trips to Wallops Flight Facility, NAS Oceana, Marine Corps Air Station, Cherry Point, Byrd Field, Richmond, or Fort Eustis. These trips average one trip per week for one person. Aircraft may require ferry to Fixed Base Operator (FBO)/145 Repair Station (North Carolina or New Jersey area) at the rate of one person for 1 week per year. Contractor will accompany the aircraft. The Boeing 757 is scheduled for three 1-week deployments to Atlanta, Georgia, requiring the participation of 3-4 contractors.

7. Security clearance required for performance of work:
Although a security clearance is not necessary for the onsite work performance, the contractor may be required to travel to military or other controlled fields where the reinstatement of a secret clearance is mandatory.

8. Period of Performance: Planned start date: May 1, 1997
Expected completion date: April 30, 1998

9. NASA Technical Monitor: Tony L. Trexler
M/S 255 Phone: (804) 864-3922

05-19-97

SAERS Task Order

1. Task Order Number and Title GNC3 Number: Revision:
Title: Flight Services Office (METRO) Support

2. Background: The Langley Research Center supports flight research missions, as well as, program support, proficiency, and mission management. The Center hosts frequent visitors arriving via transient aircraft, including the regularly scheduled mission management service based at the Wallops Flight Facility. All these activities require support from the Langley Flight Service Office in the form of meteorological reports, general ramp and airfield procedures, NOTAM information dissemination, flight plan filing, and interaction with military and commercial flight operations.

3. The contractor shall perform the following subtasks:

a. Integrate information from various sources to produce and deliver both routine and customized weather briefings, at the rate of approximately 10 per week, prior to each flight to flight crews for research aircraft, support aircraft, and transient aircraft, as well as for flight teams on deployment. Maintain continuous watch on weather conditions during normal work hours and advise the safety office of any impending weather alerts, watches or warnings. Announce over the public address system in the hangar of lightning within ten miles of the Center and repeat announcements with distance updates until the hazard has cleared the area.

b. Insure authorized Langley Air Force Base field usage by transient aircraft on NASA business, approximately 3 per month, but more during LaRC public events, functioning as point-of-contact for information and documentation required for landing and assigning of landing permit (PPR). Responsible for filing flight plans at the rate of 1-3 per day for research, support, and transient aircraft.

c. Maintain radio contact during research flights (approximately 200-300 flight hours per year) and provide current weather information during all flights (total flight hours range from 600-700 hours per year) at this Center. The Contractor shall provide notification of incoming aircraft to Aircraft Support Branch to facilitate marshaling, parking/servicing, and dispatch.

GNC3

d. Serve as the LaRC point-of-contact with Langley Air Force Base operations and other military and commercial airfield operations. Reports results of monthly Air Traffic Control Board Meetings to the Head, Flight Service Team and Chief, Flight Operations and Support Division.

e. Provide flight office dispatch support, ramp observation, and security support, with particular emphasis on active taxi way encroachment and failures in traffic hazard warning system.

f. Maintain and update current database of all flight hours generated by LaRC aircraft and pilots which includes landings, night currency, and flight hours by category and type. Pilots fly at the rate of approximately 150 hours per year. This information is printed in report form and submitted to Head, Flight Operations and Support Division each week and serves as official pilot currency record, historical file, and flight training requirement record.

g. As aircraft dispatcher, contractor is responsible for alerting proper office of unauthorized encroachment of aircraft area or malfunction of taxi way warning or alert devices during normal duty hours.

Minimum acceptable level of performance:

a. Provide forecasts for the FOSD 0815 Monday planning meetings at the rate of 90% per year.

b. Provide customized weather briefings for all research flights originating at LaRC at the rate of 90%.

c. Provides weekly pilot currency data with a 98% degree of accuracy.

Exceeds minimum acceptable level of performance:

a. Provides forecasts and weather briefings at a rate exceeding 90%.

b. Provides pilot currency data with a greater than 98% degree of accuracy.

4. Government Facilities and Equipment Provided:

All government provided office space and equipment required for the performance of this task will be made accessible to the contractor.

5. Other information needed for performance of task:

This support is required during normal work hours (currently 0700-1530), and on an as needed basis during research flight missions outside the normal shift.

6. Security clearance required for performance of task: A secret clearance is required.

7. Period of Performance: Planned start date: May 1, 1997 Expected completion: April 30, 1998

8. NASA Technical Monitor: Richard T. Bright M/S 255A Phone (804) 864-3871

SAERS Task Order

1. Task Order Number and Title GN'C4 Number: Revision: Title: Mission Control Center Operations	

2. Background: The Flight Operations Support Division has a continuing responsibility to support research flights flown out of the Langley Research Center and other flight facilities by bringing in real and near-real time data, video and audio into the Mission Control Center (MCC) for use by NASA, contractor, and industry researchers. Each flight typically requires approximately 130 data parameters, 1-2 video sources and 6-11 audio channels. It is the responsibility of this task to provide operations support for controlling and monitoring research flights data linking to the MCC. This service has become increasingly important as new technology facilitates more off-site research data collection for local researchers. Contractor is also responsible for providing Shuttle support on a mission by mission basis in the form of data and comm (voice/coordination circuits) services.

3. The contractor shall perform the following subtasks:

a. Install, checkout, operate, maintain, and troubleshoot all computer systems within the MCC, as well as interface subsystems (ITAS Series 10, ITAS Series 20, Graphics, 586, Combat Monitor, and System Support). Provide consultations services in the setup and operation of DOS and UNIX computer systems.

b. Operate and maintain all video systems (full motion, compressed, editing and tape dubbing). Assist in aircraft video system design.

c. Operate and maintain all UHF, VHF radio, cable TV headend communication systems within the MCC.

d. Operate and maintain all video and data recording systems within the MCC, to include three data recorders and nine video recorders.

e. Coordinate with remotely located flight facilities to prepare all systems required in the support of any flight at any location and remain within critical schedule perimeters, at the rate of 3-15 flights per week.

f. Operate and maintain the LaRC node on the NASCOM 2000 System serving NASA-wide/world-wide locations, most frequent being Goddard Space Flight Center, Dryden Flight Research Center, Wallops Flight Facility, Kennedy Space Center, and Vandenberg Air Force Base.

GN'C4

g. All systems within the MCC will fall under the MCC Configuration Control System.

h. Contractor will serve on MCC Configuration Control Board, meeting once every 2 weeks for approximately 2 hours. The contractor will present any configuration changes of systems or equipment in the abovementioned systems and review changes of other systems for possible impact on the contractor operated systems.

Deliverables:

a. All required recordings of data, video, and audio as requested by the researchers for each flight (at the rate of 3-15 flights per week), to include post-data processing.

b. All video post processing dubs and analysis including any video editing.

Metrics:

All necessary data, audio, video and communication systems up and running for each flight that support is requested at the rate of 3-15 flights per week

Target is 98% MCC systems availability; no less than of 98% data and video documentation recorded. Performance greater than this will exceed Minimum performance.

4. Government Facilities and Equipment Provided:
The contractor will have access to all Government provided data, video, audio, and maintenance equipment in the MCC.

5. Other information needed for performance of task:
During a typical flight, data, video and audio systems will be operated concurrently. A continuing awareness of the latest technology is a critical task aspect. Contractor will be required to fly aboard NASA aircraft to meet local mission requirements.

6. Security clearance required for performance of task:
A secret clearance will be required.

7. Period of Performance:
Planned start date: May 1, 1997
Expected completion: April 30, 1998

8. NASA Technical Monitor: Richard T. Bright
M/S 255A Phone: (804) 864-3871

1. Task Order Number and Title Number: GN05 Revision:
   Title: Advanced Avionics Design and Development for the LaRC Transport Research Facility

2. Background of Work to be Performed:
   The Operations Engineering Branch has a continuing responsibility to provide capabilities to enhance the advancement of new technologies related to air transport operations. These capabilities require modifying a transport aircraft to efficiently receive new concepts developed in the flight simulation environment, integrating new concepts onto the airplane, and conducting flight tests. The current operational capability consists of a B-737 modified to include a research support system for advanced transport operations. Augmenting the airplane is a ground-based Experimental Avionics Systems Integration Laboratory (EASILY), for checking out research hardware and software systems prior to flight test. Due to evolving technologies, studies, analysis, and operational assessments of upgrades are required to ensure the research aircraft has capabilities necessary to meet current and future research needs of LaRC. A Transport Research Facility (TRF) is being designed and built at LaRC to support future research focused at improving the transport flight deck environment as related to crew performance, safety, and flight efficiency during operations in the airport terminal area. The TRF will consist of a Cockpit Motion Facility, a Research System Integration Laboratory (RSIL) intended as a replacement for the EASILY and a B-757 airplane equipped with a research system intended as a replacement for the B-737. A key objective of the TRF design approach is to enable a simulation-to-flight process that will improve the efficiency of conducting experiments from concept development, to ground-based simulation testing, to flight testing. A general description and expected capability of the proposed TRF is provided in the TRF requirements document.

3. Description of the Work to be Performed
   Subtask Description:
   A) The contractor shall develop a design and implementation approach for interfacing a research Flight Management System (FMS) including GPS navigation with a research system host computer and the standard systems of the B-757 airplane being modified as part of the TRF development project. The research FMS interfaces shall provide for the FMS design requirements as given in the TRF Requirements Document and the NASA B757 Research Flight Management System Requirements Document. The interface design and components must be compatible with the Honeywell FMS currently manufactured as a Product Improvement Package (PIP) for B-757 airplanes. The contractor shall also provide an approach for interfacing the experimental FMS with standard Collins 702 Flight Control Computers (FCC) installed on the B-757 airplane. The interface shall be robust so that

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navigation, guidance, and steering commands from the experimental FMS will enable the FCCs to maneuver the airplane during enroute, approach, and landing operations. The interface shall have the flexibility to enable testing of all control modes of the FMS that are provided for in the standard 702 FCC. An experimental FMS capability will also be hosted as software on a research host computer onboard the airplane. The research host computer is an SGI, Inc. Onyx computer. Interfaces between the research computer and the Honeywell system will comply with standard ARINC guidelines, and will not preclude a capability to switch back to the basic airplane FMS, or to the PIP FMS.
Deliverable: A documented, recommended FMS interface approach containing information for software design, development, and implementation of an experimental FMS, and including methods for interfacing between the experimental FMS and the FCC's.

Schedule: The FMS and interfaces should be ready to support laboratory simulation testing by February 28, 1998, and flight experiments by 757 project baseline delivery (June 30, 1998).

Minimum acceptable performance:
A documented, recommended interface approach delivered by January 31, 1998. The minimal measure of success will be 95% replication of the experimental FMS to the standard B-757 FMS.

Exceeds minimum acceptable performance:
Early delivery of the recommended approach. Delivery of a prototype ready for laboratory simulation testing by February 28, 1998.

B) The contractor shall design, develop, implement, and test a VME/VXI based approach for interfacing the research computer with basic airplane sensors and experimental aircraft equipment using the SCRAMNet system. The system architecture shall interface components of the 757 Transport Research Facility (TRF) together in a real time and deterministic manner. The contractor shall develop the aircraft interfaces to the SCRAMNet architecture. The system shall adhere to the TRF Requirements Document and have upgrade potential without major redesign. Techniques for synchronizing the interfaced components in a real time manner shall be examined and an approach determined and implemented. Methods of system health monitoring shall be included in the design. The first flight experiment using the proposed architecture is a Taxi-Map display concept (LVLASO) developed by the LaRC, Flight Electronics Technology Division. Taxi-Map Displays consist of a flat panel LCD unit and a heads-up display (HUD) unit developed by Collins. These displays will be driven by SGI Indigo and Iris computers which will interface to airplane position sensors via the proposed architecture. The interface design must take into account that the Iris and Indigo computers will be replaced by an SGI Onyx which has more processing capability .

Deliverable: A functional laboratory prototype demonstrating the "proof of concept" of the design.

Schedule: The Taxi-Map LVLASO flight experiment is scheduled for August 1997.

Minimum acceptable performance:
Demonstration of system operation in laboratory simulation and in flight tests on board the NASA B-757 aircraft. The minimal measure of success is a system that will provide for a 95% successful signal transfer rate across all interfaces.

Exceeds minimum acceptable performance:
Flexibility and demonstration of potential growth to accommodate new interfaces . Successful signal transfer rate exceeding 98%.

C) The contractor shall design, develop, and implement an approach for interfacing the Thrust Management Computer (TMC) on the Boeing 757 aircraft to the experimental research system. The interface shall not modify the existing TMC on the aircraft, and will not preclude a capability to switch back to the basic aircraft configuration. The system shall adhere to the 757 (TRF) Requirements Document, and provide the capability of auto-throttle functions in climb, cruise, descent, and approach phases of flight. The interface shall include all discrete and digital signals from the TMC for the purpose of monitoring throttle lever position, Engine Pressure Ratio (EPR) limits, and warnings for both left and right engines.

Deliverable: A documented, recommended approach containing information for the design, development, and implementation of an interface to the basic B-757 TMC system including system description documents, installation drawings, interface requirements, and software requirements.

Schedule: The design and approach are to be completed by December 1997.

Minimum acceptable performance:
Demonstration of system operation in laboratory simulation and limited flight tests. A minimal acceptable level of performance will be a 90% replication rate of standard B-757 automatic flight maneuvers involving speed and thrust commands generated from the research computer.

Exceeds minimum acceptable performance:
Early delivery of approach and/or a 95% replication of standard automatic

flight maneuvers involving speed and thrust commands generated from the research computer.

D) The contractor shall design, develop, and implement an approach for interfacing the High Speed Research (HSR)-unique experimental equipment to the existing baseline research support systems on the LaRC Boeing 737 aircraft. New equipment to be installed will consist of a co-pilot windscreen mounted display screen, an overhead projection unit, an Air-to-Air Multi-Target Tracking (AAMT) Radar unit, an AAMT display unit on the HSR radar pallet, a forward-looking aircraft chin mounted external camera unit, and an interface to upgraded cameras and camera system electronics. HSR equipment will be operated during flight tests via controls located on HSR pallets in the cabin of the airplane. Existing B737 baseline system functions will be maintained and operated according to the TSRV Experimental Systems Guide in support of HSR and other planned flight tests prior to the aircraft retirement currently scheduled for June 1997.

Deliverable: A functional interface between the HSR-unique equipment and the B-737 baseline research system.

Schedule: Installation of the HSR-unique equipment shall be accomplished by May 31, 1997. HSR flight tests are currently scheduled to be completed by July 1997.

Minimum acceptable performance:
Demonstration of a working interface between the B-737 experimental baseline research system and the HSR-unique experimental equipment by May 1997. Data collection during flight tests to evaluate potential forward look sensors for future HSR candidate aircraft shall proceed with a maximum of 10% failure rate.

E) The contractor shall develop the VAX diagnostic software and specialized device driver software to support the interface of VAX computers to the EASILY research experimental system and to the CAMAC simulation interface, as well as supporting EASILY customers in their design, development, buildup, checkout, integration and validation of software and hardware systems. EASILY systems and functions are described in the Description of the EASILY (NASA TM 109072). The contractor shall also coordinate and schedule use of the EASILY facility on a daily basis. The EASILY is in maximum use (8 hours/day) for flight checkout prior to flight experiments going onboard the B-737 or B-757 airplane. Average customer use of EASILY at other times is approximately 4 hours/day 3 days/week.

Deliverable: Diagnostic and device driver software that interfaces between the VAX computers and the EASILY experimental systems. Documented support of EASILY customers. and documented maintenance of EASILY schedule.

Schedule: LVLASO is currently scheduled to use EASILY in preparation for August 1997 flight experiments.

Minimum acceptable performance: Demonstrated implementation of diagnostic and interface software that meets customer requirements and customer schedules.

Exceeds minimum acceptable performance:
Early delivery of customer requested software.

F) The contractor shall perform computer system administration for the designated EASILY facility computer systems (five Digital Equipment Corporation VAX 4000 computers). Management of the computer systems shall require hardware and software upgrades, configuration control, user consultation on VMS, computer system backups, maintenance of user accounts, installation of peripheral devices, and implementation of new system capabilities security measures. Historical data on this service is available from the Task Monitor

Deliverable: Documentation and reports of all installation of operating system patches and upgrades, user support, backups, configuration control, and maintenance. Documented logbooks reflecting activity performed.

Schedule: The date for the completion of this task and the closure of the EASILY facility is October 1, 1997..

Minimum acceptable performance: Demonstrated operation of upgrades or new capabilities installed within 3 weeks of receipt of software or customer request.

Exceeds minimum acceptable performance:
Demonstrated operation of upgrades or new capabilities installed within 2 weeks of receipt of software or customer request.

G) The contractor shall design, develop, and implement an approach for a Research Systems Integration Laboratory (RSIL) that shall adhere to the RSIL requirements stated in the TRF Requirements Document.

Deliverable: A recommended design approach with sufficient information for implementing the proposed RSIL design.

Schedule: The RSIL shall be partially operational by June 1997 in order to support the LVLASO Flight Experiment and fully operational by February 1998 for baseline.

Minimum acceptable performance: Demonstration of a functionally operational laboratory that shall adhere to the RSIL requirements stated in the TRF Requirements Document to support the 757 baseline by February 1998.

Exceeds minimum acceptable performance:
Early delivery of a functionally operable RSIL.

H) The contractor shall develop 757 TRF site-specific software to include utility, diagnostic, calibration, performance, and stand alone testing (i.e., pre-flight, signal path integrity and integration testing, etc.) software, and specialized device driver software to support the site specific systems in the RSIL and onboard the 757 aircraft as outlined in the TRF requirements document . This software shall adhere to the software specifications stated in the software section of that document.

Deliverable: Software that satisfies the TRF site-specific requirements for RSIL and the B-757 airplane.

Schedule: Software specific to the RSIL must be operational by August 1997. Software specific to the airplane only must be operational by October 1997.

Minimum acceptable performance:
Demonstration of functionally operational that shall adhere to the RSIL requirements stated in the TRF Requirements Document onboard the aircraft and in the RSIL by the required operational date.

Exceeds minimum acceptable performance:
Early delivery of functionally operational software.

I) The contractor shall perform maintenance, repair, modifications, calibration, and operation of the experimental systems of the EASILY which include the Datac Interface Unit (DIF), the Research Flight Deck Interface Unit (RFDIU), the Datac, the Research Flight Deck Station,, and the CAMAC Interface Unit. The contractor shall also maintain configuration control for the EASILY drawings (both hardcopy and electronic copy) of the above referenced systems and produce and maintain new drawings for modified systems. . Historical data on this service is available from the Task Monitor

Deliverable: Documentation and reports of daily maintenance, repair, modifications, calibration, and operation of EASILY experimental systems. Drawings of modified systems.

Schedule: The effort is to be completed upon closure of the EASILY facility. Targeted closure date is October 1997.

Minimum acceptable performance: Functionally operational EASILY with recorded facility downtime less than 2%. Exceeds less than 1%.

J) The contractor shall design, develop, and implement an approach for the RSIL physical layout and its interfaces to the simulator facility. The contractor shall also design and develop the RSIL subsystem racks and interfaces to the simulation systems. Once the RSIL is operational, the contractor shall perform maintenance, repair, modifications, calibration, and operation of the experimental systems of the RSIL. The description of the proposed RSIL and the RSIL requirements are included in the TRF Requirements Document. The contractor shall produce RSIL layout and subsystem designs and maintain configuration control for the drawings.

Deliverable: Design and layout approach for RSIL. Daily maintenance, repair, modifications, calibration, and operation of RSIL experimental systems. Drawings of RSIL layout and subsystems.

Schedule: The RSIL design and layout approach should be completed by May 1997, and the RSIL should be partially operational by June 1997 in order to support the LVLASO Experiment and fully operational by February 1998 for 757 project baseline.

Minimum acceptable performance: A documented, recommended design approach to be delivered by May 1997. The minimal measure of success will be a functionally operational laboratory by February 1998. Once the RSIL is operational, facility downtime shall not exceed 2% .

Exceeds minimum acceptable performance: Early delivery of design approach and /or implementation.

K) The contractor shall develop an architecture and a detailed design to implement a tail strike warning system for the B-757 aircraft and test and troubleshoot the system after installation and during initial flight testing. The tail strike warning system will alert the pilots that continued maneuvering at the current rates and authorities could result in the tail of the aircraft striking the runway. Design of the system will be such that the pilots are assured of reliable, timely warnings, while at the same time minimizing false alarms. Flight deck display will be unobtrusive when not active, but will give positive and unmistakable warnings when necessary. The system will operate without any pilot input or intervention. The system will be designed such that pilots may disable the system if desired. The system will be designed to use only existing aircraft sensors if possible. The system will be independent of other experimental equipment and will be self monitoring, easily testable by research crew and will be fail passive. Aircraft sensor or tail strike warning system failures will cause the system to annunciate a system failure rather than emit false alarms. Tail strike warning system failures will not adversely affect any other aircraft system. The system will be designed to have minimal weight, space, power and cooling requirements and to meet all NASA aircraft Quality Assurance requirements. Deliverables: A fully documented design, including system description documents, detailed schematics and parts lists, aircraft interface wiring diagrams, software requirements, test and acceptance procedures, troubleshooting procedures and preflight and inflight test procedures.

Schedule: The tail strike warning system should be operational by October 1997.

Minimum acceptable performance:
Demonstration of system operation in laboratory simulation and limited flight tests. The minimal measure of success is a system that will alarm in 95% of circumstances in which continued maneuvering would lead to a tail strike two seconds after alarm with no more than a 5% false alarm rate due to turbulence.

Exceeds minimum acceptable performance:
Performance which substantially exceeds requirements will be indicated by an alarm rate of at least 98% with a false alarm rate less than 2%.

L) The contractor shall prepare, revise, organize, and distribute approximately 100 aircraft electrical schematics and wiring diagrams for the experimental avionics and instrumentation systems onboard the NASA Langley Transport Systems Research Vehicle (TSRV) Boeing 737 aircraft and its replacement, the Transport Research Facility (TRF) Boeing 757 aircraft. The contractor shall maintain and update electronic Computer Aided Design (CAD) files, schematics, and notebooks of the aircraft experimental systems. Currently these files consist of approximately 500 electronic CAD files, a 25 drawer flat file containing approximately 500 drawings, and 15 notebooks.

Deliverable: Latest volume of the TSRV Wiring Diagrams Book. Latest volume of the TRF Wiring Diagrams Book. Charts, graphics, and miscellaneous documentation as required by the project.

Schedule: 737 drawings should be in final form for aircraft retirement by September 1997. 757 drawings should be in final form for baseline delivery by May 1998.

Minimum acceptable performance: Three week delivery after receipt of specifications of schematics and wiring diagrams with 95% accuracy. Exceeds: more than 98%

M) The contractor shall develop an architecture and a detailed design to implement a GLS autoland system for the B-757 aircraft and test and troubleshoot the system after installation and during initial flight testing. The system shall be designed according to the requirements set forth in the TRF requirements document. The system shall provide for automatic landing of the aircraft without safety pilot intervention. The system will be designed to have minimal weight, space, power, and cooling requirements and to meet all NASA safety requirements and aircraft Quality Assurance requirements.

Deliverables: A fully documented design approach, including system description documents, detailed schematics and parts list, aircraft interface wiring diagrams, software requirements, test and acceptance procedures, troubleshooting procedures and preflight and inflight test procedures.

Schedule: The GLS autoland should be operational by March 1998.

Minimum acceptable performance: Demonstration of system operational in laboratory simulation and limited flight tests. The minimal measure of success is a system that will autoland at a 95% success rate without safety pilot intervention.

Exceeds minimum acceptable performance: Performance which substantially exceeds requirements will be indicated by successful autoland rate of at least 98% without safety pilot intervention.

N) The contractor shall develop an architecture and a detailed design to implement an envelope alerting system for the B-757 aircraft and test and troubleshoot the system after installation and during initial flight testing. The system shall alert pilots when the aircraft is outside of its normal or experiment specific envelope. Design of the system will be such that the pilots are assured of reliable, timely alerts while at the same time minimizing false alerts. The system will be designed to have minimal weight, space, power, and cooling requirements and to meet all NASA aircraft Quality Assurance requirements.

Deliverables: A fully documented design approach, including system description documents, detailed schematics and parts list, aircraft interface wiring diagrams, software requirements, test and acceptance procedures, troubleshooting procedures and preflight and inflight test procedures.

Schedule: The envelope alerting system should be operational by March 1998.

Minimum acceptable performance: Demonstration of system operational in laboratory simulation and limited flight tests. The minimal measure of success is a system that will alert in 95% of circumstances in which the aircraft is outside of its normal operating envelope.

Exceeds minimum acceptable performance: Performance which substantially exceeds requirements will be indicated by an alert rate of at least 98% with a false alert rate less than 2%.

O) The contractor shall design, develop, and implement a video system integrating video cameras, video recorders, repeater monitors, and a video telemetry interface in the 757 aircraft. The approach shall provide for the conversion of Onyx and other computer raster graphics outputs to NTSC and SVHS video for input to standard VCRs, monitors, and telemetry equipment. as well as incorporating scan conversion and switch routing techniques.

Deliverables: A fully documented design approach, including system description documents, detailed schematics and parts list, aircraft interface wiring diagrams, test and acceptance procedures, troubleshooting procedures and preflight and inflight test procedures.

Schedule: The video system should be operational as per the LVLASO requirements document to support the August 1997 flight experiment and fully operation by June 1998 as per the TRF requirements document for baseline delivery of the research system.

Minimum acceptable performance: Demonstration of system operational in laboratory simulation and limited flight test. The minimal measure of success is a system that will support 95% of each flight hour during an experiment.

Exceeds minimum acceptable performance: Performance which substantially exceeds requirements will be indicated by a system without failure during a 3 hour flight sortie.

P) The contractor shall design aircraft pallets for the TRF research system components to be installed on the aircraft. Currently, twelve pallets are required for the B-757 aircraft to support baseline delivery. The contractor shall perform system checkout to include power, connectors, and operational performance of internal pallet components and connections and inter-pallet interfaces in laboratory and aircraft environments.

Deliverables: A fully documented design of the pallets to include TRF specified component numbering schemes and wiring diagrams. Daily maintenance, repair, modifications, calibration, and operation of pallet subsystems.

Schedule: All pallets components shall be operational and onboard the aircraft by May 1998.

Minimum acceptable performance: Fully installed and operational pallets onboard the aircraft by May 1998.

Exceeds minimum acceptable performance: Early delivery of operational palletsonboard the aircraft before March 1998.

Q) The contractor shall maintain the Configuration Management and Operational Coordination processes of the Operations Engineering Branch (OEB). The contractor shall provide analyses of NASA's flight resource management. The contractor shall provide flight customers with information for the production of Aircraft Work Orders (AWOs), and shall log, file, and route AWOs, and shall maintain, improve and/or develop computerization of the overall work order and configuration control processes for the aircraft hardware and the experimental systems hardware. The contractor shall assist customers with the production of project initiation forms, plans of test, Flight Operations and Safety Reports (FTOSRs), data requirements, data requests, and other related documentation and process. The contractor shall process project initiation forms, plans of test, FTOSRs, flight requests, manifests, flight cards, flight summary reports, data requests, data requirements, and other related documentation.

Schedule: On-going daily tasks through April 1998.

Minimum acceptable performance: Response to customer requests within 8 hours

Exceeds minimum acceptable performance: Response to customer requests within 2 hours.

R) The contractor shall support flight programs and simulation studies in the capacity of a contract pilot. In-flight co-pilot-in-command duties will be limited to in-type aircraft ratings, or as approved by NASA's Flight Operations Organization. The contractor shall fly approximately twice per month on a 3 hour sortie. Flights are scheduled several weeks (2 or more) in advance.

Schedule: On-going sporadic tasks through April 1998.

Minimum acceptable performance: Ability to fly aircraft or simulator in a manner to meet operational and research requirements without NASA pilot intervention during 95% of a flight.

Exceeds minimum acceptable performance: Ability to fly aircraft or simulator in a manner to meet operational and research requirements without NASA pilot intervention during 98% of a flight.

S) The contractor shall design, develop, and implement an approach for interfacing the Silicion Graphics Onyx computer to the other components of the transport research experimental system. Interfaces are to include video, the Flight Management Computer, the Flight Control Computer, the Thrust Management Computer, the SCRAMNET data bus, and autoland.

Deliverable: A documented, recommended approach containing information for the design, development, and implementation of the interface including system description documents, installation drawings, interface requirements, and software requirements.

Schedule: The design and approach are to be completed by December 1997.

Minimum acceptable performance:
Demonstration of system operation in laboratory simulation and limited flight tests such that the new systems meets the TRF Requirements Document by April 30, 1998.

Exceeds minimum acceptable performance:
Early delivery of approach. Early demonstration of system operation.

4. Government Furnished Items:

5.Other information needed for performance of task: Three 1-week flight research deployments to Atlanta, Georgia, are scheduled during the course of the contract period involving B-757 engineers and technicians.

6. Security clearance required for performance of work: none

7. Period of Performance	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA Technical Monitor: Lucille H. Crittenden .M/S: 256 Phone: 804-864-1776

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1. Task Order Number and Title H01 Number: Revision:
   Title: <u>Parametric Cost Estimates</u>

2. Purpose, Objective or Background of Work to be Performed:

NASA Langley' Chief Financial Officer, among other activities, provides Langley's research and engineering community support in estimating and tracking project costs. This support is provided for on-going projects as well as proposed new projects. The workload is essentially constant in the long term, but estimates for specific projects occur somewhat sporadically. "Project", as used here, may encompass the design, fabrication, flight and operation of an unmanned space or aeronautics science mission; a singular instrument to be used on a separately-conceived spacecraft; an aeronautics research test article; or possibly a major modification to an existing flight test aircraft (the aircraft itself being the "test article"). In addition, support is also provided to longer-term research programs such as Advanced Subsonic Technology and High Speed Research. Cost estimates for on-going projects are for mid course review or for updates to projects which were poorly defined in earlier analyses and should take into account all completed work and incurred costs. Completed projects are to enhance the validity of modeling tools and existing data.

A significant concern in project estimating is the need for greater accuracy and confidence in project cost estimates. To this end, cost modeling techniques, as well as the models themselves and their underlying data need constant and continual improvement and expansion.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Sub-Task 1 - Deliverable Parametric Cost Estimates:

The contractor will perform parametric cost analyses on new, on-going or completed projects. The NASA task monitor will identify those projects to be estimated. Each parametric cost estimate should include the following products, services and activities:

<u>Deliverables</u>:

- At least one interview or meeting with the cognizant NASA officials (Principal Investigator and/or Project Manager and design team) for the purpose of exchanging information on mission concept and goals, the expected instrument/test article design parameters, the work breakdown structure (WBS), the project schedule, the programmatic and technical cost ground-rules and assumptions, and the known technical characteristics of the instrument/test article.

- An information search and historical data collection activity to establish a relevant database from which to model project costs.

- An assessment and , if needed, adaptation of available modeling tools and techniques to assure the best possible relevance to the subject mission/test.

PRINTED: 4/29/97

1. Task Order Number and Title Number: Revision:

Title: Parametric Cost Estimates

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

- A presentation of the contractor's plans for proceeding with the estimate to the cognizant NASA officials, detailing the model intended for use, the completeness and relevance of available information and historical data, and the likely range of accuracy of the ultimate cost estimate. A specific time of delivery of the final estimate will be included in this presentation.
- A final cost report that incorporates all relevant information; grass-roots estimates for labor and materials; vendor quotes; comparisons to other available estimates; cost risk issues, including probability ranges and sensitivity analyses for particular aspects. The final report should also spread the expected costs across the entire project schedule and identify significant cost drivers. The final report should be presented formally to cognizant NASA officials and provide for a clear understanding of the estimate, the risk and sensitivity analyses, recommendations for improving the design process to achieve better cost estimates and possible recommendations for less costly design alternatives.
- A brief report to the task monitor on what meetings and activities were conducted in support of the completed estimate and which NASA officials were briefed and/or consulted.

Metrics (minimum acceptable level):

- Delivery of or demonstrable progress toward a completed parametric cost estimate at an overall "average" rate of one each month of contract performance. It is intended that in a twelve month contract period, there will be an equivalent of twelve estimates delivered. The concept of "average" rate is to allow for completion of previously begun estimates as well as estimates assigned late in the period that cannot be completed within the period. It is also intended to recognize that assignment of estimates to the contractor will not, in most cases, be made on a simple one-each-month basis.
- At least one fact finding or information sharing interview for each parametric estimate.
- At least one briefing on the contractor's intended modeling approach.
- At least one final cost estimate package and briefing.
- At least one report to the task monitor on deliveries and supporting activities.

Metrics (above minimum acceptable level):

- Delivery of completed parametric cost estimates at a higher overall "average" rate within the same contract costs.
- More frequent relevant interaction with cognizant NASA officials, such as advisory meetings on design parameters and suggestions for cost reductions.

1. Task Order Number and Title Number: Revision:

Title: Parametric Cost Estimates

Sub-Task 2 - Cost Model and Technique Development:

The contractor will investigate new cost modeling tools and techniques and make specific recommendations to the NASA Langley Chief Financial Officer. Further, the contractor will locate and compile historical cost data for relevant space and aeronautics projects. (These accomplishments are referred to as "improvements" in the rest of this document.) Improvements include cost models and analysis tools for preparing inputs to the cost models as well processing output from the cost models.

Deliverables:

- Incorporation of new algorithms and methods into existing cost tools.
- Design and coding of new cost estimating tools, including tools to quantify cost risks and estimate probability ranges for model results.
- Meetings with the NASA task monitor to discuss NASA project needs and ideas for needed improvements. The meetings will also provide a forum for describing the status of on-going efforts.
- A report detailing each significant improvement to estimating tools, techniques or databases. Each improvement report should clearly describe the improvement itself, the effort and approach utilized to attain the improvement and the types of projects most likely to benefit from the improvement. The report should be written such that it will be easily understandable by non-technical NASA personnel, as well as project investigators and engineers, and should be ready for various methods of informal publication throughout Langley Research Center and, in some cases, other NASA centers.
- Documentation of the improvement, including instructions for its use and examples of its possible application.

Metrics (minimum acceptable level):

- At least one improvement, including actual software, documentation and reports detailed above will be submitted to the task monitor in each six month period. The improvement should be of sufficient scope as to merit its immediate adoption into the cost estimating process for Langley Research Center. It should have demonstrated relevance to at least 50% of Langley's cost estimate requirements. This braoad relevancy requirement can be waived by the task manager when the improvement can be shown to be a significant enhancement to a norrower spectrum of high-priority cost estimates.
- Meetings to discuss proposed or planned improvements and progress on current improvements will occur with the task monitor or other designated NASA personnel on at least a quarterly basis.
-

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Metrics (above minimum acceptable level):

- **Improvements and reports describing them, when delivered, evidence such merit as to warrant expanded distribution and use at other NASA installations.**
- **Improvements and their documentation demonstrate such broad relevance or unique value as to warrant, in the judgement of the task manager, formal presentation at NASA or external conferences.**
- **Improvements are completed, delivered and implemented at a rate that exceeds one each six month period.**

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4. Government Furnished Items:

The government will provide a set of four Macintosh work-stations with Microsoft Office software, electronic mail, and World-Wide Web navigation capabilities. Also available are two IBM 486 compatible personal computers outfitted with Microsoft Office and Price H, Price M and Price HL cost modeling software. Appropriate printers are included.

5. Other information needed for performance of task.

Grass-roots estimates of Civil Service time and materials will be provided by the government for each new cost estimate.

6. Security clearance required for performance of work:

In most cases, no security clearance is required. However, approximately 30 to 40% of the estimates will require a "secret" clearance. In addition all estimating personnel will have to execute a "non-disclosure" statement prohibiting them from disclosing proprietary data obtained during the estimating process.

7. Period of Performance	
Planned start date: **5-1-97**	Expected completion date: **4-30-98**

8. NASA Technical Monitor: **Chris Johansen**
.M/S: **109** Phone: **757-864-6077**

PRINTED: 4/29/97

1. Task Order Number and Title LA01 Number: Revision:

Title: Scramjet Integrated Design Technology

2. Purpose, Objective or Background of Work to be Performed

NASA Langley Research Center has been a major player in the development of scramjet and related hypersonics technology since 1960. Over this time, the center has developed ground-based experimental testing, data analysis, analytical, computational, and design specific methodology. These design methods, which are specific to scramjet engine flowpath and associated hypersonic aerodynamic performance, loads, structural design and thermal analysis represent the state-of-the art (world-class) tools. These technologies have been extensively utilized for design studies and support of ground based experimental test programs and, specifically, from 1985-1995 on the National Aero-Space Plane (NASP) Program. NASA has recently (*Aviation Week*, May 12, 1996) initiated the Hyper-X Program to demonstrate in flight, the technology required for hypersonic cruise aircraft and efficient air breathing engine-powered orbital launch vehicles. The Hyper-X flight test is a logical step to validate, refine, and advance these design methods using data generated in flight.

HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT

3/19/97	Keel line VI (KL-VI) configuration released
5/1/97	Detailed assessment of KL-VI completed
7/1/97	Mach 7 Hyper-X vehicle CDR
4/20/98	Mach 5 scramjet final flowpath design completed
2/1/98	Mach 7 vehicle delivered
12/31/98	Mach 7 vehicle test flight
4/20/99	Mach 10 scramjet final flowpath design completed

DESCRIPTION OF MULTI-LEVEL APPROACH FOR SCRAMJET ANALYSIS AND DESIGN

Because of their highly integrated nature, detailed scramjet engine flowpath design is accomplished by a multi-level approach. This approach utilizes simple (Level I+) numerical/analytical design codes, like SRGULL, to assess performance on a system level, and other low-level specific methods, such as SCRAM3L and higher level CFD methods, such as SHIP, SPARK, CFL3D, GASP, and LARCK to assess details of the engine component performance and operability, including component interaction, and to update/improve the component level performance assumptions in the analytical code. This CFD analysis is divided into Level III, full 3-D elliptic representation, and simplified (Level II) solution approaches, such as the SHIP 3-D PNS combustor analysis. Part of the success of these design methods can be attributed to the close relation between experimental and design methods, as these methods are routinely utilized to evaluate - or compared with - experimental results, thus simultaneously interpreting the data and validating the design systems. Empirical and statistical design methods are also an integral part of the engine flowpath design methods. For example, a high speed scramjet fuel injector, combustor design system was developed (NASP DN-92-357) for the high speed, pure supersonic combustor operation. Methods for improving (Riggins) and extending the parametric range (Vitt) and extending this design system approach to lower speed (S3, CDE parametric test) represent continuing development of this scramjet/dual-mode-ramjet design technology.

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Title: Scramjet Integrated Design Technology

3. DESCRIPTION OF THE WORK TO BE PERFORMED

This task is divided into 4 sub-tasks:

- Design/Analysis of the Hyper-X Scramjet-Powered Vehicle Flight Experiment
- Pre/Post Test Numerical Analysis of Hyper-X Ground Tests
- Pre/Post Test Numerical Analysis of CIAM/NASA Ground and Flight Tests
- Pre/Post Test Numerical Analysis of Hyper-X Scramjet Thermal Structure

Some deliverable dates are outside of the base period of the SAERS Contract and are contingent on extension of the contract by options and available funding.

3.1 DESIGN/ANALYSIS OF THE HYPER-X SCRAMJET-POWERED VEHICLE FLIGHT EXPERIMENT

3.1.1 DESCRIPTION OF TASK

The contractor shall

3.1.1.1 Calculate performance, operability, thermal and pressure loads, and all key flowfield characteristics of the final Hyper-X scramjet engine flowpath and powered configuration.

3.1.1.2 Recommend design alternatives (based on calculations in 3.1.1) for improving the baseline Hyper-X engine performance to meet program objectives.

3.1.1.3 Perform thermal analysis of the complete baseline engine and the final engine design.

3.1.1.4 Analyze the Hyper-X baseline configurations (unpowered) using Euler and 3D-FNS methods for selected cases from Mach=0.5 to 10.0 at angles-of-attack.

3.1.1.5 Analyze final Mach 7 engine design including mechanical details, structures, thermal and mass properties. The contractor shall perform transient thermal analyses of the Hyper-X vehicle engines for Mach = 5, 7, and 10. The engine design details, materials, pressures, and heating rates for the Mach 7 flight test trajectories will be provided by the government and available 4/1/97.

3.1.2 DELIVERABLES

The contractor shall deliver

3.1.2.1 Hard copy and electronic version in tabular and/or graphical form of the following for each of the three baseline vehicles and the final design vehicles at design point: engine flowpath heat transfer and wall pressure loads, engine thermal loads, and engine flowpath

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flow characteristics, performance and operability.

3.1.2.2 Hard copy and electronic version in tabular and/or graphical form of integrated force and moment data consistent with the Hyper-X "cowl-to-tail" accounting system in the body and stability axis systems; surface pressure data including control surfaces for all Euler runs on the baseline configurations and 3D-FNS solutions for selected cases.

(Informal written reports shall at minimum describe the work completed, assumptions made, methods used, grids utilized, and discuss/justify recommended modifications to the preliminary flowpath and mechanical design to achieve program goals)

3.1.2.3 Electronic copies of restart files and other output files as required.

3.1.3 SCHEDULE

3.1.3.1 Written report documenting final (KL-VI) Mach 7 engine flowpath heat transfer and wall pressure loads (6/1/97)

3.1.3.2 Written report documenting final Mach 7 engine thermal loads (6/1/97)

3.1.3.3 Written report documenting final Mach 7 engine flowpath flow characteristics, performance and operability (6/1/97)

3.1.3.4 Written report documenting final design engine thermal/structural analyses (7/1/97)

3.1.3.5 Written report documenting preliminary Mach 5 engine flowpath flow characteristics, performance and operability (10/1/97)

3.1.3.6 Written report documenting final Mach 5 engine flowpath flow characteristics, performance and operability (4/1/98)

3.1.3.7 Written report documenting preliminary Mach 10 engine flowpath heat transfer and wall pressure loads, thermal loads, flow characteristics, performance and operability (8/1/98)

3.1.4 METRICS FOR DELIVERABLES

3.1.4.1 Meet schedule and cost

3.1.4.2 Completeness and depth of engine flow field analysis and documentation. Minimum acceptable to include:
- Reports in section 3.1.3.1 and 3.1.3.2 include all loads (pressure and thermal) on all internal and external engine surfaces, including leading and trailing edges.
- Report in section 3.1.3.3 to include nose-to-tail and cowl-to-tail force accounting performance, component level and inter-component level operability, and all key flowfield characteristics, such as, but not limited to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flameholding, and inlet-isolator "bubble" characteristics.

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- Report in section 3.1.3.4 to include thermal analysis of the entire engine body side and cowl structure, including variable geometry parts and thermal protection coating, at both the design test condition(s) and over the entire flight from Mach 3 on boost to Mach 3 on decent.

3.1.4.3 Confidence in predicted engine/flowpath performance, operability and loads, based on the following:
- Appropriateness of methods selected
- Documented validation for methods utilized,
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Accuracy of numerical representation of given geometry

3.1.4.4. Comparison of results from multiple level analysis approaches, including comparison and updating of the baseline SRGULL analysis contained in HX-003, May 12, 1996.

3.1.5 EXCEEDS MINIMUM REQUIREMENTS

3.1.5.1 Provide credible 3-D elliptic solution(s) for dual mode scramjet combustor.

3.1.5.2 Provide 3-D nose-to-tail evaluation of all 3 flight test conditions, compare with SRGULL performance and relevant experimental data to quantify uncertainty.

3.1.5.3 Documentation contains complete uncertainty analysis, experimentally based validation, of predicted performance, operability and loads.

3.2 PRE/POST TEST NUMERICAL ANALYSIS OF HYPER-X GROUND TESTS

The following experimental programs are scheduled for support of the Hyper-X flight program, and will require numerical support during this task period. Abbreviated identifiers, flight Mach simulation and an abbreviated test schedule are shown below:

(1) Full-scale, Hyper-X engine (DFX) test in the NASA LaRC Arc Heated Scramjet Test Facility (AHSTF), GASL Leg-4 (L-4) and the 8' High Temperature Tunnel (8'HTT):

(a) DFX-7 KL-V & -VI'	Mach 7	AHSTF	Test Mar-Apl., 97.
(b) DFX-7 KL-VI	Mach 7	L-4	Test Jul-Aug., 97.
(c) DFX-7 KL-VI	Mach 7	8'HTT	Test Dec., 97.
(d) DFX-5 KL-VI	Mach 5	AHSTF	Test Sept.-Oct., 97.
(e) DFX-5 KL-VI	Mach 5	L-4	Test Feb., 98.
(f) DFX-5 KL-VI	Mach 5	8'HTT	Test Feb., 98.

(2) Full-scale, Hyper-X engine (DHX) test in the NASA LaRC HYPULSE Reflected Shock Tunnel Scramjet Test Facility at GASL:

(a) DHX-10 KL-VI	Mach 10	Test Mar-Apl., 98.
(b) DHX-7-Baseline	Mach 7	Test May-Jun., 98.

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(3) Full-scale, Hyper-X combustor/nozzle (HCN) test in the NASA LaRC HYPULSE Expansion tube and Reflected Shock Tunnel Scramjet Test Facility at GASL:

(a) HCN-12-DCV	Mach 12	Test Completed Mar. 1-31, 96.
(b) HCN-7-Baseline	Mach 7	Test Completed Jun. 15-30, 97.

(4) Large-scale, Hyper-X Mach 5 combustor (DCX) test in the GASL Direct Connect Facility:

(a) DCX-5-Baseline	Mach 5	Test Completed Mar. 1-31, 96.

(5) Hyper-X inlet starting (HXIS) test in the NASA Mach 4, 6 and 10 facility:

(a) HXIS-4-Baseline	Mach 4	Test May, 97.
(b) HXIS-6-Baseline	Mach 6	Test Sept., 97.
(c) HXIS-4-Baseline	Mach 10	Test Mar, 98.

(6) Hyper-X Mach 7 powered test in the NASA LaRC 8 foot High Temperature Tunnel (8'HTT):

(a) Hyper-X-7	Mach 7	Test Jan-Mar., 98.

3.2.1 DESCRIPTION OF WORK

3.2.1.1 The contractor shall provide results from the following computations and analysis associated with all Hyper-X ground tests experiments listed above:

3.2.1.1.1 Pre-test analysis which are of interest to and requested by the governments designated respective test engineer.

3.2.1.1.2 Post test analysis for both the design point for Hyper-X simulation, and up to 5 off-design conditions to be specified by the government.

3.2.1.1.3 Flight scaling of the experimental results.

3.2.1.2 The contractor shall provide data reduction of all fuel plume images (FPI) generated in the HYPULSE or other experimental tests (expect 50) to determine fuel mixing efficiency.

3.2.1.3 The contractor shall provide post-test analysis for selected Hyper-X baseline wind tunnel test runs which shall include calculating increments for wall and sting corrections and Reynolds number effects.

3.2.2 DELIVERABLES

3.2.2.1 Pretest analysis documentation

3.2.2.2 Post test analysis and flight scaling documentation.

3.2.3 SCHEDULE

3.2.3.1 The contractor shall negotiate with each experimental program's Government Designated Test Engineer (GDTE) to determine the required delivery date for pretest analysis.

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3.2.3.2 Post test document shall be delivered two months from delivery of experimental data

3.2.3.3 Post test document for existion test data shall be delivered by June 1997 for item 4 (DCM data), and by Sept. 97 for items 3 (HYPULSE data).

3.2.4 METRICS FOR DELIVERABLES

3.2.4.1 Meet schedule and cost.

3.2.4.2 Pre-test analysis includes, as a minimum, performance, operability, heat transfer and pressure distribution (for instrumentation location selection) and loads and all key flowfield characteristics such as, but not limited to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flame holding, and inlet-isolator "bubble" characteristics which are of interest to and requested by the governments designated respective test engineer.

3.2.4.3 Post-test analysis documentation includes, as a minimum, all items in 3.2.4.2 plus direct comparison with all experimental measurement, and clearly identify differences between measurement and pre-test and post-test analysis, and the impact on flight predictions of performance, operability and loads.

3.2.4.4 Confidence in flight scaled component/engine flowpath performance, operability and loads, based on:
- Appropriateness of methods selected related to the important flow physics
- Documented validation for methods utilized
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Inclusion of facility contaminant effects
- Accuracy of numerical representation of given geometry

3.2.4.5 FPI analysis procedure equal to or improved from that described in NASA CR 1186.

3.2.5 EXCEEDS MINIMUM REQUIREMENTS

3.2.5.1. Provide credible 3-D (strip) elliptic solution(s), compared with experimental data, for 3 of the dual mode scramjet combustors (DFX-7, DFX-5, DHX-7 or DCX-5).

3.2.5.2. Provide credible 2-D time-accurate solution, compared to experimental data from either the HXIS-4, HXIS-4 or HXIS-4 inlet starting door tests.

3.2.5.3 Provide Hyper-X deliverables ahead of schedule.

3.3 PRE/POST TEST NUMERICAL ANALYSIS OF CIAM/NASA GROUND AND FLIGHT

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TESTS

3.3.1 DESCRIPTION OF WORK

The contractor shall provide results from the following computations and analysis for the CIAM and NASA tests of the CIAM-NASA ground and flight test scramjet engine.

3.3.1.1 Pre-test analysis, to include performance, operability, heat transfer and pressure and thermal loads and all key flowfield characteristics at both the design condition and up to 4 off-design conditions for both ground and flight experiments. Ground test analysis for the 8' HTT entry shall include assessment of alternate cooling, including water, gaseous hydrogen and liquid nitrogen

3.3.1.2 Post test analysis for both the design and up to five off design conditions to be specified by the government based on ground and flight test experimental operating conditions.

3.3.2 DELIVERABLES

3.3.2.1 Pre/post test documentation of ground test and flight scaling documentation

3.3.2.2 Pre/post test documentation of flight test and flight scaling documentation

3.3.3 SCHEDULE

3.3.3.1 Ground Test documentation

3.3.3.1.1 Pre-Test for 8'HTT Mar.98 entry: Aug. 1, 1997

3.3.3.1.2 Post-Test: Six months from delivery (est. May 1997) of CIAM ground test experimental data.

3.3.3.1.3 Post-Test: Six months from delivery (est. May 1998) of NASA 8'HTT ground test experimental data.

3.3.3.2 Flight Test documentation

3.3.3.2.1 Update Pre-Test: April. 1, 1997

3.3.3.2.2 Post-Test: Six months from delivery (est. May 30. 1997) of flight test data.

3.3.4 METRICS

3.3.4.1 Meet schedule and cost.

3.3.4.2 Pre-test analysis documentation includes performance, operability, heat transfer and pressure and thermal loads and all key flowfield characteristics (such as, but not limited

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to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flame holding, and inlet-isolator "bubble" characteristics).

3.3.4.3 Post-test analysis documentation includes, as a minimum, all items in 3.3.4.2 plus direct comparison with all experimental measurement, and clearly identify differences between measurement and pre-test and post-test analysis, and the impact on flight predictions of performance, operability and loads.

3.3.4.4 Confidence in flight scaled component/engine flowpath performance, operability and loads, based on:
- Appropriateness of methods selected
- Documented validation for methods utilized
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Inclusion of facility contaminant effects

3.3.5 EXCEEDS MINIMUM REQUIREMENTS

3.3.5.1 Provide credible 3-D (strip) elliptic solution(s) for the dual mode scramjet combustor operation, compared with experimental data, for both ground and flight test.

3.3.5.2 Verify the engine flowpath and thermal analysis tools to within 10% of the experimentally measured combustor wall temperature for both ground and flight conditions.

3.4 PRE/POST TEST NUMERICAL ANALYSIS OF DFX SCRAMJET THERMAL STRUCTURE

3.4.1 DESCRIPTION OF TASK

The contractor shall provide pretest analysis of the DFX Mach 7 AHSTF scramjet structure thermal response and compare predictions with experimental measurements obtained during the test to “validate” transient thermal analysis method

3.4.2 DELIVERABLES

NASA Contractor Report documenting validation of the transient thermal analysis method.

3.4.3 SCHEDULE

Task to begin 5/1/97. Preliminary results to be completed and presented by 7/1/97. Documentation to be completed 9/15/97.

3.4.4 METRICS FOR DELIVERABLES

Quality of analytical methods used in analysis (NASTRAN, SINDA, etc.). Quality of analytical models used (resolution of gradients, element size, etc.). Temperature predicted to +/- 10%.

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1. Task Order Number and Title	Number:	Revision:
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4. GOVERNMENT FURNISHED ITEMS

4.1 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S,4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

4.2 Available Software
- GASP 2.2 and GASP 3.0 site license
- GRIDGEN, TEKPLOT, GRIDTOOLS
- SHIP3D
- SRGULL
- SCRAM3L
- LARCK
- SAM3D
- USM3D
- PARAFLOW

4.3 Special furniture
- Safes for storage of classified material

5. OTHER INFORMATION NEEDED FOR PERFORMANCE OF WORK

5.1 Estimated Travel requirements

-Performance of these tasks may require travel to GASL, Ronkonkoma, NY; Micro Craft, Inc., Tullahoma, TN; Boeing North American, Seal Beach, CA; NASA Dryden Flight Research Center; and participation in JANNAF Propulsion meetings.

5.2 Applicable Documents - ATTACHMENT A

6. SECURITY CLEARANCE REQUIRED FOR PERFORMANCE OF WORK

6.1 Most of the work performed on this work order requires a SECRET clearance.

6.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

6.3 Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.

7. PERIOD OF PERFORMANCE	
Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA TECHNICAL MONITOR:	Charles R. McClinton	M/S: 352	Phone: 804-864-6253
NASA TM ALTERNATE:	Sharon H. Stack	M/S: 352	Phone: 804-864-3742

PRINTED: 4/30/97, 8:10 AM

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ATTACHMENT A

Bibliography of Reference Material
(NOTE: Contact the NASA Langley Research Center Technical Library or Sharon H. Stack for copies or information on these documents)

Jachimowski, C. J.: An Analysis of Combustion Studies in Shock Expansion and Reflected Shock Tunnels. NASA TP-3224, July 1992.

Jentink, T. N.: An Evaluation of Nozzle Relaminarization Using Low Reynolds Number K-e Turbulence Models. Presented at the 31st Aerospace Sciences Meeting, January 11-14, 1993, Reno, Nevada. AIAA Paper No. 93-0610.

Kamath, P.S. and Mao, M.: Computation of Transverse Injection into a Supersonic Flow with the SHIP3D PNS Code. Presented at the AIAA Fourth International Aerospace Planes Conference, Orlando, Florida, December 1-4, 1992.

Kamath, P. S.; Hawkins, R. W.; and McClinton, C. R.: A Highly Efficient Engineering Tool for Three-Dimensional Scramjet Flowfield and Heat Transfer Computations. Presented at the Computational Fluid Dynamics Symposium on Aeropropulsion, April 24-26, 1990. In NASP CP 3078.

Riggins, D. W.; McClinton, C. R.: Analysis of Losses in Supersonic Mixing and Reacting Flows. Presented at the AIAA/SAE/ASME/ASEE 27th Joint Propulsion Conference and Exhibit, June 24-27, 1991, Sacramento, CA. AIAA Paper No. 91-2266.

Srinivasan, S.; Bittner, R. D.; Bobskill, G. J.; and McClinton, C. R.: Summary of the Code Validation Effort of GASP for Scramjet Combustor Flow Fields. Presented at the 29th AIAA/SAE/ASME/ASEE Joint Propulsion Conference, June 28-July 1, 1993, Monterey, CA. AIAA Paper No. 93-1973.

SAERS (NAS1-96013) Task Order

1. Task Order Number and Title LA02 **Number:**	**Revision:**
Title: Design and Analysis of Airbreathing Hypersonic Vehicles	

2. Purpose, Objective or Background of Work to be Performed:

The results of this work (design/performance studies on airbreathing/rocket hypersonic vehicles) will contribute substantially to the evolution of this nation's airbreathing hypersonic vehicle matrix. to NASA's assessment of future operational airbreathing/rocket hypersonic technologies, to prioritization of hypersonic research activities, and to define hypersonic flight test vehicles. Thus, the purpose of this work is to provide NASA with definitive design/performance information on airbreathing/rocket hypersonic vehicles and their sensitivities such that the airbreathing/rocket hypersonic vehicle matrix can be resolved and understood along with definitive designs/performance of flight test vehicles to demonstrate the capabilities of the hypersonic designs/technologies.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor will perform design and performance evaluation/quantification tasks focused on airbreathing/rocket powered hypersonic vehicles. The work shall be accomplished in sufficient detail to establish design and performance characteristics, meet stated task requirements, and deliver a specified level of resolution/accuracy. Unless otherwise stated, all tasks will require a weekly review with the task monitor.

Task 1: The contractor shall provide the design/performance of the high fineness ratio C250, SSTO configuration under "Access to Space Study" constraints/requirements and using systems that are consistent with the A/R HTHL Access to Space vehicle where possible. This study will compliment Code X's HRST ARP and ASTT programs.

1.1 Deliverables: A definitive design/performance of the C250 SSTO configuration under "Access to Space " guidelines including 3DOF trajectory simulation. Data shall be made available as both an electronic report and a written report.

1.2 Schedule: To begin on May1, 1997, and be completed/delivered by November 1, 1997.

1.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve fuel loading (completeness of systems volumes and detail, etc.). Completeness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant varaibles included, rsolution, ranges covered, etc.). Appropriateness of simulation methods (energy state, 3DOF, 6DOF, etc.) within the scheduled time.

Task 2: The contractor will update and improve the design and performance for the existing Single-Stage-to-Orbit Airbreathing/Rocket (SSTO A/R) vehicle design, developed under Option 3, during NASA's Access to Space study. This will include optimization of the

LA02

propulsion system design and integration to the airframe, updating of materials/structural concepts for primary structure/TPS, and improvements in vehicle mass properties and packaging.

2.1 Deliverables: A definitive design and performance resolution, including a trjectory simulation, following the "Access to Space" guidelines. This will include configuration geometry, packaging, aerodynamics, propulsion, structures, and mass properties.

2.2 Schedule: To begin on May1, 1997 and be completed/delivered on August 1, 1997.

2.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve propellant loading (completness of systems volumes and detail, systems content, etc.). Completness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant variables included, resolution, ranges considered, etc.). Appropriateness of simulation methods (energy state, 3DOF, or 6DOF, etc.).

Task 3

The contractor will provide an analytical determination of the impact of reducing the shock-on-lip Mach number from M=15 to M=12 on the existing Single-Stage -to-Orbit Airbreathing/Rocket (SSTO A/R) vehicle design, developed under Option 3, during NASA's Access to Space study. This will include revision of the propulsion system design and integration to the airframe, impact on vehicle mass properties and packaging, aerodynamic and propulsive performance changes, and trajectory changes to capture expected improvements in vehicle characteristics.

3.1 Deliverables: A definitve design and performance resolution, including a trajectory simulation, following the "Access-to-Space" guidelines. This will include configuration geometry, packaging, aerodynamics, propulsion, structures, and mass properties.

3.2 Schedule: To begin on May 1, 1997 and be completed/delivered on September 1, 1997.

3.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve propellant loading (completness of systems volumes and detail, systems content, etc.). Completness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant variables included, resolution, ranges considered, etc.). Appropriateness of simulation methods (energy state, 3DOF, or 6DOF, etc.).

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Title: Design and Analysis of Airbreathing Hypersonic Vehicles

4. Government Furnished Items:

a. Use of secure computing areas in Bldg. 1300, Room 216, Room 05, & Room 08.

b. Software licenses such as:
PATRAN, NASTRAN, ProENGINEER, OptdesX, MECHANICA, Tgraphx, and ACAD.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:

a. U.S. citizens

b. Secret clearances

7. Period of Performance

Planned start date: May 1, 1997 Expected completion date: November 1, 1997

8. NASA Technical Monitor: James L. Hunt M/S 350 Phone: (757) 864-3742
NASA T M Alternate: Robert J. Pegg M/S 350 Phone: (757) 864-3760

1. Task Order Number:: LA03 Revision: ____ Date of Revision:_
Title: **Hypersonic Valve Engineering Design**

2. Purpose, Objective or Background of Work to be Performed:
Provide Engineering and design for the Hypersonic Vehicle Quick Acting Valve project. The contractor will integrate with the NASA appointed technical representative to secure information/specifications/concepts of two valve configurations. These two configurations will be developed such that possible patents could be secured and prototypes fabricated.

The specific objectives of the work to be performed under the present task are to; 1) Continue development of the Hypersonic Valve; 2) initiate development of the Gatevalve concept.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor will implement NASA conceptual design, develop engineering specifications and detail/assembly fabrication drawings for the Hypersonic Valve and the Gatevalve prototypes. The designs shall be prepared with the anvil 1000 or Pro engineer CAD source codes whichever is most appropriate for a clear description of the concepts and hardware involved. Required vendor components shall be researched and identified by stock number and purchase source. Paper and electronic copies of engineering and assembly drawing shall be deliverables.

3.1. PERFORMANCE:

Performance will vary from "Minimally Acceptable (MA) to Substantially Exceeds (SE)" Ratings based on the ability to meet the performance metric targets for deliverables 3.2.1, 3.2.2 and the following criteria:

3.1.1. Ability to meet delivery schedules for all conceptual designs and designed mechanism assemblies. Delivery within two week of stated milestones will constitute "MA" and delivery two weeks ahead of schedule will constitute "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control.

Delivery schedule deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2. Manufacturability of designed components per contractor-generated engineering detail drawings.

3.1.3. Ability of final release engineering detailed drawing to describe accurately "as-built-condition" of delivered components and assemblies. 40 hours of engineering drafting required to make final release drawing in full compliance with "as-built-condition" shall constitute "MA" and 6 hours of required changes shall constitute "SE" rating.

3.2 DELIVERABLES:

The listed items shall constitute the specific deliverables by the contractor for this task.

DELIVERABLES	DATE
3.2.1. Hypersonic Valve Design	
A. Conceptual Design Drawings	August 13, 1997
B. Engineering Specification Notes	August 29, 1997
C. Detail and Assembly Fabrication Drawings	Sept. 30, 1997
3.2.2. Gatevalve Design	
A. Conceptual Design Drawings	August 29, 1997
B. Engineering Specification Notes	August 29, 1997
*C. Detailed and Assembly Fabrication Drawings	Oct. 31, 1997

*(The detail and assembly drawing will be in the preliminary stages of development)

4. Government Furnished Items:
The use of government support computers an software programs may be required during the performance of this task.

5. Other information needed for performance of task.
Periodic participation in study team status reviews at LaRC and off-site locations will be necessary

6. Security clearance required for performance of work:
None

7. Period of Performance	
Planned start date: 07/01/97	Expected completion date: 10/31/97

8. NASA Technical Monitor: Robert J. Pegg
M/S: 350 Phone: (757) 864-3760

1. Task Order Number and Title LA01	Number:	Revision:
Title: Scramjet Integrated Design Technology		

2. Purpose, Objective or Background of Work to be Performed

NASA Langley Research Center has been a major player in the development of scramjet and related hypersonics technology since 1960. Over this time, the center has developed ground-based experimental testing, data analysis, analytical, computational, and design specific methodology. These design methods, which are specific to scramjet engine flowpath and associated hypersonic aerodynamic performance, loads, structural design and thermal analysis represent the state-of-the art (world-class) tools. These technologies have been extensively utilized for design studies and support of ground based experimental test programs and, specifically, from 1985-1995 on the National Aero-Space Plane (NASP) Program. NASA has recently (*Aviation Week*, May 12, 1996) initiated the Hyper-X Program to demonstrate in flight, the technology required for hypersonic cruise aircraft and efficient air breathing engine-powered orbital launch vehicles. The Hyper-X flight test is a logical step to validate, refine, and advance these design methods using data generated in flight.

HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT

3/19/97	Keel line VI (KL-VI) configuration released
5/1/97	Detailed assessment of KL-VI completed
7/1/97	Mach 7 Hyper-X vehicle CDR
4/20/98	Mach 5 scramjet final flowpath design completed
2/1/98	Mach 7 vehicle delivered
12/31/98	Mach 7 vehicle test flight
4/20/99	Mach 10 scramjet final flowpath design completed

DESCRIPTION OF MULTI-LEVEL APPROACH FOR SCRAMJET ANALYSIS AND DESIGN

Because of their highly integrated nature, detailed scramjet engine flowpath design is accomplished by a multi-level approach. This approach utilizes simple (Level I+) numerical/analytical design codes, like SRGULL, to assess performance on a system level, and other low-level specific methods, such as SCRAM3L and higher level CFD methods, such as SHIP, SPARK, CFL3D, GASP, and LARCK to assess details of the engine component performance and operability, including component interaction, and to update/improve the component level performance assumptions in the analytical code. This CFD analysis is divided into Level III, full 3-D elliptic representation, and simplified (Level II) solution approaches, such as the SHIP 3-D PNS combustor analysis. Part of the success of these design methods can be attributed to the close relation between experimental and design methods, as these methods are routinely utilized to evaluate - or compared with - experimental results, thus simultaneously interpreting the data and validating the design systems. Empirical and statistical design methods are also an integral part of the engine flowpath design methods. For example, a high speed scramjet fuel injector, combustor design system was developed (NASP DN-92-357) for the high speed, pure supersonic combustor operation. Methods for improving (Riggins) and extending the parametric range (Vitt) and extending this design system approach to lower speed (S3, CDE parametric test) represent continuing development of this scramjet/dual-mode-ramjet design technology.

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3. DESCRIPTION OF THE WORK TO BE PERFORMED

This task is divided into 4 sub-tasks:

- Design/Analysis of the Hyper-X Scramjet-Powered Vehicle Flight Experiment
- Pre/Post Test Numerical Analysis of Hyper-X Ground Tests
- Pre/Post Test Numerical Analysis of CIAM/NASA Ground and Flight Tests
- Pre/Post Test Numerical Analysis of Hyper-X Scramjet Thermal Structure

Some deliverable dates are outside of the base period of the SAERS Contract and are contingent on extension of the contract by options and available funding.

3.1 DESIGN/ANALYSIS OF THE HYPER-X SCRAMJET-POWERED VEHICLE FLIGHT EXPERIMENT

3.1.1 DESCRIPTION OF TASK

The contractor shall

3.1.1.1 Calculate performance, operability, thermal and pressure loads, and all key flowfield characteristics of the final Hyper-X scramjet engine flowpath and powered configuration.

3.1.1.2 Recommend design alternatives (based on calculations in 3.1.1) for improving the baseline Hyper-X engine performance to meet program objectives.

3.1.1.3 Perform thermal analysis of the complete baseline engine and the final engine design.

3.1.1.4 Analyze the Hyper-X baseline configurations (unpowered) using Euler and 3D-FNS methods for selected cases from Mach=0.5 to 10.0 at angles-of-attack.

3.1.1.5 Analyze final Mach 7 engine design including mechanical details, structures, thermal and mass properties. The contractor shall perform transient thermal analyses of the Hyper-X vehicle engines for Mach = 5, 7, and 10. The engine design details, materials, pressures, and heating rates for the Mach 7 flight test trajectories will be provided by the government and available 4/1/97.

3.1.2 DELIVERABLES

The contractor shall deliver

3.1.2.1 Hard copy and electronic version in tabular and/or graphical form of the following for each of the three baseline vehicles and the final design vehicles at design point: engine flowpath heat transfer and wall pressure loads, engine thermal loads, and engine flowpath

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flow characteristics, performance and operability.

3.1.2.2 Hard copy and electronic version in tabular and/or graphical form of integrated force and moment data consistent with the Hyper-X "cowl-to-tail" accounting system in the body and stability axis systems; surface pressure data including control surfaces for all Euler runs on the baseline configurations and 3D-FNS solutions for selected cases.

(Informal written reports shall at minimum describe the work completed, assumptions made, methods used, grids utilized, and discuss/justify recommended modifications to the preliminary flowpath and mechanical design to achieve program goals)

3.1.2.3 Electronic copies of restart files and other output files as required.

3.1.3 SCHEDULE

3.1.3.1 Written report documenting final (KL-VI) Mach 7 engine flowpath heat transfer and wall pressure loads (6/1/97)

3.1.3.2 Written report documenting final Mach 7 engine thermal loads (6/1/97)

3.1.3.3 Written report documenting final Mach 7 engine flowpath flow characteristics, performance and operability (6/1/97)

3.1.3.4 Written report documenting final design engine thermal/structural analyses (7/1/97)

3.1.3.5 Written report documenting preliminary Mach 5 engine flowpath flow characteristics, performance and operability (10/1/97)

3.1.3.6 Written report documenting final Mach 5 engine flowpath flow characteristics, performance and operability (4/1/98)

3.1.3.7 Written report documenting preliminary Mach 10 engine flowpath heat transfer and wall pressure loads, thermal loads, flow characteristics, performance and operability (8/1/98)

3.1.4 METRICS FOR DELIVERABLES

3.1.4.1 Meet schedule and cost

3.1.4.2 Completeness and depth of engine flow field analysis and documentation. Minimum acceptable to include:

- Reports in section 3.1.3.1 and 3.1.3.2 include all loads (pressure and thermal) on all internal and external engine surfaces, including leading and trailing edges.
- Report in section 3.1.3.3 to include nose-to-tail and cowl-to-tail force accounting performance, component level and inter-component level operability, and all key flowfield characteristics, such as, but not limited to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flameholding, and inlet-isolator "bubble" characteristics.

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- Report in section 3.1.3.4 to include thermal analysis of the entire engine body side and cowl structure, including variable geometry parts and thermal protection coating, at both the design test condition(s) and over the entire flight from Mach 3 on boost to Mach 3 on decent.

3.1.4.3 Confidence in predicted engine/flowpath performance, operability and loads, based on the following:
- Appropriateness of methods selected
- Documented validation for methods utilized,
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Accuracy of numerical representation of given geometry

3.1.4.4. Comparison of results from multiple level analysis approaches, including comparison and updating of the baseline SRGULL analysis contained in HX-003, May 12, 1996.

3.1.5 EXCEEDS MINIMUM REQUIREMENTS

3.1.5.1 Provide credible 3-D elliptic solution(s) for dual mode scramjet combustor.

3.1.5.2 Provide 3-D nose-to-tail evaluation of all 3 flight test conditions, compare with SRGULL performance and relevant experimental data to quantify uncertainty.

3.1.5.3 Documentation contains complete uncertainty analysis, experimentally based validation, of predicted performance, operability and loads.

3.2 PRE/POST TEST NUMERICAL ANALYSIS OF HYPER-X GROUND TESTS

The following experimental programs are scheduled for support of the Hyper-X flight program, and will require numerical support during this task period. Abbreviated identifiers, flight Mach simulation and an abbreviated test schedule are shown below:

(1) Full-scale, Hyper-X engine (DFX) test in the NASA LaRC Arc Heated Scramjet Test Facility (AHSTF), GASL Leg-4 (L-4) and the 8' High Temperature Tunnel (8'HTT):

(a) DFX-7 KL-V & -VI'	Mach 7	AHSTF	Test Mar-Apl., 97.
(b) DFX-7 KL-VI	Mach 7	L-4	Test Jul-Aug., 97.
(c) DFX-7 KL-VI	Mach 7	8'HTT	Test Dec., 97.
(d) DFX-5 KL-VI	Mach 5	AHSTF	Test Sept.-Oct., 97.
(e) DFX-5 KL-VI	Mach 5	L-4	Test Feb., 98.
(f) DFX-5 KL-VI	Mach 5	8'HTT	Test Feb., 98.

(2) Full-scale, Hyper-X engine (DHX) test in the NASA LaRC HYPULSE Reflected Shock Tunnel Scramjet Test Facility at GASL:

(a) DHX-10 KL-VI	Mach 10	Test Mar-Apl., 98.
(b) DHX-7-Baseline	Mach 7	Test May-Jun., 98.

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(3) Full-scale, Hyper-X combustor/nozzle (HCN) test in the NASA LaRC HYPULSE Expansion tube and Reflected Shock Tunnel Scramjet Test Facility at GASL:

(a) HCN-12-DCV	Mach 12	Test Completed Mar. 1-31, 96.
(b) HCN-7-Baseline	Mach 7	Test Completed Jun. 15-30, 97.

(4) Large-scale, Hyper-X Mach 5 combustor (DCX) test in the GASL Direct Connect Facility:

(a) DCX-5-Baseline	Mach 5	Test Completed Mar. 1-31, 96.

(5) Hyper-X inlet starting (HXIS) test in the NASA Mach 4, 6 and 10 facility:

(a) HXIS-4-Baseline	Mach 4	Test May, 97.
(b) HXIS-6-Baseline	Mach 6	Test Sept., 97.
(c) HXIS-4-Baseline	Mach 10	Test Mar, 98.

(6) Hyper-X Mach 7 powered test in the NASA LaRC 8 foot High Temperature Tunnel (8'HTT):

(a) Hyper-X-7	Mach 7	Test Jan-Mar., 98.

3.2.1 DESCRIPTION OF WORK

3.2.1.1 The contractor shall provide results from the following computations and analysis associated with all Hyper-X ground tests experiments listed above:

3.2.1.1.1 Pre-test analysis which are of interest to and requested by the governments designated respective test engineer.

3.2.1.1.2 Post test analysis for both the design point for Hyper-X simulation, and up to 5 off-design conditions to be specified by the government.

3.2.1.1.3 Flight scaling of the experimental results.

3.2.1.2 The contractor shall provide data reduction of all fuel plume images (FPI) generated in the HYPULSE or other experimental tests (expect 50) to determine fuel mixing efficiency.

3.2.1.3 The contractor shall provide post-test analysis for selected Hyper-X baseline wind tunnel test runs which shall include calculating increments for wall and sting corrections and Reynolds number effects.

3.2.2 DELIVERABLES

3.2.2.1 Pretest analysis documentation

3.2.2.2 Post test analysis and flight scaling documentation.

3.2.3 SCHEDULE

3.2.3.1 The contractor shall negotiate with each experimental program's Government Designated Test Engineer (GDTE) to determine the required delivery date for pretest analysis.

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3.2.3.2 Post test document shall be delivered two months from delivery of experimental data

3.2.3.3 Post test document for existion test data shall be delivered by June 1997 for item 4 (DCM data), and by Sept. 97 for items 3 (HYPULSE data).

3.2.4 METRICS FOR DELIVERABLES

3.2.4.1 Meet schedule and cost.

3.2.4.2 Pre-test analysis includes, as a minimum, performance, operability, heat transfer and pressure distribution (for instrumentation location selection) and loads and all key flowfield characteristics such as, but not limited to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flame holding, and inlet-isolator "bubble" characteristics which are of interest to and requested by the governments designated respective test engineer.

3.2.4.3 Post-test analysis documentation includes, as a minimum, all items in 3.2.4.2 plus direct comparison with all experimental measurement, and clearly identify differences between measurement and pre-test and post-test analysis, and the impact on flight predictions of performance, operability and loads.

3.2.4.4 Confidence in flight scaled component/engine flowpath performance, operability and loads, based on:
- Appropriateness of methods selected related to the important flow physics
- Documented validation for methods utilized
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Inclusion of facility contaminant effects
- Accuracy of numerical representation of given geometry

3.2.4.5 FPI analysis procedure equal to or improved from that described in NASA CR 1186.

3.2.5 EXCEEDS MINIMUM REQUIREMENTS

3.2.5.1. Provide credible 3-D (strip) elliptic solution(s), compared with experimental data, for 3 of the dual mode scramjet combustors (DFX-7, DFX-5, DHX-7 or DCX-5).

3.2.5.2. Provide credible 2-D time-accurate solution, compared to experimental data from either the HXIS-4, HXIS-4 or HXIS-4 inlet starting door tests.

3.2.5.3 Provide Hyper-X deliverables ahead of schedule.

3.3 PRE/POST TEST NUMERICAL ANALYSIS OF CIAM/NASA GROUND AND FLIGHT

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TESTS

3.3.1 DESCRIPTION OF WORK

The contractor shall provide results from the following computations and analysis for the CIAM and NASA tests of the CIAM-NASA ground and flight test scramjet engine.

3.3.1.1 Pre-test analysis, to include performance, operability, heat transfer and pressure and thermal loads and all key flowfield characteristics at both the design condition and up to 4 off-design conditions for both ground and flight experiments. Ground test analysis for the 8' HTT entry shall include assessment of alternate cooling, including water, gaseous hydrogen and liquid nitrogen

3.3.1.2 Post test analysis for both the design and up to five off design conditions to be specified by the government based on ground and flight test experimental operating conditions.

3.3.2 DELIVERABLES

3.3.2.1 Pre/post test documentation of ground test and flight scaling documentation

3.3.2.2 Pre/post test documentation of flight test and flight scaling documentation

3.3.3 SCHEDULE

3.3.3.1 Ground Test documentation

3.3.3.1.1 Pre-Test for 8'HTT Mar.98 entry: Aug. 1, 1997

3.3.3.1.2 Post-Test: Six months from delivery (est. May 1997) of CIAM ground test experimental data.

3.3.3.1.3 Post-Test: Six months from delivery (est. May 1998) of NASA 8'HTT ground test experimental data.

3.3.3.2 Flight Test documentation

3.3.3.2.1 Update Pre-Test: April. 1, 1997

3.3.3.2.2 Post-Test: Six months from delivery (est. May 30. 1997) of flight test data.

3.3.4 METRICS

3.3.4.1 Meet schedule and cost.

3.3.4.2 Pre-test analysis documentation includes performance, operability, heat transfer and pressure and thermal loads and all key flowfield characteristics (such as, but not limited

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to inlet boundary layer flow separation, boundary layer transition, fuel mixing, ignition/flame holding, and inlet-isolator "bubble" characteristics).

3.3.4.3 Post-test analysis documentation includes, as a minimum, all items in 3.3.4.2 plus direct comparison with all experimental measurement, and clearly identify differences between measurement and pre-test and post-test analysis, and the impact on flight predictions of performance, operability and loads.

3.3.4.4 Confidence in flight scaled component/engine flowpath performance, operability and loads, based on:

- Appropriateness of methods selected
- Documented validation for methods utilized
- Approach, such as grid convergence studies, and documentation of inputs and assumptions
- Inclusion of facility contaminant effects

3.3.5 EXCEEDS MINIMUM REQUIREMENTS

3.3.5.1 Provide credible 3-D (strip) elliptic solution(s) for the dual mode scramjet combustor operation, compared with experimental data, for both ground and flight test.

3.3.5.2 Verify the engine flowpath and thermal analysis tools to within 10% of the experimentally measured combustor wall temperature for both ground and flight conditions.

3.4 PRE/POST TEST NUMERICAL ANALYSIS OF DFX SCRAMJET THERMAL STRUCTURE

3.4.1 DESCRIPTION OF TASK

The contractor shall provide pretest analysis of the DFX Mach 7 AHSTF scramjet structure thermal response and compare predictions with experimental measurements obtained during the test to "validate" transient thermal analysis method

3.4.2 DELIVERABLES

NASA Contractor Report documenting validation of the transient thermal analysis method.

3.4.3 SCHEDULE

Task to begin 5/1/97. Preliminary results to be completed and presented by 7/1/97. Documentation to be completed 9/15/97.

3.4.4 METRICS FOR DELIVERABLES

Quality of analytical methods used in analysis (NASTRAN, SINDA, etc.). Quality of analytical models used (resolution of gradients, element size, etc.). Temperature predicted to +/- 10%.

1. Task Order Number and Title		
	Number:	**Revision:**
Title: Scramjet Integrated Design Technology		

1. Task Order Number and Title

Number: Revision:

Title: Scramjet Integrated Design Technology

4. GOVERNMENT FURNISHED ITEMS

4.1 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S,4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

4.2 Available Software
- GASP 2.2 and GASP 3.0 site license
- GRIDGEN, TEKPLOT, GRIDTOOLS
- SHIP3D
- SRGULL
- SCRAM3L
- LARCK
- SAM3D
- USM3D
- PARAFLOW

4.3 Special furniture
- Safes for storage of classified material

5. OTHER INFORMATION NEEDED FOR PERFORMANCE OF WORK

5.1 Estimated Travel requirements

-Performance of these tasks may require travel to GASL, Ronkonkoma, NY; Micro Craft, Inc., Tullahoma, TN; Boeing North American, Seal Beach, CA; NASA Dryden Flight Research Center; and participation in JANNAF Propulsion meetings.

5.2 Applicable Documents - ATTACHMENT A

6. SECURITY CLEARANCE REQUIRED FOR PERFORMANCE OF WORK

6.1 Most of the work performed on this work order requires a SECRET clearance.

6.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

6.3 Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.

7. PERIOD OF PERFORMANCE

Planned start date: May 1, 1997	Expected completion date: April 30, 1998

8. NASA TECHNICAL MONITOR:	Charles R. McClinton	M/S: 352	Phone: 804-864-6253
NASA TM ALTERNATE:	Sharon H. Stack	M/S: 352	Phone: 804-864-3742

1. Task Order Number and Title	Number:	Revision:
Title: Scramjet Integrated Design Technology		

ATTACHMENT A

Bibliography of Reference Material
(NOTE: Contact the NASA Langley Research Center Technical Library or Sharon H. Stack for copies or information on these documents)

Jachimowski, C. J.: An Analysis of Combustion Studies in Shock Expansion and Reflected Shock Tunnels. NASA TP-3224, July 1992.

Jentink, T. N.: An Evaluation of Nozzle Relaminarization Using Low Reynolds Number K-e Turbulence Models. Presented at the 31st Aerospace Sciences Meeting, January 11-14, 1993, Reno, Nevada. AIAA Paper No. 93-0610.

Kamath, P.S. and Mao, M.: Computation of Transverse Injection into a Supersonic Flow with the SHIP3D PNS Code. Presented at the AIAA Fourth International Aerospace Planes Conference, Orlando, Florida, December 1-4, 1992.

Kamath, P. S.; Hawkins, R. W.; and McClinton, C. R.: A Highly Efficient Engineering Tool for Three-Dimensional Scramjet Flowfield and Heat Transfer Computations. Presented at the Computational Fluid Dynamics Symposium on Aeropropulsion, April 24-26, 1990. In NASP CP 3078.

Riggins, D. W.; McClinton, C. R.: Analysis of Losses in Supersonic Mixing and Reacting Flows. Presented at the AIAA/SAE/ASME/ASEE 27th Joint Propulsion Conference and Exhibit, June 24-27, 1991, Sacramento, CA. AIAA Paper No. 91-2266.

Srinivasan, S.; Bittner, R. D.; Bobskill, G. J.; and McClinton, C. R.: Summary of the Code Validation Effort of GASP for Scramjet Combustor Flow Fields. Presented at the 29th AIAA/SAE/ASME/ASEE Joint Propulsion Conference, June 28-July 1, 1993, Monterey, CA. AIAA Paper No. 93-1973.

SAERS (NAS1-96013) Task Order

1. **Task Order Number and Title** LA02 **Number:**	**Revision:**
Title: Design and Analysis of Airbreathing Hypersonic Vehicles	

2. Purpose, Objective or Background of Work to be Performed:

The results of this work (design/performance studies on airbreathing/rocket hypersonic vehicles) will contribute substantially to the evolution of this nation's airbreathing hypersonic vehicle matrix, to NASA's assessment of future operational airbreathing/rocket hypersonic technologies, to prioritization of hypersonic research activities, and to define hypersonic flight test vehicles. Thus, the purpose of this work is to provide NASA with definitive design/performance information on airbreathing/rocket hypersonic vehicles and their sensitivities such that the airbreathing/rocket hypersonic vehicle matrix can be resolved and understood along with definitive designs/performance of flight test vehicles to demonstrate the capabilities of the hypersonic designs/technologies.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor will perform design and performance evaluation/quantification tasks focused on airbreathing/rocket powered hypersonic vehicles. The work shall be accomplished in sufficient detail to establish design and performance characteristics, meet stated task requirements, and deliver a specified level of resolution/accuracy. Unless otherwise stated, all tasks will require a weekly review with the task monitor.

Task 1: The contractor shall provide the design/performance of the high fineness ratio C250, SSTO configuration under "Access to Space Study" constraints/requirements and using systems that are consistent with the A/R HTHL Access to Space vehicle where possible. This study will compliment Code X's HRST ARP and ASTT programs.

1.1 Deliverables: A definitive design/performance of the C250 SSTO configuration under "Access to Space " guidelines including 3DOF trajectory simulation. Data shall be made available as both an electronic report and a written report.

1.2 Schedule: To begin on May1, 1997, and be completed/delivered by November 1, 1997.

1.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve fuel loading (completeness of systems volumes and detail, etc.). Completeness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant varaibles included, rsolution, ranges covered, etc.). Appropriateness of simulation methods (energy state, 3DOF, 6DOF, etc.) within the scheduled time.

Task 2: The contractor will update and improve the design and performance for the existing Single-Stage-to-Orbit Airbreathing/Rocket (SSTO A/R) vehicle design, developed under Option 3, during NASA's Access to Space study. This will include optimization of the

LA02

propulsion system design and integration to the airframe, updating of materials/structural concepts for primary structure/TPS, and improvements in vehicle mass properties and packaging.

2.1 Deliverables: A definitive design and performance resolution, including a trjectory simulation, following the "Access to Space" guidelines. This will include configuration geometry, packaging, aerodynamics, propulsion, structures, and mass properties.

2.2 Schedule: To begin on May1, 1997 and be completed/delivered on August 1, 1997.

2.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve propellant loading (completness of systems volumes and detail, systems content, etc.). Completness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant variables included, resolution, ranges considered, etc.). Appropriateness of simulation methods (energy state, 3DOF, or 6DOF, etc.).

Task 3

The contractor will provide an analytical determination of the impact of reducing the shock-on-lip Mach number from M=15 to M=12 on the existing Single-Stage -to-Orbit Airbreathing/Rocket (SSTO A/R) vehicle design, developed under Option 3, during NASA's Access to Space study. This will include revision of the propulsion system design and integration to the airframe, impact on vehicle mass properties and packaging, aerodynamic and propulsive performance changes, and trajectory changes to capture expected improvements in vehicle characteristics.

3.1 Deliverables: A definitve design and performance resolution, including a trajectory simulation, following the "Access-to-Space" guidelines. This will include configuration geometry, packaging, aerodynamics, propulsion, structures, and mass properties.

3.2 Schedule: To begin on May 1, 1997 and be completed/delivered on September 1, 1997.

3.3 Metrics: Quality of surface geometry produced (freedom from laps and seams, smoothness, etc.). Adequacy of internal packaging to resolve propellant loading (completness of systems volumes and detail, systems content, etc.). Completness of mass properties (level of detail, systems content, etc.). Appropriateness of aerodynamic/propulsive methods (APAS, SAM3D, DATCOM, SRGULL, cycle codes, etc.). Completeness of performance databases generated (all significant variables included, resolution, ranges considered, etc.). Appropriateness of simulation methods (energy state, 3DOF, or 6DOF, etc.).

	Number:	Revision:
Title: Design and Analysis of Airbreathing Hypersonic Vehicles		

4. Government Furnished Items:

a. Use of secure computing areas in Bldg. 1300, Room 216, Room 05, & Room 08.

b. Software licenses such as:
PATRAN, NASTRAN, ProENGINEER, OptdesX, MECHANICA, Tgraphx, and ACAD.

5. Other information needed for performance of task.

6. Security clearance required for performance of work:

a. U.S. citizens

b. Secret clearances

7. Period of Performance

Planned start date: May 1, 1997 Expected completion date: November 1, 1997

8. NASA Technical Monitor: James L. Hunt M/S 350 Phone: (757) 864-3742
NASA T M Alternate: Robert J. Pegg M/S 350 Phone: (757) 864-3760

1. Task Order Number:: LA03 Revision: ____ Date of Revision:_
Title: **Hypersonic Valve Engineering Design**

2. Purpose, Objective or Background of Work to be Performed:

Provide Engineering and design for the Hypersonic Vehicle Quick Acting Valve project. The contractor will integrate with the NASA appointed technical representative to secure information/specifications/concepts of two valve configurations. These two configurations will be developed such that possible patents could be secured and prototypes fabricated.

The specific objectives of the work to be performed under the present task are to; 1) Continue development of the Hypersonic Valve; 2) initiate development of the Gatevalve concept.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor will implement NASA conceptual design, develop engineering specifications and detail/assembly fabrication drawings for the Hypersonic Valve and the Gatevalve prototypes. The designs shall be prepared with the anvil 1000 or Pro engineer CAD source codes whichever is most appropriate for a clear description of the concepts and hardware involved. Required vendor components shall be researched and identified by stock number and purchase source. Paper and electronic copies of engineering and assembly drawing shall be deliverables.

3.1. PERFORMANCE:

Performance will vary from "Minimally Acceptable (MA) to Substantially Exceeds (SE)" Ratings based on the ability to meet the performance metric targets for deliverables 3.2.1, 3.2.2 and the following criteria:

3.1.1. Ability to meet delivery schedules for all conceptual designs and designed mechanism assemblies. Delivery within two week of stated milestones will constitute "MA" and delivery two weeks ahead of schedule will constitute "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control.

Delivery schedule deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2. Manufacturability of designed components per contractor-generated engineering detail drawings.

3.1.3. Ability of final release engineering detailed drawing to describe accurately "as-built-condition" of delivered components and assemblies. 40 hours of engineering drafting required to make final release drawing in full compliance with "as-built-condition" shall constitute "MA" and 6 hours of required changes shall constitute "SE" rating.

3.2 DELIVERABLES:

The listed items shall constitute the specific deliverables by the contractor for this task.

DELIVERABLES	DATE
3.2.1. Hypersonic Valve Design	
A. Conceptual Design Drawings	August 13, 1997
B. Engineering Specification Notes	August 29, 1997
C. Detail and Assembly Fabrication Drawings	Sept. 30, 1997
3.2.2. Gatevalve Design	
A. Conceptual Design Drawings	August 29, 1997
B. Engineering Specification Notes	August 29, 1997
*C. Detailed and Assembly Fabrication Drawings	Oct. 31, 1997

*(The detail and assembly drawing will be in the preliminary stages of development)

4. Government Furnished Items:
The use of government support computers an software programs may be required during the performance of this task.

5. Other information needed for performance of task.
Periodic participation in study team status reviews at LaRC and off-site locations will be necessary

6. Security clearance required for performance of work:
None

7. Period of Performance	
Planned start date: 07/01/97	Expected completion date: 10/31/97

8. NASA Technical Monitor: Robert J. Pegg	
M/S: 350	Phone: (757) 864-3760

96013

LA04 Rt.

1. Task Order Number and Title Number: LA04 Revision:
Title: Hyper-X Separation Simulation Tool Development

2. Purpose, Objective or Background of Work to be Performed:

The Hyper-X Program requires a multi-body dynamics and control software tool for the separation analysis of the Free Flyer from the Pegasus Booster. The SepSim2 software was developed under NASA Purchase Order L-68670D to satisfy this requirement. In its current state, the software includes all required discipline models (i.e., aerodynamics, control system, mechanisms, etc.,) and is fully operational. The utilities necessary to perform Monte Carlo analysis using SepSim2 have also been developed.

3. Description of the Work to be Performed:

3.1 SCOPE OF WORK

3.1.1 Provide enhancements to the SepSim2 software to include:

a) the improved 9-dimensional aerodynamic force and moment model that is based on Hyper-X Stage Separation Aero database Release 2.0 (AEDC wind tunnel data.)

b) all updates on geometry, mass properties, mechanisms, and sequencing, including recent test results.

3.1.2 Perform simulations to evaluate the currently proposed stage separation scenario. Explore variations in separation sequencing and initial conditions.

3.1.3 Perform an expanded Monte Carlo analysis of the separation maneuver, attempting to address all sources of uncertainty. Will utilize knowledge gained from the limited Monte Carlo analysis performed under L-68670D.

3.1.4 Develop a MUSE based animation tool to playback SepSim2 simulation output, providing high fidelity animation, presentation, and collision detection capability.

3.1.5 Incorporate the Release 3.0 stage separation aero database (available 3/31/99) and re-perform the Monte Carlo analysis.

3.2 DELIVERABLES

3.2.1 The contractor shall provide the fully functional software and analysis per 3.1.1 and 3.1.2 above.

3.2.2 The contractor shall provide an expanded user's guide and training in the use of the tool.

3.2.3 The contractor shall provide a report assessing the separation maneuver in light of the new data (including Aero Release 2.0) and expanded Monte Carlo analysis per 3.1.3 above.

3.2.4 The contractor shall provide the fully functional MUSE based animation software tools per 3.1.4 above.

3.2.5 The contractor shall perform expanded Monte Carlo analysis per 3.1.5 above and provide a report documenting this analysis (using Release 3.0 aero model).

3.2.6 The contractor shall provide an electronic copy of all Monte Carlo analysis input/output files.

3.2.7 The contractor shall provide consultation and technical support within the scope of this task order.

3.3 SCHEDULE

Due date	Deliverable
2/28/99	3.2.1 The contractor shall provide the fully functional software and analysis per 3.1.1 and 3.1.2 above.
2/28/99	3.2.2 The contractor shall provide an expanded user's guide and training in the use of the tool.
3/31/99	3.2.3 The contractor shall provide a report assessing the separation maneuver in light of the new data (including Aero Release 2.0) and expanded Monte Carlo analysis per 3.1.3 above.
4/30/99	3.2.4 The contractor shall provide the fully functional MUSE based animation software tools per 3.1.4 above.
5/31/99	3.2.5 The contractor shall perform expanded Monte Carlo analysis per 3.1.5 above and provide a report documenting this analysis (using Release 3.0 aero model).
5/31/99	3.2.6 The contractor shall provide an electronic copy of all Monte Carlo analysis input/output files.

3.4 METRICS

Minimum Acceptable Performance:

The final report shall be assessed for-

a) technical accuracy
b) adequacy of supporting information (i.e., definitions, assumptions, etc.)
c) clarity of stated findings and recommendations

Software deliverables shall be assessed for:

a) functionality
b) organization and structure
c) ease of use by a competent user

Software documentation shall be assessed for:

a) accuracy
b) organization
c) usability

Exceeds Minimum Performance:

If the report contains-

a) recommendations that reduce risk for the stage separation maneuver
b) proposals of alternative concepts that will benefit Hyper-X
c) recommendations for improving efficiency, capability and quality of analysis

If software deliverables are-

a) well commented
b) easily modified
c) easily learned by a new user

Software documentation shall be assessed for:

a) extensive use of examples

4. Government Furnished Items:

The government will provide access to a UNIX Workstation, ADAMS® software, Tecplot® software, FORTRAN 77 and C Compilers. The government will also provide all data and model updates at start of task, with the exception of the Release 3.0 aero model which will be provided on 3/31/99.

5. Other information needed for performance of task.

The contractor shall be provided all results, documentation, and software from L-68670D.

6. Security clearance required for performance of work:

United States Citizenship is required for access to input data and simulation results.

7. Period of Performance	
Planned start date: 12/1/98	Expected completion date: 5/31/99

8. NASA Technical Monitor:	John G. Martin	M/S: 353x	Phone: 757-864-3755
NASA TM Alternate:	David E. Reubush	M/S: 353x	Phone: 757-864-3749

1. Task Order Number and Title Number: LA05 Revision: 0 DATE: **3/1/99**
Title: Design/analysis of Hyper-X Scramjet-Powered Vehicle Flight Experiment

2. Purpose, Objective or Background of Work to be Performed

(NOTE: This Task writeup is a revision of Task LA01rev1, for clarification, corrections, changes in priority, and adjustment of certain deliverables relative to Hyper-X Program events.)

NASA Langley Research Center has been a major player in the development of scramjet and hypersonic vehicle systems technology since 1960. Over this time, the center has developed ground-based experimental testing, data analysis, analytical, computational, and design specific methodology. These design methods, which are specific to airbreathing hypersonic vehicles, scramjet engine flowpath definition, and associated hypersonic aerodynamic performance, loads, structural design and thermal analysis, represent the state-of-the art (world-class) tools. These technologies have been extensively utilized for design studies and support of ground based experimental test programs and, specifically, from 1985-1995 on the National Aero-Space Plane (NASP) Program. NASA has recently (*Aviation Week*, May 12, 1996) initiated the Hyper-X Program to demonstrate in flight, the technology required for hypersonic cruise aircraft and efficient air breathing engine-powered orbital launch vehicles. The Hyper-X flight test is a logical step to validate, refine, and advance these design methods using data generated in flight.

The HXRV development is accomplished using an integrated government, government contractor team.

<u>HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT</u>

4/19/96	Baseline configuration released
8/1/96	Detailed assessment of baseline completed; final design recommendations for Mach 7 vehicle
12/16/97	Hyper-X Launch Vehicle (HXLV) Critical Design Review (CDR) for Mach 7
12/30/97	Detailed assessment of final design completed; Mach 7 flight test configuration lines/design frozen
2/3/98	Hyper-X Research Vehicle (HXRV) CDR for Mach 7
6/30/99	Mach 7 vehicle delivered
2/18/99	PDR for Mach 10 flight vehicle
8/30/99	FDR for Mach 10 flight vehicle
1/00	Mach 7 vehicle test flight
2/1/00	CDR for Mach 10 flight vehicle

Note: Actual Hyper-X Program event dates should be taken from current program schedule.

1 Task Order Number: LA06 Revision: ___ Date of Revision:
Title: Hyper-X Scaled-up X-Airplane Conceptual Study for Mach 4 to 7 Flight

2 Purpose, Objective or Background of Work to be Performed:

Hyper-X will demonstrate that an airframe-integrated scramjet can accelerate a vehicle in flight at Mach 7 in January and October of 2000 and at Mach 10 in October of 2001. The Hyper-X vehicle is 12-feet long and structurally designed with sufficient stiffness to be dropped from the wing of a B-52 mounted at the apex of a long Pegasus Booster System. This task addresses what is to be done in the next phase of the Hyper-X program follow-on to demonstrate Mach 0 to 7 flight.

The idea is to examine a scaled-up Hyper-X configuration (about 25 feet in length) with lighter weight structures (aluminum shell with TPS) that could be ground launched or mounted under the wing of the B-52, with a small booster or boosters to accelerate the X-airplane from Mach 0.8 to 4. The primary focus of the initial design of the scaled-up configuration will be endothermic hydrocarbon fuel (JP-7). The scaled-up hydrogen engine will be modified downstream of the throat to accommodate a hydrocarbon combustor with fuel injection from both the body and cowl sides. This lengthened combustor will be faired into the scaled-up nozzle providing as little deviation from the original keel-line as possible.

The hydrocarbon combustor is to be actively cooled using the P&W HyTech engine architecture. The fuel is injected in the gaseous state. This scaled-up configuration will have a fuel tank, which is designed to contain hydrocarbon fuel or liquid hydrogen. The fuel system will be designed for hydrocarbon fuel initially, then it will be redesigned and assembled in a hydrogen fuel configuration. The vehicle will be flown with hydrocarbon fuel first. Then after the tank is thoroughly cleaned and the fuel system reconfigured, the vehicle may be flown again using hydrogen fuel in the hydrocarbon engine with as little modification as possible.

This scaled-up Hyper-X Airplane and booster is to accelerate to Mach 4 and after separation at about Mach 4, would be propelled by an airframe integrated dual mode ramjet on endothermic hydrocarbon fuel (JP-7) and demonstrate the potential of this system from Mach 4 to 7. After depleting its fuel it would decelerate and land horizontally, unpowered. The vehicle would then be overhauled, refueled and reflown . . . a reusable system! The vehicle would then be reconfigured for hydrogen fuel and the process would be repeated.

The dual mode ramjet of choice is the P&W HyTech engine, which will be furnished by P&W. Many booster candidates are being examined; the most favorable appears to be the SR19, a Minute Man upper stage. With this system the X-airplane, which may weigh about 8,000 lbs. could probably be mounted at the apex of the SR19 booster and ground launched or dropped from beneath the wing of a B-52. The X-airplane is to have an active control system and therefore will employ minimum ballast in its nose for stability augmentation.

3 Description of Work to be Performed

The contractor shall perform conceptual design and performance analysis of an X-Airplane, based on a scaled-up (approximately a factor of 2) Hyper-X, capable of being rocket boosted (ground launched or air launched from the wing of a B-52) to Mach 4 velocity for staging. The X-Airplane would then accelerate in free flight, powered by an airframe integrated dual-mode ramjet to Mach 7, then descend and land unpowered. The X-airplane will employ an active control system (minimum ballast for stability) and is to fly autonomously (preprogrammed).

3.1 Scope of Work

3.1.1 Scale-up the Hyper-X geometry by a photographic scale factor of 2 and establish a first-order estimated weight for the resulting configuration with a hydrocarbon fueled dual-mode ramjet engine, based on the HyTech P&W design. This activity is for establishing the feasibility of a scale factor of 2, which will depend on planform loading and total weight for launch with a selected booster(s).

3.1.2 Develop a hydrogen fueled engine design capable of operation from about Mach 4 to Mach 7 for the scale factor 2 Hyper-X vehicle. Update the structural architecture and materials to reflect the lightest weight concepts practical for this vehicle. Develop vehicle performance and required propellant fraction for the Mach 4 to Mach 7 flight and adjust to hydrocarbon performance. Size the airframe to accommodate the required propellant fraction.

3.1.3 Modify the scaled-up hydrogen fueled Mach 4 to 7 Hyper-X engine, downstream of the throat to accommodate hydrocarbon fuel combustion. This modified combustor will then be faired into the scaled-up nozzle providing as little deviation from the original keel-line as possible. Assume use of a movable cowl inlet flap and consider a movable cowl nozzle flap, but otherwise fixed geometry.

3.1.4 Refine the conceptual design of the scaled-up vehicle for use with hydrocarbon fuel. The final vehicle should have a light weight structural architecture similar to the HySID design or better and a hydrocarbon engine design based on the Hyper-X keel-line definition and the P&W HyTech engine structure and systems. The resulting configuration is resized if required to become the hydrocarbon fueled X-Airplane configuration. Complete packaging and weights shall be developed.

3.1.5 Establish conceptual level performance for the hydrocarbon fueled, scaled-up X-airplane for post-staging including both powered and unpowered free flight from Mach 4 to 7 and Mach 7 to landing.

3.1.6 Screen Boosters and select best candidates for integrating with scaled-up, hydrocarbon fueled X-airplane for ground launch or air launch from a B-52 and acceleration to Mach 4 at approximately 2,000 psf dynamic pressure (to be determined) for staging.

3.1.7 Establish a conceptual launch configuration and performance matrix (aero and propulsion from booster vendor). The booster activity is also being performed in parallel by Boeing under contract to NASA and may be followed for added information to assist this process.

3.1.8 Perform trajectory analysis for the launch configuration (from ground or air launch) and the free flying X-Airplane from staging through powered flight and descent to landing.

3.1.9 Examine feasibility of altering the hydrocarbon design for testing with hydrogen including the following hypotheses: • Insulated fuel tank could be cleaned and used for liquid hydrogen. • Fuel ramp and fuel lines could be changed for hydrogen use. • Engine fuel injectors/combustor could be modified for burning hydrogen in the hydrocarbon engine architecture with acceptable performance.

3.2 Deliverables and Schedule

The contractor shall provide the following:

3.2.1 Provide the first order weight estimate for a 2X scale Hyper-X June 18, 1999
3.2.2 Provide the 2X Hyper-X with hydrogen engine and performance adjusted for hydrocarbon fuel and scaled up size to perform mission July 16, 1999
3.2.3 Provide revised engine design with hydrocarbon fuel system August 13, 1999
3.2.4 Provide X-Airplane concept with hydrocarbon engine/systems September 3, 1999
3.2.5 Provide post-staging performance of X-Airplane September 10, 1999
3.2.6 Provide booster selection with rationale July 23, 1999
3.2.7 Provide launch vehicle performance matrix July 30, 1999
3.2.8 Provide results of complete mission trajectory analysis September 19, 1999
3.2.9 Provide concept alterations for hydrogen fuel September 30, 1999 Provide facing page text type report of study September 30, 1999

3.3 Metrics

3.3.1 Meet schedule and cost.

3.3.2 Analysis performed with state-of-the-art methods and documented in presentations to IPT and copy in Hyper-X official files.

3.3.3 Quality of analysis documented by reference to previous work or new validation performed.

3.4 Exceeds MinimumRequirements

3.4.1 Methods utilized exceed standard and/or that requested by contractor team members.
3.4.2 Results presented in NASA contractor report
3.4.3 Documentation includes assumptions, models and/or inputs to programs required to produce results

4. Government Furnished Items

4.1 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S,4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

4.2 Available Software
- GASP 2.2 - GASP 3.0 - GRIDGEN - TECPLOT - GRIDTOOLS - SHIP3D - SRGULL - SCRAM3L - LARCK - SAM3D - USM3D - PARAFLOW - POST - APAS - PATRAN - PRO-E - UG - SINDA85 - MSCNASTRAN - MSCTHERMAL - HYPERSIZER - I3G - ACAD - AML
- Other desktop S/W for word processing, etc.

4.3 Special furniture
- Safes for storage of classified material

5. OTHER INFORMATION NEEDED FOR PERFORMANCE OF WORK

5.1 Estimated Travel requirements

-Performance of these tasks may require travel to: Dryden Flight Research Center, Edwards, CA; Glenn Research Center, Cleveland, OH; GASL, Ronkonkoma, NY; Boeing, St Louis and Long Beach CA; Microcraft, Tullahoma, TN and Ontario, CA; Pratt & Whitney, West Palm Beach, FL; Aerojet, Sacramento, CA; and participation in the JANNAF Propulsion meeting(s), KSFC, FL and LosAngeles, CA.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

6. Security clearance required for performance of work:

6.1 Much of the work performed on this work order requires a SECRET clearance.

6.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

6.3 Contractor shall be responsible for following NASA Langley Research Center regulations/requirements regarding the securing of classified computing areas and the protection of classified documents.

7. Period of Performance	
Planned start date: June 1, 1999	Expected completion date: Sept. 30, 1999

8. NASA Technical Monitor: Charles R. McClinton M/S: 353X Phone: 757-864-6253
NASA TM Alternate: James L. Hunt M/S: 365 Phone: 757-864-3732

1. Task Order Number: LA07 Revision: __ Date of Revision:

Title: Airbreathing Launch Vehicle Optimization

2 Purpose, Objective or Background of Work to be Performed:

A viable lifting-body baseline airbreathing launch vehicle design has been established employing an AceTR low speed propulsion system in conjunction with triple-point hydrogen as fuel for the Access-to-Space mission. This baseline was established from a previous lifting-body design with a fineness ratio of 5.7 that employed a LACE ejector as a low-speed propulsion system in conjunction with SLUSH hydrogen as fuel. The new AceTR baseline offers substantial improvements . . . no SLUSH hydrogen, better low speed system and slightly lower takeoff gross weight.

In order to realize the full potential of this new baseline airbreathing launch vehicle system, it must be optimized. This optimization will start by translating to a higher fineness ratio lifting-body . . . the 202a configuration at a fineness ratio of 6.8 . . . and optimizing the keel line, packaging and trajectory for maximum performance of a trimmed design across the Mach range (Phase I). After this work is completed providing a more viable design, the fineness ratio of the configuration will be then optimized in a follow-on task (Phase II).

3 Task Technical Requirements:

A design study will be performed on a scaled-up 202a configuration for optimizing an airbreathing launch vehicle design keel-line, packaging and trajectory for the Access-to-Space mission employing an AceTR low speed propulsion system in conjunction with a Dual Mode Ramjet high-speed propulsion system in an under-slung, over/under integration concept with triple-point hydrogen as fuel. A Design of Experiments method will be used to optimize the airbreathing flowpath.

3.1 Scope of Work

3.1.1 Generate candidate flowpath matrix, generate propulsion data base with SRGULL, and generate aerodynamic database over the ABLV mission envelope for the purpose of developing a first pass set of linear regression equations for screening of the design variables to produce an optimized flowpath. Linear regression analysis to be provided by NASA. These results will enable development of an initial vehicle geometry for further discipline analysis.

3.1.2 Using the initial optimized keel line and resulting vehicle geometry, complete the vehicle design to include airframe/engine integration of both Ace-TR low-speed (sizing) and the ram/scramjet high speed systems. Completely package the vehicle with systems and propellant volumes accounted for and all vehicle weights established.

3.1.3 Provide preliminary vehicle performance to develop a preliminary propellant fraction required (PFA) and perform a sizing (closure) to the Acess-to-Space mission requirements.

3.1.4 Develop an updated candidate flowpath matrix, updated propulsion performance, and updated aerodynamics in order to develop a new set of higher order regression equations. Regression analysis to be provided by NASA. This set of results will produce the final optimized flowpath for developing the geometry of the ABLV-9a configuration.

3.1.5 Using the ABLV-9a configuration, update propulsion performance, aerodynamic performance, vehicle packaging, and weights. Using this performance data, perform the vehicle to determine the propellant fraction required (PFR) to accomplish the Access-to-Space mission.

3.1.6 Perform a final vehicle sizing (closure) to the mission required PFR.

3.2 Deliverables and Schedule

3.2.1 The contractor shall provide the initial screening matrix results and initial keel line definition. 7-2-99

3.2.2 The contractor shall provide the initial vehicle geometry (ABLV-9DOE). 7-16-99

3.2.3 The contractor shall provide the preliminary closure for ABLV-9DOE with preliminary weight statement. 8-6-99

3.2.4 The contractor shall provide the final optimized keel line for development of vehicle configuration (OML) ABLV-9a. 8-6-99

3.2.5 The contractor shall provide the packaging drawing for ABLV-9a. 9-3-99

3.2.6 The contractor shall provide the final closure and weight statement for ABLV-9a. 9-3-99

3.2.7 The contractor shall provide a facing page text of figures covering the evolution and final closure of the optimized airbreathing launch vehicle ABLV-9a. 9-24-99

3.3 Metrics

3.3.1 Meet schedule and cost.

3.3.2 Analysis performed with state-of-the-art methods and documented in presentations and copy in Hyper-X official files.

3.4 Exceeds Minimum Requirements

3.4.1 Novel use of methods to enhance efficiency without compromising quality.

3.4.2 Results presented in NASA contractor reports

4. Government Furnished Items:

4.1 Computational support in the form of specialized regression analysis.

4.2 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S,4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

4.2 Available Software
- GASP 2.2 - GASP 3.0 - GRIDGEN - TECPLOT - GRIDTOOLS - SHIP3D
- SRGULL - SCRAM3L - LARCK - SAM3D - USM3D - PARAFLOW - POST
- APAS - PATRAN - PRO-E - UG - SINDA85 - MSCNASTRAN
- MSCTHERMAL - HYPERSIZER - I3G - ACAD - AML
- Other desktop S/W for word processing, graphics generation, spreadsheets, PC based math codes, communication tools, etc.

4.4 Special furniture - Safes for storage of classified material

5. Other information needed for performance of task:

5.1 Estimated Travel requirements

-Performance of these tasks may require travel to: Dryden Flight Research Center, Edwards, CA; Lewis Research Center, Cleveland, OH; GASL, Ronkonkoma, NY; Boeing North American, Seal Beach CA; Microcraft, Tullahoma, TN and Ontario, CA; Pratt & Whitney, West Palm Beach, FL; Aerojet, Sacramento, CA; and participation in the JANNAF Propulsion meeting(s), KSC, FL and Las Angeles, CA.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

6. Security clearance required for performance of work:

6.1 Much of the work performed on this work order requires a SECRET clearance.

6.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

6.3 Contractor shall be responsible for following NASA Langley Research Center regulations/requirements regarding the securing of classified computing areas and the protection of classified documents.

7. Period of Performance	
Planned start date: June 1, 1999	Expected completion date: Sept. 24, 1999

8. NASA Technical Monitor: Charles R. McClinton M/S: 353X Phone: 757-864-6253
NASA Co-Technical Lead: James L. Hunt M/S: 365 Phone: 757-864-3732
NASA TM ALTERNATE: Sharon H. Stack M/S: 353X Phone: 757-864-3742

1. Task Order Number and Title Number: LA08 Revision: 0 DATE:
Title: Hyper-X Design Evaluation and Flight Dynamics

2. Purpose, Objective or Background of Work to be Performed

NASA Langley Research Center has been a major player in the development of scramjet and hypersonic vehicle systems technology since 1960. Over this time, the center has developed ground-based experimental testing, data analysis, analytical, computational, and design specific methodology. These design methods, which are specific to airbreathing hypersonic vehicles, scramjet engine flowpath definition, and associated hypersonic aerodynamic performance, loads, structural design and thermal analysis, represent the state-of-the art (world-class) tools. These technologies have been extensively utilized for design studies and support of ground based experimental test programs and, specifically, from 1985-1995 on the National Aero-Space Plane (NASP) Program. NASA has recently (*Aviation Week*, May 12, 1996) initiated the Hyper-X Program to demonstrate in flight, the technology required for hypersonic cruise aircraft and efficient air breathing engine-powered orbital launch vehicles. The Hyper-X flight test is a logical step to validate, refine, and advance these design methods using data generated in flight.

The HXRV development is accomplished using an integrated government, government contractor team.

<u>HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT</u>

4/19/96	Baseline configuration released
8/1/96	Detailed assessment of baseline completed; final design recommendations for Mach 7 vehicle
12/16/97	Hyper-X Launch Vehicle (HXLV) Critical Design Review (CDR) for Mach 7
12/30/97	Detailed assessment of final design completed; Mach 7 flight test configuration lines/design frozen
2/3/98	Hyper-X Research Vehicle (HXRV) CDR for Mach 7
6/30/99	Mach 7 vehicle delivered
2/18/99	PDR for Mach 10 flight vehicle
8/30/99	FDR for Mach 10 flight vehicle
1/00	Mach 7 vehicle test flight
2/1/00	CDR for Mach 10 flight vehicle

Note: Updated Hyper-X Program event dates should be taken from current program schedule.

1. Task Order Number and Title Number: LA08 Revision: 0 DATE:
Title: Hyper-X Design Evaluation and Flight Dynamics

3. DESCRIPTION OF THE WORK TO BE PERFORMED

3.1.1 DESCRIPTION OF TASK

The contractor shall provide an independent design evaluation of the Hyper-X Program research and launch vehicles and research vehicle to booster adapters. Assessment and evaluation will be performed in sufficient detail to provide confidence that the Hyper-X Contractor Team (HXCT) basic designs and analyses are appropriate to the mission. The contractor shall support and participate within the Integrated Product Team (IPT) structure developed by the HXCT and Hyper-X Program Office (HXPO). Support of these HXCT led IPT's is intended to reduce risk and cost of the Hyper-X flight program. The contractor shall also provide leadership for the Structures Government Technology Team (GTT) and coordinate contractor and Government efforts required for the development of the Preliminary design of HXRV Mach 10 modifications.. The GTT's purpose is to develop, apply and validate technologies required for the development of future hypersonic, scramjet powered vehicles. Specific areas and anticipated levels of effort are described as follows:

3.1.1.1 Loads Development – Monitor and critique development of launch, test, and descent trajectories for the purpose of establishing appropriate structural and thermal design load envelopes. Assess the Monte Carlo uncertainty analysis data provided by NASA and the HXLV contractor. Perform Monte Carlo analysis for stage separation and HXRV test segment of the flight.

3.1.1.2 Airframe/Adapter Structural Design –Provide a preliminary review of Hyper-X airframe and adapter structural designs and assess functionality, including but not limited to load paths, structural arrangement, and overall architecture of assembled systems. Supplemental structural analysis shall be performed on critical parts to assure adequacy of HXRV and adapter design to be flown at Mach 7 (two flights) and Mach 10.

3.1.1.3 Airframe Thermal Design and Analysis – Identify to NASA management, areas requiring detailed thermal analysis, perform analysis and/or review results of both NASA and the Hyper-X contractor studies of Hyper-X airframe thermal designs and functionality.

3.1.1.4 Engine Structural Design – Perform structural and mechanical evaluations of the Hyper-X engine designs to be flown at Mach 7 (two flights) and Mach 10.

3.1.1.5 Engine Thermal Design – Perform detailed thermal analysis and review results of both NASA and the Hyper-X contractor studies of the Hyper-X engine system to be flown at Mach 7 (two flights) and Mach 10.

3.1.1.6 Launch Stack Dynamics – Provide a detailed review of Hyper-X Launch Vehicle (HXLV) design, adapter, interfaces, and HXLV interfaces to assess structural dynamics and compliance with specifications. Develop and validate supplemental finite-element models for assessment of launch stack dynamics. Coordinate LaRC activities and support team required test planning, requirements, modal test pre-test analyses, and post-test data correlation.

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3.1.1.7Separation Mechanism and Systems – Review HXRV separation sequence, designs, analyses and HXRV contractor stage separation development tests to minimize risk to the research vehicle during separation. Provide pre and post test evaluation/analysis for stage separation tests, including the piston/jaw, mass simulator and "full-up" systems test. Co-ordinate activity with stage separation simulation and Monte Carlo analysis.

3.1.1.8 Propulsion Performance Analysis – Provide analysis of propulsion performance, both on design and off-design, as required to develop engine and/or research vehicle design, including support for mission planning and flight control activities. Provide validation of predicted forces and pitching moment, as well as wall pressure and heat flux.

3.1.1.9 Aerothermal analysis – Provide predictions (and uncertainty) of aerodynamic heating, for the Hyper-X flight vehicles, using a combination of analytical and numerical methods. Iterate with airframe thermal design and analysis tasks. Provide validation of methods using appropriate experimental data.

3.1.1.10 Mission Planning and Trajectory – Provide mission planning and trajectory design support for all missions, as required to develop appropriate flight profiles and loads, and reduce design risk to airframe and engine. Apply Monte Carlo analysis methods using both the POST and ADAMS (sepsim2) codes.

3.1.1.11 Maintain and improve methods as required to support tasks. Also, assist other organizations designated by the customer in support of this overall task.

3.1.2 DELIVERABLES

Dates presented below are consistent with current NASA Hyper-X schedules, which may change (be extended).

3.1.2.1 Loads Development –
3.1.2.1.A Updated design loads for the Mach 10 mission. 9/1/99
3.1.2.1.B Mach 7 vehicle and adapter separation loads 8/1/99

3.1.2.2 Airframe Structural Design –
3.1.2.2.A Prelim airframe structural design assessment for the Mach 10 mission. 10/1/99.
3.1.2.2.B Final airframe structural design assessment for the Mach 10 mission. 4/1/00

3.1.2.3 Airframe Thermal Design and Analysis –
3.1.2.3.A Prelim. airframe thermal design assessment for the Mach 10 mission. 9/20/99
3.1.2.3.B Update airframe thermal design assessment for the Mach 10 mission. 3/20/00

3.1.2.4 Engine Structural Design –
3.1.2.4.A Prelim. engine structural design assessment for the Mach 10 mission. 9/20/99
3.1.2.4.B Updated engine structural design assessment for the Mach 10 mission. 6/1/00

3.1.2.5 Engine Thermal Design –
3.1.2.5.A Prelim. engine thermal design assessment for the Mach 10 mission. 8/18/99
3.1.2.5.B Updated engine thermal design assessment for the Mach 10 mission. 6/1/00

3.1.2.6 Launch Stack Dynamics –
3.1.2.6.A Provide pre-test support and documented predictions for the short-stack

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structural dynamics modal test. 7/1/99

3.1.2.6.B Provide post-test data correlation (short-stack dynamic modal test) documentation of model validation and flight scaling. 8/1/99

3.1.2.6.C Provide HXLV dynamic analysis as required by GTT/IPT's continuous through 6/1/00

3.1.2.7 Separation Mechanism and Systems –

3.1.2.7.A Updated Mach 7separation mechanism and adapter mechanical/structural design assessment. 8/15/99

3.1.2.7.B Preliminary Mach 10 separation mechanism and adapter mechanical/structural design assessment. 9/15/99

3.1.2.7.C Final Mach 7 separation mechanism and adapter mechanical/structural design assessment. 10/1/99

3.1.2.7.D Provide pretest evaluation and test design support for "FULL-UP" systems test. 7/1/99

3.1.2.7.E Provide post-test analysis of results from contractor performed stage separation ground tests. 9/30/99

3.1.2.8 Propulsion Performance Analysis –

3.1.2.8.A Propulsion performance results to support 3 DOF simulation using SRGULL to guide Mach 10 design. As required, until 6/1/00

3.1.2.8.B Doc. Preliminary Mach 10 "aero" propulsion database 7/18/99

3.1.2.8.C Doc. final Mach 7 propulsion database 9/1/99

3.1.2.9 Aerothermal analysis –

3.1.2.9.A "Final" Mach 10 HXRV/HXLV aerodynamic heating. 8/1/99

3.1.2.9.B Document APAS validation to detailed CFD/experimental data 10/1/99

3.1.2.10 Mission Planning and Trajectory –

3.1.2.10.A Candidate trajectories to guide loads definition and design. As required, until 6/1/00

3.1.2.10.B Document updated Mach 7 stage separation sequence/trajectory and uncertainty 8/15/99

3.1.2.10.C Document final Mach 7 boost trajectory and uncertainty 9/1/99

3.1.2.10.D Document updated Mach 10 boost trajectory and uncertainty 10/1/99

3.1.2.10.E Document preliminary Mach 10 stage sep. sequence, trajectory and uncertainty 10/1/99

3.1.2.10.F Document Mach 10 RV powered trajectory and uncertainty 2/15/00

3.1.2.10.G Document Mach 10 RV decent trajectory and uncertainty 4/15/99

3.1.2.11 Maintain and improve methods –

3.1.2.11.A Methods development, code maintenance, small analytical tasks, charts, and miscellaneous assistance. As required, until 6/1/00

3.1.3 SCHEDULE
(See section 3.1.2)

3.1.4 METRICS

3.1.4.1 Meet schedule and cost.

1. Task Order Number and Title	**Number: LA08 Revision: 0** DATE:
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3.1.4.2 Analysis performed with state-of-the-art methods and documented in presentations to IPT and copy in Hyper-X official files.

3.1.4.3 Quality of analysis documented by reference to previous work or new validation performed.

3.1.5 EXCEEDS MINIMUM REQUIREMENTS

3.1.5.3 Methods utilized exceed standard and/or that requested by contractor team members.

3.1.5.2 Results presented in NASA contractor reports

3.1.5.3 Documentation includes assumptions, models and/or inputs to programs required to produce results

1. Task Order Number and Title Number: LA08 Revision: 0 DATE:
Title: Hyper-X Design Evaluation and Flight Dynamics

4. GOVERNMENT FURNISHED ITEMS

4.1 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing Facility.
- Access to a secure Cray J90 (8 CPU'S,4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

4.2 Available Software
- GASP 2.2 - GASP 3.0 - GRIDGEN - TEKPLOT - GRIDTOOLS - SHIP3D
- SRGULL - SCRAM3L - LARCK - SAM3D - USM3D - PARAFLOW - POST
- APAS - PATRAN - PRO-E - UG - SINDA85 - MSCNASTRAN
- MSCTHERMAL - HYPERSIZER - XESS - I3G - ACAD
- Other desktop S/W for word processing, graphics generation, spreadsheets, PC based math codes, communication tools, etc.

4.3 Special furniture
- Safes for storage of classified material

5. OTHER INFORMATION NEEDED FOR PERFORMANCE OF WORK

5.1 Estimated Travel requirements

-Performance of these tasks may require travel to: Dryden Flight Research Center, Edwards, CA; Lewis Research Center, Cleveland, OH; GASL, Ronkonkoma, NY; Boeing North American, Seal Beach CA; Microcraft, Tullahoma, TN and Ontario, CA; Pratt & Whitney, West Palm Beach, FL; Aerojet, Sacramento, CA; and participation in the JANNAF Propulsion meeting(s), KSC, FL and Las Angeles, CA.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

1. Task Order Number and Title Number: LA08 Revision: 0 DATE:	
Title: Hyper-X Design Evaluation and Flight Dynamics	

6. SECURITY CLEARANCE REQUIRED FOR PERFORMANCE OF WORK

6.1 Much of the work performed on this work order requires a SECRET clearance.

6.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

6.3 Contractor shall be responsible for following NASA Langley Research Center regulations/requirements regarding the securing of classified computing areas and the protection of classified documents.

7. PERIOD OF PERFORMANCE	
Planned start date: June 1, 1999	Expected completion date: May 30, 2000

8. NASA TECHNICAL MONITOR:	Charles R. McClinton	M/S: 353X	Phone: 757-864-6253
NASA TM ALTERNATE:	R. T. Sherrill	M/S: 430	Phone: 757-864-7085

1. Task Order Number:: M01 Revision: ____ Date of Revision:
Title: **Independent Assessment of the International Space Station Crew Return Vehicle Program**

2. Purpose, Objective or Background of Work to be Performed:
LaRC IPAO has been requested by the NASA Chief Engineer and the Program Management Council (PMC) to perform an Independent Assessment of the International Space Station (ISS) Crew Return Vehicle (CRV) Program. The contractor shall provide technical experts to perform an independent assessment of the ISS CRV Program. The CRV Program includes the X-38 project, CRV and Crew Transfer Vehicle (CTV). The CRV is an emergency vehicle to perform the following defined ISS missions: 1) emergency medical return of an ill or injured crew person, 2) return of crew in the event that the ISS environment is not habitable, or 3) return of crew in the event that the ISS cannot be re-supplied. The current CRV concept has been designed to accommodate a crew of 0 to 6 persons and to land using a Parafoil/Recovery system. The contractor shall focus the independent technical assessment on the Crew Accommodations/Crew Systems and the Parafoil/Recovery systems of the proposed CRV.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):
The contractor shall conduct an independent assessment of the CRV Program. The contractor shall develop a detailed plan to perform the assessment. The contractor's plan shall include schedules of the deliverable products. The primary product shall be a final report and a floppy disk version consisting of, as a minimum, written assessments on each of the technical areas reviewed. Other products consist of weekly reports and monthly cost expenditures. The schedules shall be developed by the contractor in cooperation with the IPAO Office.

The contractor shall implement the plan to perform an Independent Assessment focusing in on the following two technical areas of the proposed CRV and for the purpose of demonstrating Crew Transfer Vehicle (CTV) technologies or concepts: 1) the Crew Accommodations/Crew Systems and 2) the Parafoil/Recovery systems. During the assessment, the contractor shall provide an in-depth technical review of the proposed design and provide possible alternative concepts for these technical areas when required.

A schedule of meetings to be attended by the contractor for the assessment shall be developed by the contractor in cooperation with the IPAO Office. An overall coordination schedule that reflects the contractor's involvement in document reviews and special studies shall also be generated and shall be modified at the discretion of the contractor to reflect changes in the required workload.

The contractor shall provide all administrative support (travel, stipend where required, secretarial support, etc.) necessary for the completion of this Independent Assessment.

Deliverables and Schedules:

1. The plan and schedules shall be delivered 3 weeks after Task Order has been let.
2. Weekly status reports on any findings, reviews, and concerns generated by the contractor's assessment when required.
3. Total monthly costs shall be provided by the 15th of each month when required.
4. The contractor shall deliver the final report per the plan specified in paragraph 1.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall conduct an independent assessment of the CRV Program. The contractor shall develop a detailed plan to perform the assessment. The contractor's plan shall include schedules of the deliverable products. The primary product shall be a final report and a floppy disk version consisting of, as a minimum, written assessments on each of the technical areas reviewed. Other products consist of weekly reports and monthly cost expenditures. The schedules shall be developed by the contractor in cooperation with the IPAO Office.

The contractor shall implement the plan to perform an Independent Assessment focusing in on the following two technical areas of the proposed CRV and for the purpose of demonstrating Crew Transfer Vehicle (CTV) technologies or concepts: 1) the Crew Accommodations/Crew Systems and 2) the Parafoil/Recovery systems. During the assessment, the contractor shall provide an in-depth technical review of the proposed design and provide possible alternative concepts for these technical areas when required.

A schedule of meetings to be attended by the contractor for the assessment shall be developed by the contractor in cooperation with the IPAO Office. An overall coordination schedule that reflects the contractor's involvement in document reviews and special studies shall also be generated and shall be modified at the discretion of the contractor to reflect changes in the required workload.

The contractor shall provide all administrative support (travel, stipend where required, secretarial support, etc.) necessary for the completion of this Independent Assessment.

Deliverables and Schedules:

1. The plan and schedules shall be delivered three weeks after Task Order has been let.
2. Weekly status reports on any findings, reviews, and concerns generated by the contractor's assessment when required.
3. Total monthly costs shall be provided by the 15th of each month when required.
4. The contractor shall deliver the final report per the plan specified in paragraph 1.

Metrics:

Minimum acceptable performance:

1. The plan shall clearly state the activities required to perform the assessment within the agreed upon schedule.

2. The weekly status reports shall provide adequate insight into the evolving findings and recommendations.
3. The monthly costs shall clearly indicate the expenditures incurred as well as expected future expenditures through the completion of this task.
4. The final report shall be assessed by:
   - Technical accuracy
   - Findings must be clearly stated
   - Alternative concepts must be clearly stated
   - Recommendations must be clearly stated
   - Overall assessment must be provided
   - Executive summary

Exceeds minimum performance:

1. The final report shall be assessed by:
   - Findings to improve design and development process
   - Propose alternative concepts that will benefit government
   - Recommendations for improving efficiency, capability, cost and quality
   - Executive summary identifying risks

4. Government Furnished Items:

A Program briefing will be given to the contractor that will provide available CRV design concept information.

5. Other information needed for performance of task.

6. Security clearance required for performance of work: None

7. Period of Performance	
Planned start date: 10/1/97	Expected completion date: 4/30/98

8. NASA Technical Monitor: Mr. Steve Cavanaugh
M/S: 215 Phone: (757) 864-7019

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number:: MO02 Revision: ____ Date of Revision:
Title: **Independent Assessment of the New Millenium Interferometer Project**

2. Purpose, Objective or Background of Work to be Performed:

LaRC IPAO has been requested by the NASA Chief Engineer and the Program Management Council (PMC) to perform an Independent Assessment of the New Millenium Interferometer (NMI) project. The contractor shall provide technical experts to perform an independent assessment of the NMI project. The NMI, being managed by NASA JPL, is a set of 3 spacecraft which form a visible-light interferometer with two collector and 1 combiner spacecraft. Key technologies requiring assessment include interferometry, laser metrology, kilometric optical gyros, and precision formation flying systems derived from pseudo-GPS technology.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall conduct an independent assessment of the NMI Project. The contractor shall develop a detailed plan to perform the assessment. The contractor's plan shall include schedules of the deliverable products. The primary product shall be a final report and a floppy disk version consisting of, as a minimum, written assessments on each of the technical areas reviewed. Other products consist of weekly reports and monthly cost expenditures. The schedules shall be developed by the contractor in cooperation with the IPAO Office.

The contractor shall implement the plan to perform an Independent Assessment focusing in on the following three technical areas of the proposed NMI project: 1) Optical interferometry, 2) the Laser metrology, 3) Kilometric Optical Gyros. During the assessment, the contractor shall provide an in-depth technical review of the proposed design and provide possible alternative concepts for these technical areas when required.

A schedule of meetings to be attended by the contractor for the assessment shall be developed by the contractor in cooperation with the IPAO Office. An overall coordination schedule that reflects the contractor's involvement in document reviews and special studies shall also be generated and shall be modified at the discretion of the contractor to reflect changes in the required workload.

The contractor shall provide all administrative support (travel, stipend where required, secretarial support, etc.) necessary for the completion of this Independent Assessment.

Deliverables and Schedules:
1. The plan and schedules shall be delivered three weeks after Task Order has been let.
2. Weekly status reports on any findings, reviews, and concerns generated by the contractor's assessment when required.
3. Total monthly costs shall be provided by the 15th of each month when required.
4. The contractor shall deliver the final report per the plan specified in paragraph 1.

Metrics:

Minimum acceptable performance:

1. The plan shall clearly state the activities required to perform the assessment within the agreed upon schedule.
2. The weekly status reports shall provide adequate insight into the evolving findings and recommendations.
3. The monthly costs shall clearly indicate the expenditures incurred as well as expected future expenditures through the completion of this task.
4. The final report shall be assessed by:
   - Technical accuracy
   - Findings must be clearly stated
   - Alternative concepts must be clearly stated
   - Recommendations must be clearly stated
   - Overall assessment must be provided
   - Executive summary

Exceeds minimum performance:

1. The final report shall be assessed by:
   - Findings to improve design and development process
   - Propose alternative concepts that will benefit government
   - Recommendations for improving efficiency, capability, cost and quality
   - Executive summary identifying risks

4. Government Furnished Items:

A Program briefing will be given to the contractor that will provide available NMI design concept information.

5. Other information needed for performance of task.

6. Security clearance required for performance of work: None

7. Period of Performance	
Planned start date: 11/20/97	Completion date: 3/31/98

8. NASA Technical Monitor: Mr. Jeffrey S. Lavell
M/S: 215 Phone: (757) 864-5191

1. Task Order Number:: MO03 Revision: ____ Date of Revision:
Title: **Independent Assessment of the Mars 2001 Mission**

2. Purpose, Objective or Background of Work to be Performed:

LaRC IPAO has been requested by the NASA Chief Engineer and the Program Management Council (PMC) to perform an Independent Assessment of the Mars 2001 Mission. The contractor shall provide technical expertise to perform an independent assessment of the Systems Engineering activities of the Mars 2001 Mission. The Mars 2001 Mission is part of the NASA Mars Exploration Program and consists of an Orbiter, a Lander, and a Rover. The Orbiter will nominally orbit Mars for 3 years with the objective of conducting a detailed mineralogical analysis of the planet's surface from orbit and measuring the radiation environment. The Lander/Rover is equipped to study soil and atmospheric chemistry and radiation at the surface. The contractor shall focus the independent technical assessment on the system engineering of the proposed Mars 2001 Mission.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall conduct an Independent Assessment of the Mars 2001 Mission. The contractor shall develop a detailed plan to perform the assessment. The contractor's plan shall include schedules of the deliverable products. The primary product shall be a final report and a floppy disk version consisting of, as a minimum, written assessments on the technical areas reviewed. Other products consist of weekly reports and monthly cost expenditures. The contractor shall develop the schedules in cooperation with the IPAO Office.

The contractor shall implement the plan to perform an Independent Assessment focusing in on the system engineering technical areas of the proposed Mars 2001 Mission. During the assessment, the contractor shall provide an in-depth technical review of the proposed design and provide possible alternative concepts for these technical areas when required.

A schedule of meetings to be attended by the contractor for the assessment shall be developed by the contractor in cooperation with the IPAO Office. An overall coordination schedule that reflects the contractor's involvement in document reviews and special studies shall also be generated and shall be modified at the discretion of the contractor to reflect changes in the required workload.

Deliverables and Schedules:

1. The plan and schedules shall be delivered 3 weeks after Task Order has been let.
2. Weekly status reports on any findings, reviews, and concerns generated by the contractor's assessment when required.
3. Total monthly costs shall be provided by the 15th of each month when required.
4. The contractor shall deliver the final report per the plan specified in paragraph 1.

Metrics:

Minimum acceptable performance:

1. The plan should clearly state the activities required to perform the assessment within the agreed upon schedule.
2. The weekly status reports should provide adequate insight into the evolving findings and recommendations.
3. The monthly costs shall clearly indicate the expenditures incurred as well as expected future expenditures through the completion of this task.
4. The final report shall be assessed by:
   - Technical accuracy
   - Findings must be clearly stated
   - Alternative concepts must be clearly stated
   - Recommendations must be clearly stated
   - Overall assessment must be provided
   - Executive summary must identify risks

Exceeds minimum performance:

1. The final report shall be assessed by:
   - Findings to improve design and development process
   - Propose alternative concepts that will benefit government
   - Recommendations for improving efficiency, capability, cost and quality
   - Executive summary identifying risks

4. Government-Furnished Items: A program briefing will be given to the contractor that will provide available Mars 2001 Mission design concept information.

5. Other information needed for performance of task.

6. Security clearance required for performance of work: None.

7. Period of Performance	
Planned start date: 11/17/97	Completion date: 3/1/98

8. NASA Technical Monitor: Douglas A. Craig M/S: 215 Phone: (757) 864-7008

1. Task Order Number:: MO04 Revision: ____ Date of Revision:
Title: Independent Annual Review of the Alternate Turbo Pump.

2. Purpose, Objective or Background of Work to be Performed:

The LaRC Independent Program Assessment Office (IPAO) will conduct an Independent Annual Review (IAR) of the Alternate Turbo-Pump (ATP). The contractor shall provide a technical expert to perform an IAR of the ATP under the Shuttle Main Engine Program.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall conduct an Independent Annual Review of the ATP Program, developing a detailed plan to perform the review and including schedules of the deliverable products. The primary product shall be a final report summarizing the cost, schedule, and technical analyses conducted. The schedule for the final report and a schedule of meetings to be attended by the contractor shall be developed by the contractor in cooperation with the IPAO.

The contractor shall implement the plan to perform an IAR focusing in the following three areas of the ATP:

1. Liquid rocket engine performance
2. Turbo machinery performance
3. Adequacy of test program

During the review, the contractor shall provide in-depth cost, schedule, and technical analyses.

Deliverables:

1. The contractor shall deliver the final report per the plan specified in paragraph 1 (approximately June 1, 1998).

Metrics:

Minimum acceptable performance:

1. The final report shall be assessed for:
   - technical accuracy
   - findings must be clearly stated
   - alternative concepts must be clearly stated
   - recommendations must be clearly stated
   - overall assessment must be provided
   - executive summary

Exceeds minimum performance:

1. The final report shall be assessed for:
   - findings to improve design and development process
   - propose alternative concepts that will benefit government
   - recommendations for improving efficiency, capability, cost and quality
   - executive summary identifying risks

4. Government Furnished Items:
None.

5. Other information needed for performance of task.
This IAR will be conducted at Pratt & Whitney, West Palm Beach, Florida.

6. Security clearance required for performance of work: None.	

7. Period of Performance	
Planned start date: May 1, 1998	Expected completion date: June 15, 1998

8. NASA Technical Monitor: Dennis P. Botkin	
M/S: 215	Phone: (757) 864-2756

1. Task Order Number:: M005 Revision: ____ Date of Revision:
Title: Independent Annual Review of the Advanced Subsonic Technology Program.

2. Purpose, Objective or Background of Work to be Performed:

The LaRC Independent Program Assessment Office (IPAO) will conduct an Independent Annual Review (IAR) of the Advanced Subsonic Technology (AST) Program. The contractor shall provide a technical expert to perform an IAR of the AST Program.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall conduct an Independent Annual Review of the AST Program, developing a detailed plan to perform the review and including schedules of the deliverable products. The primary product shall be a final report summarizing the cost, schedule, and technical analyses conducted. The schedule for the final report and a schedule of meetings to be attended by the contractor shall be developed by the contractor in cooperation with the IPAO.

The contractor shall implement the plan to perform an IAR focusing in the following three areas of the AST Program:

1. Noise reduction
2. Emissions reduction
3. Environmental assessment
4. Engine systems

During the review, the contractor shall provide in-depth cost, schedule, and technical analyses.

Deliverables:
1. The contractor shall deliver the final report per the plan specified in paragraph 1 (approximately June 15, 1998).

Metrics:
Minimum acceptable performance:
1. The final report shall be assessed for:
   - technical accuracy
   - findings must be clearly stated
   - alternative concepts must be clearly stated
   - recommendations must be clearly stated
   - overall assessment must be provided
   - executive summary

Exceeds minimum performance:
1. The final report shall be assessed for:
   - findings to improve design and development process
   - propose alternative concepts that will benefit government
   - recommendations for improving efficiency, capability, cost and quality
   - executive summary identifying risks

4. Government Furnished Items:
None.

5. Other information needed for performance of task. This IAR will be conducted at Langley Research Center, Hampton, VA.	
6. Security clearance required for performance of work: None.	
7. Period of Performance	
Planned start date: May 11, 1998	Expected completion date: June 30, 1998
8. NASA Technical Monitor: Kerry L. Christian M/S: 215	Phone: (757) 864-3264

1. Task Order Number and Title Number: Revision: Date: Oct 7 1999
Title: Mars Climate Orbiter (MCO) Mission Failure Mishap Investigation

2. Purpose, Objective or Background of Work to be Performed:
Background: The MCO spacecraft, designed to study the weather and climate of Mars, was launched on December 11, 1998. After cruise to Mars of approximately 9 1/2 months, the spacecraft fired its main engine to go into orbit around Mars on September 23, 1999. The spacecraft passed behind the planet as seen from Earth. Signal reacquisition, expected when the spacecraft was to reemerge from behind Mars, did not occur. Both a JPL internal peer review group, established early on September 23, 1999, and a special review board appointed by JPL on September 24, 1999 are in place to investigate the failure. On September 30, 1999, NASA Press Release #99-113 announced, as a preliminary finding by the JPL internal peer review, that a failure to recognize and correct an error in a transfer of information between the Lockheed Martin Astronautics (LMA) spacecraft team in Colorado and the JPL mission navigation team in California led to the loss of the spacecraft.

Review Objectives:
The Contractor shall provide expert support to perform an independent review of the MCO mission failure. The review shall first focus on any aspect of the MCO mission failure which must be addressed in order to contribute to Mars Polar Lander's (MPL) safe landing on Mars with delivery of a report no later than November 5, 1999.

The Contractor shall review and evaluate the processes used by the MCO mission, develop lessons learned, make recommendations for future missions, and deliver a report no later than February 1, 2000.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):
A. Recognizing the time-criticality of the MPL landing and the activities the MPL mission team must perform to successfully land the MPL spacecraft on Mars, the Contractor shall determine and focus first on any aspects of the MCO mission failure which must be addressed in order to contribute to MPL's safe landing on Mars, and deliver a report no later than November 5, 1999. The report shall address the following topics.

i. Recommend tests, analyses, and simulations capable of being conducted in the near term to root out possible MPL failures and enable timely corrective actions.

ii. Review of the MPL contingency plans and recommended improvements.

B. The Contractor shall review and evaluate the processes used by the MCO mission, develop lessons learned, make recommendations for future missions, and deliver a report no later than February 1, 2000. This report shall cover the following topics and any other items the team thinks relevant.

i. Processes used to ensure mission safety and reliability with mission success as the primary objective. The review and evaluation shall include those processes that do not just react to hard failures but identify potential failures throughout the life of the mission for which corrective actions can be taken. The Contractor shall consider the question: Does NASA have the correct philosophy for mission assurance in its space missions?

ii. System engineering issues,
iii. Testing, simulation and verification of missions operations,
iv. Personnel training provided to the MCO operations team and its adequacy for conducting operations
v. Suggested specific processes to prevent basic types of human and machine error, as that discovered by the JPL peer review for the MCO failure, from going unrecognized and uncorrected.
vi. Re-examination of the current approach to planetary navigation. Specifically, are we asking for more accuracy and precision than we can deliver?
vii. How in-flight accumulated knowledge was captured and utilized for future operational maneuvers.

Deliverables and Schedule:

The Contractor shall document the findings in a report and provide them to the Mars Climate Orbiter Mission Failure Mishap Investigation Board Chairperson.

1. Start review at JPL on October 18.
2. Provide a report no later than November 5, 1999 on aspects of the MCO mission failure which must be addressed in order to contribute to MPL's safe landing on Mars.
3. Provide a report no later than February 1, 2000 that evaluates the processes used by the MCO mission, documents lessons learned, and makes recommendations for future missions.
4. The monthly status report required by the Contract shall describe the status of the technical reviews, a summary of open and closed technical issues and a cost report. The cost report shall include the total monthly cost of the task, and a graphic chart that compares estimated to actual costs. This monthly report shall be provided by the 15th of each month.

Metrics:
• Monthly reports for reviews provide progressive and conclusive insight into evolving findings and recommendations supported by available data and the analysis performed.

Exceeds : Statements and justification of all assumptions and of all arguments leading to final conclusions must be understandable to the average non-technical person.

• In general, content, agenda, and/or summary of all scheduled meetings shall be consistent with the stated technical and professional intent of the meetings.

Exceeds: Each meeting content must be understandable to a non-technical attendee.• Final Report:

- All findings must be identified and tabulated. Point of contact identified.
- The subject of each finding must be clearly stated.
- Recommendations must be tabulated to correlate with findings.
- Recommendations must be clearly stated.
- Overall assessment must be provided
- Executive summary.

Exceeds : Statements and justification of all assumptions and of all arguments leading to final conclusions must be understandable to the average non-technical person.

4. Government Furnished Items:

5. Other information needed for performance of task. When there are meetings of the Mars Climate Orbiter Mission Failure Mishap Investigation Board, travel by the Contractor will be required.

6. Security clearance required for performance of work: None.

7. Period of Performance	
Planned start date: October12, 1999	Completion date: March 31, 2000

8. NASA Technical Monitor: Cindy Daniels MS 160 Phone: 757-864-9865

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number: OC01 Revision: ____ Date of Revision:
Title: Mars Sample Return Earth Entry Vehicle Analysis and Simulation

2. Purpose, Objective or Background of Work to be Performed:

The task will provide preliminary design, layout, and analysis for candidate Earth Entry Vehicle (EEV) concepts. The specific task focus is modeling, structural analysis, and impact simulation. Products from these efforts will include packaging study results, static and dynamic finite element analysis results, and the use of advanced visualization methods to accurately present complex study results.

3. Description of the Work to be Performed:

Task 1.0: Mars Sample Return Earth Entry Vehicle Static Structural Analysis

The contractor shall provide structural analysis of Earth Entry Vehicle concepts and baseline designs.

Task Elements

1.1 The contractor shall provide a static structural analysis of a carbon-carbon EEV subjected to atmospheric flight loads and heating. The contractor shall use the analysis to determine the minimum feasible structural mass for this design that will successfully support the aerodynamic loads encountered during entry.

1.2 The contractor shall provide a structural analysis of the EEV baseline design under design launch environment. Analysis should evaluate the baseline structure in terms of stress and deflection criteria as well as verifying that the vehicle meets the minimum natural frequency requirements of the launch vehicle.

1.3 The contractor shall provide a structural analysis of the EEV revised baseline design under design launch environment. Analysis should evaluate the baseline structure in terms of stress and deflection criteria as well as verifying that the vehicle meets the minimum natural frequency requirements of the launch vehicle.

Deliverables/Schedule

1.1 The contractor shall deliver electronic copies of the I-DEAS finite element model and structural analysis results of carbon-carbon EEV design along with an informal written report describing the model, analysis conditions, and final results. (August 30, 1999)

1.2 The contractor shall deliver an electronic copy of the baseline EEV finite element model along with all relevant analysis results. The contractor shall also deliver an informal written report describing the finite element model, the loads used and the analysis results. (August 30, 1999).

1.3 The contractor shall deliver non-impact structural analysis results of revised EEV baseline design. (March 15, 2000)

Metrics:

The finite element models shall be free of modeling and implementation errors

The analysis must accurately represent the structural response to the loading environment

The reports must be complete, understandable, and professionally written in a contractor-specified form.

Task 2.0: Mars Sample Return Earth Entry Vehicle Dynamic Structural Analysis

The contractor shall provide dynamic structural analysis of Earth Entry Vehicle concepts , baseline designs, and development test models.

Task Elements:

2.1 The contractor shall survey available dynamic finite element analysis tools suitable for simulation of EEV ground impact event and suggest appropriate tool for use in EEV development and analysis.

2.2 The contractor shall provide a non-linear finite element simulation of the impact of a rigid structure and a surface whose properties are representative of the soil of the Utah UTTR, a hard surface, and a hard irregular surface.

2.4 The contractor shall provide a non-linear finite element analyses of the EEV sub-scale drop model tests and compare with test data.

2.3 The contractor shall provide a non-linear finite element analysis of the impact of the revised EEV baseline design and a surface whose properties are representative of the soil of the Utah UTTR, a hard surface, and a hard irregular surface.

Deliverable/Schedule

2.1 The contractor shall deliver an informal written report listing the dynamic finite element analysis tools surveyed, the criteria used for comparison, and a recommendation of an appropriate analysis program. (September 30, 1999)

2.2 The contractor shall deliver electronic copies of all computer files used in the analysis as well as an informal written report describing the analysis model and results. (September 30, 1999)

2.3 The contractor shall deliver an electronic copy of the finite element models along with the final analysis results. The contractor shall also deliver an informal written report describing the finite element model, the loads used and the analysis results. (February 15, 2000)

2.4 The contractor shall deliver a dynamic finite element analysis of revised EEV baseline design impacting surface conditions. (March 15, 2000)

Metrics:

• The finite element models shall be free of modeling and implementation errors

• The analysis must accurately represent the structural response to the dynamic loading environment

• The reports must be complete. understandable. and professionally written in a contractor-specified form.

Task 3.0: Mars Sample Return Earth Entry Vehicle Modeling and Configuration

The contractor shall provide CAD models and vehicle mass property and inertia data for candidate EEV design concepts.

Task Elements:

3.1 The contractor shall provide a CAD model of the Mars Sample Return EEV baseline design suitable for determining its mass properties and identifying internal system and subsystem packaging issues. The CAD model should be suitable for use as the basis of structural analysis and thermal analysis models.

3.2 The contractor shall use the EEV baseline CAD model to calculate the mass properties of the EEV baseline design. Calculated properties should include the vehicle mass, center of gravity, and inertia.

3.3 The contractor shall provide a CAD model of the Mars Sample Return EEV revised baseline design suitable for determining its mass properties and identifying internal system and subsystem packaging issues. The CAD model should be suitable for use as the basis of structural analysis and thermal analysis models.

Deliverable/Schedule

3.1 The contractor shall deliver an electronic copy of the I-DEAS geometry model that accurately represents the baseline design. (July 12, 1999).

3.2 The contractor shall deliver preliminary estimates of the vehicle's mass, center of gravity, and inertia. (July 19, 1999)

3.3 The contractor shall deliver a CAD model of the revised EEV baseline design with mass properties assessment, and transfer of model suitable for thermal analysis. (March 1, 2000)

Metrics

• The geometry models shall be free of modeling and implementation errors.

• The vehicle data should be delivered in a form that is understandable by someone who was not involved with their creation.

Task 4.0: Mars Sample Return Earth Entry Vehicle Animation

The contractor shall provide animations EEV flight dynamics and impact events visualizing engineering analysis data.

Task Elements:

4.1 The contractor shall create an animation of EEV flight dynamics based upon a six degree-of-freedom trajectory simulation.

4.2 The contractor shall create a qualitative animation of EEV ground impact dynamics which illustrates the range of impact conditions that the vehicle may encounter and must survive.

4.3 The contractor shall create a quantitative animation of EEV ground impact dynamics which illustrates the range of impact conditions that the vehicle may encounter and must survive.

Deliverable/Schedule

4.1 The contractor shall deliver a computer animation, suitable for transfer to video tape and suitable for transferring for viewing on Web, which accurately depicts the predicted EEV entry dynamics. (November 30, 1999)

4.2 The contractor shall deliver a computer animation, suitable for transfer to video tape and suitable for transferring for viewing on Web, which clearly depicts the important features of the ground impact event. (September 24, 1999)

4.3 The contractor shall deliver a computer animation, suitable for transfer to video tape and for viewing on Web, which accurately depicts the predicted EEV entry dynamics. (December 22, 1999)

Metrics

• The animation shall be free of modeling and implementation errors

• The animation should clearly illustrate the dynamics of the vehicle entry so that someone not involved with the creation of the data may understand it.

4. Government Furnished Items:

The Government will furnish access to I-DEAS, Alias/Wavefront MAYA, and non-linear finite element analysis software on Government computer(s).

The Government will furnish complete geometric descriptions of EEV concepts that are to be modeled, animated, or analyzed. For finite element analysis models, the Government will furnish a description of the vehicle's structural concept, the structural materials proposed in the concept, and the engineering properties of those materials.

For finite element analysis models, the Government will furnish a description of the vehicle or test article structural concept, and materials.

For finite element analysis models, the Government will designate the flight or test condition to be analyzed and furnish a description of the vehicle's predicted thermal and mechanical loads for that condition.

For computer animations, the Government will furnish the raw engineering data to be visualized.

5. Other information needed for performance of task.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

6. Security clearance required for performance of work:

Not applicable.

7. Period of Performance	
Planned start date: 7/12/99	Completion date: 3/15/00

8. NASA Technical Monitor: Robert A. Mitcheltree
M/S: 408A Phone: X44382

SAERS (NAS1-96013) Task Order

1. Task Order Number:: RD01 Revision: ____ Date of Revision:
   Title: Analysis of Conformal Load Bearing Antennas

Revision Record:

R1:

2. Purpose, Objective or Background of Work to be Performed:
   The objective of this task is to investigate the utility of research and Computational Electromagnetic (CEM) codes, developed under the Contract task GL-37 "Analysis of Coupling Effects of High Intensity Radiated Fields to Interior Aircraft Wiring," for conformal load bearing antenna design and performance predictions. It is important for Langley researchers to understand if these codes, with possible minor modifications, can be used as antenna design algorithms for aircraft configurations such as the Blended Wing Body (BWB) for the Futuristic Aircraft Concepts Technology/Advanced Vehicle Control System (FACT/AVCS) Program or the proposed Joined Wing RECON Program with Boeing and the Navy. It is believed that the modal/Method of Moments (MoM) analysis technique, if successful, will have computational speed up advantages over more standard Finite Element and Method of Moments modeling techniques.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements): The Contractor shall conduct the following subtasks to investigate the utility of CEM codes, developed under task GL-37 "Analysis of Coupling Effects of High Intensity Radiated Fields to Interior Aircraft Wiring," for conformal load bearing antenna design and performance predictions.

- 3.10 Review previous research and CEM codes and develop a plan for modifying/enhancing the modal/MoM code that is capable of designing and predicting the performance of conformal load bearing aperture antennas.

  Deliverable: Oral presentation describing the approach and plans for modifying the modal/MoM code.

  Metrics: (Meets): Oral presentation completed 2-weeks after task initiation (ATI) identifying previous research review conclusions and plans for modifying the modal/MoM code.

  (Exceeds): Same as "Meets" above and also includes multiple approach options.

- 3.20. Select, develop, and validate a viable approach from subtask 3.10 above for modifying the modal/MoM code.

  Deliverable: Oral presentation justifying the selection of approach for modifying the modal/MoM code and demonstration of code validity.

  Metrics: (Meets): Oral presentation completed 10-weeks ATI justifying the selection approach for modifying the modal/MoM code and demonstration of code validity by comparison with known correct results.

  (Exceeds): Same as "Meets" above except demonstration of code validity and superior computational speed (factor of 2 or greater) must be by comparison with NASA LaRC Electromagnetics Research Branch (ERB) developed FEM/MoM code results.

- 3.30 The Contractor shall prepare and deliver a final written report of the study to investigate the utility of research and CEM codes, developed under the Contract task GL-37 "Analysis of Coupling Effects of High Intensity Aircraft Wiring," for conformal load bearing antenna design and performance predictions.

Deliverable: A final written report containing the results and conclusions of Sub-Task 3.10 and 3.20.

Metrics: (Meets): Final report completed 3-months ATI, containing the results and conclusions of Sub-Tasks 3.10 and 3.20.
(Exceeds): Same as "Meet" above and also demonstrates a computational speed-up (factor of 2 or greater) when compared to ERB developed FEM/MoM code results. Demonstration of application and estimation of computational time saved for antenna design and performance predictions for airborne configurations such as the AVCS/BWB and the REVCON/Joined Wing program.

4. Government Furnished Items:

Access to Government owned computer resources and analysis tools provided by the Electromagnetics Analytical Research Group of ERB.

5. Other information needed for performance of task.
Advance Government approval for any disclosure of analytical results and the interpretation thereof shall be required.

6. Security clearance required for performance of work: None

7. Period of Performance:

Planned start date: August 21, 1999	Expected completion date: November 30, 1999

8. NASA Technical Monitor: Fred Beck
M/S: 490 Phone: 757-864-1829

SAERS (NAS1-96013) Task Order

1. Task Order Number:: RD02 Revision: ____ Date of Revision:
Title: Analysis of Slotted Waveguide Arrays and Conformal Load Bearing Antennas
Revision Record:
R1:

2. Purpose, Objective or Background of Work to be Performed:
The objective of this task is to investigate the utility of research and Computational Electromagnetic (CEM) codes, developed under the contract task RD01 "Analysis of Conformal Load Bearing Antennas" for slotted waveguide arrays and conformal load bearing antenna design and performance predictions. It is believed that a major portion of the previous effort of task RD01, with some innovative modifications, can be used as a design algorithm for on orbit inflatable slotted waveguide arrays for space applications and low profile antenna design for advanced aircraft configurations such as the Blended Wing Body (BWB) for the Futuristic Aircraft Concepts Technology/Advanced Vehicle Control System (FACT/AVCS) Program or the proposed joined wing REVCON Program with Boeing and the Navy.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements): The Contractor shall conduct the following subtasks to investigate the utility of enhancements to the CEM Modal/MoM codes developed under task RD01 " Analysis of Conformal Load Bearing Antennas", for slotted waveguide and cavity backed conformal antenna design and performance predictions.

- 3.10 The Contractor shall develop the methodology and analysis for incorporating slot excitations of simultaneous orthogonal polarizations into the Modal/MoM codes.

  Deliverable: Oral presentation describing the approach and plans for modifying the Modal/MoM code.

  Metrics: (Meets): Oral presentation completed 1-month after task initiation (ATI) describing the approach and plans for modifying the Modal/MoM codes.

  (Exceeds): Same as "Meets" above but includes multiple approach options or demonstration of validity/soundness of a particular approach and plans.

- 3.20. The Contractor shall select, develop, and validate a viable approach from subtask 3.10 above for enhancing the Modal/MoM code that incorporates slot/aperture excitations of simultaneous orthogonal polarizations for a slotted waveguide and cavity backed conformal antenna design applications.

  Deliverable: Oral presentation justifying the selection of approach for enhancing the Modal/MoM code and demonstration of the code validity..

Metrics: (Meets): Oral presentation completed 11-months ATI justifying the selection approach and unambiguous demonstration of code validity by comparison with known correct results.

(Exceeds): Same as "Meets" above including demonstration of code application and validity for variable incidence angle field penetration and shielding effectiveness for slots/apertures in a rectangular cavity.

- 3.30 The Contractor shall prepare and deliver a final written report of the study to investigate the utility of research and CEM Modal/MoM code enhancements developed under the Contract task RD-01 "Analysis of Conformal Load Bearing Antennas."

Deliverable: A final written report containing the results and conclusions of Sub-Task 3.10 and 3.20.

Metrics: (Meets): Final report completed 12-months ATI, containing the results and conclusions of Sub-Tasks 3.10 and 3.20.

(Exceeds): Some as "Meets" above including demonstration of the enhanced Modal/MoM codes to design and predict the performance for (1) a space application slotted waveguide array, (2) a low profile cavity backed antenna for an advanced aircraft application and (3) variable incidence angle field penetration through slots/apertures into a rectangular cavity.

4. Government Furnished Items:

Access to Government owned computer resources and analysis tools provided by the Electromagnetics Analytical Research Group of ERB.

5. Other information needed for performance of task.

Advance Government approval for any disclosure of analytical results and the interpretation thereof shall be required.

6. Security clearance required for performance of work: None

7. Period of Performance:	
Planned start date: November 21, 1999	Expected completion date: November 20, 2000

8. NASA Technical Monitor: Fred Beck
M/S: 490 Phone: 757-864-1829

SAERS (NAS1-96013) Task Order

1. Task Order Number: RD02 Revision: ____ Date of Revision:
   Title: Analysis of Slotted Waveguide Arrays and Conformal Load Bearing Antennas
Revision Record:
   R1:

2. Purpose, Objective or Background of Work to be Performed:
   The objective of this task is to investigate the utility of research and Computational Electromagnetic (CEM) codes, developed under the contract task RD01 "Analysis of Conformal Load Bearing Antennas" for slotted waveguide arrays and conformal load bearing antenna design and performance predictions. It is believed that a major portion of the previous effort of task RD01, with some innovative modifications, can be used as a design algorithm for on orbit inflatable slotted waveguide arrays for space applications and low profile antenna design for advanced aircraft configurations such as the Blended Wing Body (BWB) for the Futuristic Aircraft Concepts Technology/Advanced Vehicle Control System (FACT/AVCS) Program or the proposed joined wing REVCON Program with Boeing and the Navy.

3. Description of the Work to be Performed (list all Subtasks, Deliverables and/or Products, and Performance Measurements): The Contractor shall conduct the following subtasks to investigate the utility of enhancements to the CEM Modal/MoM codes developed under task RD01 " Analysis of Conformal Load Bearing Antennas", for slotted waveguide and cavity backed conformal antenna design and performance predictions.

- 3.10 The Contractor shall develop the methodology and analysis for incorporating slot excitations of simultaneous orthogonal polarizations into the Modal/MoM codes.

  Deliverable: Oral presentation describing the approach and plans for modifying the Modal/MoM code.

  Metrics: (Meets): Oral presentation completed 1-month after task initiation (ATI) describing the approach and plans for modifying the Modal/MoM codes.

  (Exceeds): Same as "Meets" above but includes multiple approach options or demonstration of validity/soundness of a particular approach and plans.

- 3.20. The Contractor shall select, develop, and validate a viable approach from subtask 3.10 above for enhancing the Modal/MoM code that incorporates slot/aperture excitations of simultaneous orthogonal polarizations for a slotted waveguide and cavity backed conformal antenna design applications.

  Deliverable: Oral presentation justifying the selection of approach for enhancing the Modal/MoM code and demonstration of the code validity..

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number:: RF01 **Revision:** ____ **Date of Revision:**

Title: RLV Sub-component Joint Test Hardware

2. Purpose, Objective or Background of Work to be Performed:

Provide engineering design, analysis, and fabrication/installation support for test hardware in support of the NRA 8-21 electron beam-cure liquid hydrogen tank sub-component joint test. The objective of the work to be performed under the present task is to design a reaction load-frame for the hydraulic actuators, load cells, etc., and a cryogenic enclosure.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

The contractor shall design and perform analysis to validate a reaction load-frame and a cryogenic enclosure for bi-axial tensile testing of a sub-component y-joint at -423 degrees Fahrenheit. The test hardware shall be designed to accept and test a y-joint sub-component test article as detailed in the attached test plan. The cryogenic enclosure shall be designed to be capable of containing enough liquid Helium to submerge the test article within the enclosure. The enclosure shall be designed with insulation to prevent (a) injury to personnel in close proximity to the external surfaces and (b) excessive loss of cryogen due to evaporation. The chamber walls thermal insulation core shall be cryogenic rated and non-moisture absorbent. Wall insulation core thermal conductivity shall be less than .1665 BTU/ft^2 @ -256°F and less than .066 BTU/ft^2 @ 284°F at the thinnest total wall thickness. Total wall thickness shall not exceed more than six (6) inches. NASA-LaRC will review and give final approval for each design concept. Engineering drawings and parts lists of the test hardware shall be provided in paper and electronic copies for each component as well as the assembled hardware.–Analyses of test hardware shall be given in a paper report listing per item margins of safety and other applicable data. The engineering design documents shall be prepared with the Pro-Engineer CAD source code ~~(?)~~ provided by the Government. Paper and electronic copies of engineering and assembly drawings representing `as-built' condition of delivered hardware shall also be deliverables.

The contractor shall be responsible for supporting design-related issues during fabrication and installation of the hardware. Bi-monthly status meetings shall be scheduled and held with the Technical Monitor and the test manager to provide design updates and resolve engineering development issues within the scope of this task.

3.1. PERFORMANCE:

Performance measurement may vary from "Minimally Acceptable (MA) to Substantially

Exceeds (SE)" ratings based on the ability to meet the performance metric targets for deliverables described on section 3.2 and the following criteria:

3.1.1. Ability to meet delivery schedules for all mechanism assemblies. Delivery within two weeks of stated milestones will constitute "MA" and delivery two weeks ahead of schedule will constitute "SE" rating. The contractor will be evaluated for ability to meet schedules based on conditions solely under their control. Delivery schedule deficiencies caused by items under US Government control or general industry anomaly event will not be counted against the contractor performance.

3.1.2. Manufacturability of designed components per contractor-generated engineering detail drawings will be determined by… and will be MA if … and SE if….

3.1.3. Ability of final release engineering detailed drawings to describe accurately 'as-built-condition' of delivered components and assemblies. 40 hours of engineering drafting required to make final release drawing in full compliance with "as-built-condition" shall constitute "MA" and 6 hours of required changes shall constitute "SE" rating.

3.2. DELIVERABLES:

The listed items shall constitute the specific deliverables for this task.

DELIVERABLE	DATE
3.2.1. *Design and develop reaction load-frame*	11/30/99

The contractor is to complete the design, development, and analysis of a reaction load-frame conducive to the successful implementation of the RLV Sub-component Joint test implementation plan provided by the Technical Monitor.

PERFORMANCE METRIC: The hardware shall be designed to successfully accommodate test equipment and the Y-joint test specimen interfaces to provide directional loading conditions within 3% of the requirements set by the test plan.

The reaction load-frame shall be designed to withstand 100% of load conditions at the specified test temperature range without incurring structural damage or developing mechanically unstable behavior requiring stoppage of ongoing test or resulting in loss of data.

3.2.2. *Design and develop cryogenic enclosure* 12/15/99

The contractor is to complete the design, development, and analysis of a cryogenic enclosure to achieve a test specimen temperature of –423°F during the application of the bi-axial load as per test plan specification.

PERFORMANCE METRIC: The hardware shall be designed to accommodate test equipment and the Y-joint test specimen interfaces to maintain test specimen temperature within 15% of specified test requirements. The test enclosure shall be designed to maintain refrigerant consumption within 15% of analysis estimates.

The cryogenic enclosure shall be designed to meet all OSHA requirements and LaRC requirements for transport and handling of cryogenics and operation of test hardware while in cryogenic operation mode.

3.2.3. *Coordinate the fabrication, assembly and integration of items 3.2.1 & 3.2.2.* 2/28/2000

The contractor shall provide a fabrication and integration plan. The contractor shall implement the development plan and complete all milestones within two weeks of final product delivery.

PERFORMANCE METRIC: The hardware will be considered successfully integrated into the final test configuration when measured angles for line loads are confirmed and engineering design and analysis of 'as built' delivered hardware is delivered to the Technical Monitor.

4. Government Furnished Items: Government software will be furnished for the design, fabrication and testing of the deliverable items.

5. Other information needed for performance of task.

6. Security clearance required for performance of work: None.

7. Period of Performance	
Planned start date: 07/01/1999	Expected completion date: 6/30/2000

8. NASA Technical Monitor: .M/S: William M. Berrios Phone: 757-864-7183

SAERS (NAS1-96013) Task Order

1. Task Order Number and Title: Number: RF03 Revision: Date of Revision: Title: Pyrovalve Investigation	

2. Purpose, Objective or Background of Work to be Performed:

Purpose: Conduct a functional evaluation of a pyrotechnically actuated valve.

Objective: Provide functional performance data to resolve a failure, determine functional margin and predict functional reliability of this pyrovalve design.

Background: Pyrovalves have been developed in the past without a clear understanding of the effects of functional parameters. When a failure occurred with this design, little information was available for redesign and to verify functional margin or predict reliability.

3. Tasks, Deliverables and or Products, and performance measurements:

The Contractor shall conduct functional tests on pyrovalve components in the following subtasks:

The contractor shall determine the energy and forces required in functioning the pyrovalve by conducting weight drop tests on four actuator assemblies.

Deliverables: "Energy required" levels and force versus time performance data.

Metrics: Minimally acceptable – Minimum "energy required" data not precisely determined. Three of four force/time data plots collected by November 30, 1999

Exceeds – Collection of all data with delivery prior to November 20, 1999.

3.1. The Contractor shall duplicate the "energy required" force/time history with aluminum honeycomb by conducting weight drop tests over a range of levels encompassing those in subtask 1.

Deliverables: Honeycomb strength and force/time weight drop test data.

Metrics: Minimally acceptable – Duplicating force/time histories only at levels the same as subtask 1 by December 22, 1999.

Substantially exceeds – Duplicating force/time histories over a wide range of energy inputs by December 22, 1999.

3.2. The contractor shall conduct functional tests of several booster-charge assembly configurations against the honeycomb calibrated in subtask 2.

Deliverables: Honeycomb crush distance-measured energy delivery from the booster charge configurations.

Metrics: Minimally acceptable – All tests completed by March 31, 2000.

Substantially exceeds – All tests completed by February 29, 2000.

4. Government Furnished Items:

The Pyrotechnic Test Facility, which includes assembly and test cells, all performance monitoring equipment, data acquisition systems, computers, etc. Also supplied will be all pyrotechnic materials, honeycomb and pyrovalve components necessary to accomplish the required tests.

5. Other information needed for performance of task.
NONE

6. Security clearance required for performance of work: Unclassified

7. Period of Performance.

Planned start date: October 1, 1999

Expected completion date: March 30, 2000

8. NASA Technical Monitor: Laurence J. Bement
M/S: 456 Phone: 757-864- 7084

1. Task Order Number and Title: Number: RF04 Revision: Date of Revision:
   Title: JAVELIN Igniter Investigation

2. Purpose, Objective or Background of Work to be Performed:

   Purpose: Conduct a functional evaluation of the first stage igniter of the JAVELIN missile.

   Objective: Provide functional performance data to determine the most likely cause of an ignition delay.

   Background: The JAVELIN igniter experienced an ignition delay (hangfire) during development. This hangfire resulted in a significant redesign of the flight sensors and computer. A physical change to the igniter to eliminate the potential of hangfires would enhance the reliability of the missile

3. Tasks, Deliverables and or Products, and performance measurements:

   The Contractor shall conduct functional tests on JAVELIN igniter components in the following subtasks:

   3.1. The Contractor shall conduct ignitability output tests on two types of initiators (at least 5 tests per type) to determine relative performance.

   Deliverables: Electrical initiation (current versus function time) and ignitability data.

   Metrics: Minimally acceptable – Data collected by October12, 1999

   Exceeds – Collection of all data with delivery prior to October 8, 1999.

   3.2. The contractor shall conduct a series of 5 ignitability tests on the flight configuration of the igniter assembly.

   Deliverables: Ignitability data.

   Metrics: Minimally acceptable – Collection of data on only 4 tests by October15, 1999.

   Substantially exceeds – Collection of all data by October 12, 1999.

   3.3. The contractor shall conduct ignitability tests on 2 improperly-assembled igniters (each with only one type of igniter pellets.

   Deliverables: Ignitability data.

   Metrics: Minimally acceptable – Tests completed by October 18, 1999.

Substantially exceeds – All tests completed by October 15, 1999.

3.4. The contractor shall conduct a series of 6 ignitability tests with the least-sensitive pellet alignment and assembly tape configurations that inhibit ignition.

Deliverables: Ignitability data.

Metrics: Minimally acceptable – Tests completed by October 22, 1999.

Substantially exceeds – Tests completed by October 20, 1999.

3.5. The contractor shall conduct a series of 6 tests with pellet gap and assembly tape configurations that inhibit ignition.

Deliverables: Ignitability data.

Metrics: Minimally acceptable – Tests completed by October 26 1999.

Substantially exceeds – Tests completed by October 22, 1999.

3.6. The contractor shall conduct a series of up to 5 igniter assemblies that exhibit the greatest delays.

Deliverables: Ignitability data.

Metrics: Minimally acceptable – Tests completed by October 29, 1999.

Substantially exceeds – Tests completed by October 26, 1999.

4. Government Furnished Items:

The Pyrotechnic Test Facility, which includes assembly and test cells, all performance monitoring equipment, data acquisition systems, computers, etc. Also supplied will be all pyrotechnic materials and igniter components necessary to accomplish the required tests.

5. Other information needed for performance of task.

NONE

6. Security clearance required for performance of work: Unclassified

7. Period of Performance.

Planned start date: October 1, 1999

Expected completion date: November 10, 1999

8. NASA Technical Monitor: Laurence J. Bement
M/S: 456 Phone: 757-864- 7084

1. Task Order Number:: RF05 Revision: __ Date of Revision:
Title: **DACOM, DLH and NDIR Support for the SOLVE Expedition**

2. Purpose, Objective or Background of Work to be Performed:

The SAGE III Ozone Loss and Validation Experiment (SOLVE) is a measurement campaign designed to examine the processes controlling ozone levels at mid- to high latitudes. Measurements will be made in the Arctic high-latitude region in winter using the NASA DC-8 and ER-2 aircraft, as well as balloon platforms and ground-based instruments. The mission will also acquire correlative data needed to validate the Stratospheric Aerosol and Gas Experiment (SAGE) III satellite measurements that will be used to quantitatively assess high-latitude ozone loss. SOLVE is co-sponsored by the Upper Atmosphere Research Program (UARP), Atmospheric Effects of Aviation Project (AEAP), Atmospheric Chemistry Modeling and Analysis Program (ACMAP), and Earth Observing System (EOS) of NASA's Earth Science Enterprise (ESE) as part of the validation program for the SAGE III instrument.

The Sensor Systems Branch of the Systems Engineering Competency has an important role in SOLVE by providing measurements of key gas species on the DC-8 aircraft. In situ measurements of CO, CH_4 and N_2O will be provided by the Differential Absorption CO Measurement (DACOM), $H_2O(v)$ measurements will be provided by the Diode Laser Hygrometer (DLH), and CO2 measurements by a non-dispersive infrared (NDIR) sensor. The DACOM, DLH and NDIR instrument systems are scheduled to be in the field at the DC-8 integration site (NASA Dryden) or based from an operations site at Kiruna, Sweden during three time periods between October 17, 1999 and March , 2000. Personnel are needed to support SOLVE during preparation of the instruments at Langley, shipment of the instruments to Dryden, aircraft integration, preflight testing, in-flight operation, maintenance and post flight data handling.

DACOM has the following subsystems: air sampling, calibration, optics, cryogenics, electronics (control and detection) and data acquisition. The DLH includes the following subsystems: laser transceiver, electronics (control and detection) and data acquisition. The NDIR shares air sampling, calibration, and data acquisition with DACOM but has a separate optical subsystem.

This task covers the preparation of DACOM, DLH and NDIR; their shipment their shipment to Dryden; their integration on the DC-8; preflight tests of the instruments; operation and maintenance of the instruments during the SOLVE deployment; return of the instruments and supporting hardware/software to Langley; consolidation of the equipment into the laboratory; and documentation of the hardware, software and procedures associated with the instruments necessary for ISO 9000 compliance. SAERS task responsibilities during the aircraft integration and operations of DACOM, DLH and NDIR are to ensure operation of the aforementioned subsystems except for the optical subsystems. The NASA PI will be responsible for the optical subsystems in each instrument. The PI will also interpret mission objectives and requirements of the SOLVE project office and will determine measurement strategy.

Description of the Work to be Performed

Subtask 1.0: Prepare and check out DACOM, DLH and NDIR according to procedures developed during tasks GL 12 and 25.

Deliverables

1. Log entries summarizing tests of DACOM,DLH and NDIR (according to above procedures), including anomalous behavior and / or failures.

2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

3. DACOM, DLH and NDIR test data files and/or strip charts generated during check out tests.

4. List of instrument calibration status.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM,DLH and NDIR verified operational via Government approved procedures barring optics failure.
2. Delivery of DACOM, DLH and NDIR data files and/or strip charts to task monitor within 24 hours of each test.

Exceeds:

1. DACOM, DLH and NDIR are ready three days prior to scheduled ship date, barring optics failure.

Subtask 2.0: Shipment of DACOM, DLH and NDIR to the DC-8 integration site. The Contractor shall arrange for shipment of DACOM, DLH and NDIR to the integration site.

Deliverables

1. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DACOM, DLH and NDIR packed to meet scheduled ship date of October 14, 1999.
2. Shipping list complete and up-to-date on day of shipment.

Exceeds:

1. Shipping list complete and up-to-date at least one day prior to shipment.

Subtask 3.0: Integrate and preflight test DACOM, DLH and NDIR on the NASA DC-8. This requires the Contractor to unpack, assemble and install DACOM and DLH on the NASA DC-8. The Contractor shall verify the DACOM, DLH and NDIR operation using the procedures developed under previous SAERS tasks GL12 and GL25.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM, DLH and NDIR subsystems (according to above procedures), including anomalous behavior and / or failures.

2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

3. DACOM, DLH and NDIR test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM, DLH and NDIR are ready, i.e. verified operational via Government-approved procedures to meet scheduled science flights barring optics failure
2. Delivery of DACOM, DLH and NDIR data files to PI within 24 hours of each test.

Exceeds:

1. DACOM, DLH and NDIR are ready one week prior to first scheduled science flight barring optics failure.

Subtask 4.0: Operate, according to previously developed procedures, and maintain DACOM, DLH and NDIR subsystems during the SOLVE mission, i.e. test and science flights.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM, DLH and NDIR instruments (according to above procedures) prior to each flight, including anomalous behavior and / or failures.

2. Log entries summarizing procedural operation and performance of DACOM, DLH and NDIR subsystems (according to above procedures) during each flight, including anomalous behavior and / or failures.

3. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

4. DACOM, DLH and NDIR test data files and/or stripcharts.

Performance Standards and Evaluation Criteria

Meets:

1. CO data for each flight barring laser, optics or detector failures.
2. CH_4 data for at least 50% of the flights barring laser, optics or detector failures.
3. N_2O data for at least 30% of the flights barring laser, optics or detector failures.
4. $H_2O(v)$ data for at least 50% of the flights barring laser, optics or detector failures.

5. CO_2 data for at least 70% of the flights barring optical subsystem failure.
6. Delivery of DACOM and DLH data files to PI within 24 hours of each flight.

Exceeds:

1. CH_4 data for at least 75% of the flights barring laser, optics or detector failures.
2. N_2O data for at least 50% of the flights barring laser, optics or detector failures.
3. $H_2O(v)$ data for at least 75% of the flights barring laser, optics or detector failures.
4. CO_2 data for at least 90% of the flights barring optical subsystem failure.

Subtask 5.0: Coordinate off-loading of DACOM, DLH and NDIR with DC-8 support personnel and shipping of equipment to Langley with SOLVE project personnel.

Deliverables

1. Log entries of handling or work performed on subsystems.
2. Provide PI with shipping list at time of shipment.

Performance Standards and Evaluation Criteria

Meets:

1. Equipment packed and shipping list complete and up-to-date on day of shipment.

Exceeds:

2. Equipment packed and shipping list complete and up-to-date two days prior to shipment.

Subtask 6.0: After return from deployment, unpack DACOM, DLH and NDIR supporting equipment, reorganize laboratory, conduct equipment inventory, and send instruments in need of calibration to LaRC Calibration Laboratory.

Deliverables

1. Log entries of handling or work performed on subsystems.
2. Results of equipment inventory.
3. List of instrument calibration status

Performance Standards and Evaluation Criteria

Meets:

1. Equipment unpacked and laboratory reorganized within two months of receipt at LaRC.

Exceeds:

1. Equipment unpacked and laboratory reorganized within one month of receipt at LaRC.

General Performance Standards and Evaluation Criteria (apply to all subtasks)

Meets:

Logbooks are maintained complete and up-to-date within 48 hours.

Exceeds:

Contractor suggested improvements are accepted (government reviewed and approved) to operating procedures which decrease the turn-around time of the instruments between flights or significantly reduce the over-all cost of preparation and deployment. These improvements shall in no way compromise the health, safety, or performance of the instruments.

3. Government Furnished Items:

1. The DACOM, DLH and NDIR instruments as well as supporting instrumentation, flight racks, shipping containers, hardware, software, and manuals. Access will be available to standard tools and lab test equipment (e.g. meters and 'scopes).
2. Laboratory facilities for instrument checkout are available in rooms 123 and 124 of Building 1202.
3. Government to ship equipment to Dryden from LaRC and return.
4. Government to furnish existing documentation, including notebooks, AutoCAD schematics, etc.

4. Other information needed for performance of task.

Travel: Deployment schedule calendars for the DC-8 operations are very changeable. They can be accessed on the web at the SOLVE site URL:
http://cloud1.arc.nasa.gov/solve/
There will be 3 operators with DACOM, DLH and NDIR during all local flights from Kiruna and two operators during transit flights between Dryden and Kiruna. (Note: the PI or his

designee will count as one operator of these instruments) Typically, more personnel are used at the initial stages when the equipment is configured for the aircraft and characterized during the "shakedown flights" at the beginning of the deployment.

Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC

5. Security clearance required for performance of work:

None required

6. Period of Performance:	
Planned start date: September 13, 1999	Completion date: June 30, 2000

7. NASA Technical Monitor: Glen W. Sachse
M/S: 472 Phone: 757-864-1566

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number: RF06 **Revision:** ____ **Date of Revision:**

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

2. Purpose, Objective or Background of Work to be Performed:

A Boeing 757-200 aircraft obtained by NASA in 1994 is now serving as a "flying laboratory" for aeronautical research. The aircraft has been modified extensively for a broad range of flight research programs in the next 20 years to benefit the U.S. aviation industry and commercial airline customers. Called the Airborne Research Integrated Experiments System (ARIES), the aircraft is being used to conduct research to increase aircraft safety, operating efficiency and compatibility with future air traffic control systems. It is a vital research tool in support of the agency's Aviation Safety and Aviation Systems capacity programs.

The Flight Instrumentation Branch (FIB) at NASA Langley Research Center is responsible for acquiring and recording the data for over 1000 parameters on the 757 ARIES project utilizing a Data Acquisition System (DAS) developed by FIB.

The overall objective of this task is to operate, maintain and upgrade the Data Acquisition System (DAS) and validate data acquired by the DAS.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Subtask 1

1. The Contractor shall operate the government provided Data Acquisition System (DAS) on the ARIES 757. This will include providing an operator for the DAS during all system and environmental ground test and all research flights on the ARIES 757. The Contractor shall also operate the DAS for research flights during deployments at remote sites. The Contractor shall verify the DAS is performing as requested before each research flight

2. The Contractor shall maintain the DAS in an operational mode. This will include analysis and repair of any anomalies that will prevent the DAS from acquiring data specified in the current Government provided Data Recording List (Document TRF-023). The Contractor shall notify the Technical Monitor (TM) of any DAS failures or anomalies. The Contractor shall document all failures and anomalies, determine cause, and recommend corrective action. The Contractor shall be responsible for maintaining all DAS drawings and hardware. Drawings and hardware shall be under configuration control as specified in the Transport research Facilities (TRF) Configuration Control Documents. The Contractor shall maintain configuration control management for all of the DAS flight spares equipment.

3. The Contractor shall modify, integrate, qualify, and validate the DAS as required to support changes/upgrades for scheduled research flights to meet FY00 and FY01 mission goals. The Contractor shall present integration designs, including a list of required Government Furnished Equipment (GFE), test plans and schedule for the upgrades to the TM for approval. Upon TM approval (or after 10 working days if the approval or disapproval has not been received), the Contractor shall generate configuration change request, data recording list changes, design drawings, experimental work orders, database configuration changes, DAS SCRAMNet data block software configuration changes, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.

4. The Contractor shall provide Pulse Coded Modulated (PCM) digital data and IRIG-B time to the Data Display and Processing System (DPDS).

5. For each flight test series, the Contractor shall develop a list of mission critical DAS parameters. This list shall be referred to as the "Flight Critical Parameter List" and shall be submitted to the TM for approval before each flight test series. The parameters in the Flight Critical Parameter List shall be verified within 18 working hours after each research flight. Other DAS parameters specified in the current version of the Government provided Data Recording List (TRF-023), shall be verified as time permits not to exceed 10 working days after each research flight.

6. Using the Data Recording List, provide a measurement calibration database in a standard NASA ground station data processing format for the NASA Aerospace Data Acquisition and Processing Station (ADAPS) use. This database shall also be supplied to the DPDS database manager. The Contractor shall provide a database for use by the DAS setup computer and the DAS quick-look computer to display data in an appropriate format.

7. The Contractor shall perform calibrations on the aircraft flight instruments which are part of the DAS and other ground support equipment (i.e. scopes, meters, function generators) at less than or equal to 12 months intervals. Calibration interval for onboard flight instruments may be extended for up to two months upon written approval of the B757 Project Manager when critical flight schedules conflict with accomplishing these calibrations.

8. The Contractor shall be compliant with NASA-LaRC ISO 9001 requirements as applicable to this task.

Note: As part of this subtask, the Contractor should continuously evaluate possible equipment replacement, upgrades and/or process changes that could potentially enhance or improve operations.

Deliverables:

1. Recorded data media delivered to NASA Aerospace Data Acquisition and Processing

Station (ADAPS).
2. Test plans and procedures.
3. A list of all Flight Spares under configuration management.
4. Operation/Instruction Manuel for DAS
5. Flight notes for each research flight available to ADAPS and the TM.
6. Configuration change request, data recording list changes, design drawings, experimental work orders, database configuration changes, DAS SCRAMNet data block software configuration changes, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.
7. Database for ADAPS, the DAS setup computer and the DAS quick look computer.
8. Data Recording List accurately reflecting the DAS recorded data.
9. Monthly written status reports.
10. Calibrated sensors in response to the Data Recording list.
11. A short abbreviated report following each validation test and each research flight.
12. Notification, in writing, of any failures or anomalies.
13. Flight Critical Parameter List for the current flight series.
14. Copies of any software or code written by the Contractor to support the DAS.

Performance Standards and Evaluation Criteria

Meets:

1. Database delivered to ADAPS five working days before the Instrumentation Check Flight (ICF) of any flight test series.
2. Flight Critical Parameter List delivered to TM five working days before the flight test series.
3. Parameters described in the Flight Critical Parameter List have been verified though DAS and ADAPS 1 day before the ICF of a requested flight test series.
4. An operational DAS, capable of recording parameters described in the Flight Critical Parameter List, 1 day before the ICF of a requested flight test series.
5. Recorded data media delivered to ADAPS two working hours following any test or research flight conducted out of Langley Research Center.
6. Data, described in the Flight Critical Parameter List and acquired by DAS during as research flight, verified within 18 working hours following each research flight. Any anomalies with the data shall be immediately reported to the TM.
7. A short abbreviated report delivered to the TM, within five working days, after each validation test or research flight estimating the quantity of data acquired and documenting any events that affected DAS during the flight or test.
8. All procedures, drawing and hardware are under configuration control, as determined by review and random checks by the TM against actual hardware, procedures and drawings.
9. DAS sensors, signal conditioning and other ground support equipment are calibrated at less than or equal to 12 months intervals.
10. All drawings conform to Mil STD 100 and are clear, accurate, and comprehensive, as determined by review and random checks by the TM against actual hardware.

Exceeds:

1. Database delivered to ADAPS ten working days before the Instrumentation Check Flight

(ICF) of any flight test series.

2. Flight Critical Parameter List delivered to TM ten working days before flight test series.
3. Parameters described in the Flight Critical Parameter List have been verified though DAS and ADAPS five days before the ICF of a requested flight series.
4. An operational DAS, capable of recording parameters described in the Flight Critical Parameter List, five days before the ICF of a requested flight test series.
5. Recorded data media delivered to ADAPS one working hour following any test or research flight.
6. Data, described in the Flight Critical Parameter List and acquired by DAS during as research flight, verified within 12 working hours following each research flight. Any anomalies with the data shall be immediately reported to the TM.
7. A short abbreviated report, within three working days, after each validation test or research flight estimating the quantity of data acquired and documenting any events that affected DAS during the flight or test.

4. Government Furnished Items

Access to the following

1. Personal Ground Computers for generation of schematics and documentation.
2. Use of NASA ground station is available for post flight data processing on a scheduled basis.
3. Standard laboratory support equipment (power supplies, multi-meters, oscilloscopes, etc.)

Hardware:

1. AATIS data system with documentation
2. AATIS compatible recording media
3. Assorted collection of Sensors
4. Sensor calibration data
5. Access to Experimental Aircraft Systems Integration Laboratory (EASILY) for testing.
6. SCRAMNet Laboratory Simulator to test Subsystems.
7. PCM Data Systems, Signal Conditioning Units, Signal Condition Modules
8. Smart Decommutator/Display Systems
9. Recorders: Magnetic Tape, Optical Disk, Strip Charts
10. Time Code Generators / Readers / Receivers
11. Power Subsystems; Control Units, and Power Supplies
12. PC based "quick-look" system for DAS validation, post-test and post-flight quick-look.

Documentation:

1. Data Recording List (Document TRF-023)
2. NASA Transport Research Facilities Requirements Document
3. DAS/757 Schedule
4. AATIS system setup documentation
5. Data System Specifications/ Operation / Maintenance / Troubleshooting information.
6. Calibration database information / software.
7. Smart Decommutator / Real-time Display System Applications Software Manual.
8. TRUE TIME Manual

9. Assorted ARINC 429 Bus Manuals
10. List of equipment that Contractor may elect to have NASA service due to availability of expertise and facilities already existing at NASA.

5. Other information needed for performance of task.

1. Major system buildup, installation and validation will occur at Langley Research Center (LaRC) Aircraft Hanger B1244.
2. There are times when A/C access is restricted, such as C-Checks, The 757 Sim-to-Flight Master schedule can/should be monitored to determine availability.
3. NASA Quality Assurance Inspection required for all flight data systems/subsystems/sensors, etc., which are installed on the B757 aircraft. No exceptions are allowed in flight hardware inspection. Inspection must be scheduled.
4. Soldering shall be performed to NASA Standard NASA-STD 8739.3.
5. Crimping, interconnecting cables harness, and wring shall be performed to NASA Standard NASA-STD-8739.4.
6. Electro Static Discharge procedures stated in n NASA-STD-8739.7 shall be followed.
7. Wiring, crimping, installation, etc., of aircraft hardware must be performed by certified personnel.
8. All instrumentation must meet NASA Flight requirements as per memorandum dated June 5, 1996 "Test Procedures and Test Conditions for the environmental Testing of Airborne Research Equipment".
9. Component environmental testing will occur at NASA LaRC unless vendor performed.
10. Repair of Government furnished items may be scheduled through NASA funded equipment repair facilities.
11. Contractor shall perform calibration on supporting instruments, such as meters, oscilloscopes, hot-bench instruments, etc., at less than or equal to 12-month intervals. Calibration interval for onboard flight instruments may be extended for up to 2 months upon written approval of B757 Project Manager when critical flight schedules conflict with accomplishing these calibrations. Calibration of equipment shall comply with NASA Policy Directive NPD 8730.1 and may be scheduled through NASA funded calibration facilities traceable to National Calibration Standards.
12. Contractor may use NASA environmental (Environmental Test Facility, bldg. 1250) and EMI test facilities to qualify flight hardware.
13. Contractor may utilize NASA furnished parts and components.
14. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards.
15. Contractor may utilize NASA furnished fabrication facilities/resources to complete fabrication, packaging and assembly of flight hardware, including mechanical hardware and wiring.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the Contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

6. Security clearance required for performance of work: None	
7. Period of Performance.	
Planned start date: December 1, 1999	Completion date: November 30, 2000
8. NASA Technical Monitor: F. Keith Harris M/S: 257 Phone: 804-864-3824	

SAERS (NAS1-96013) Task Order Page 1

1. Task Order Number: RF07 **Revision:** ____ **Date of Revision:**

Title: Aerospace Data Acquisition and Processing Station (ADAPS) support for the B-757 Airborne Research Integrated Experiments System (ARIES) DAS data

2. Purpose, Objective or Background of Work to be Performed:

A Boeing 757-200 aircraft obtained by NASA in 1994 is now serving as a "flying laboratory" for aeronautical research. The aircraft has been modified extensively for a broad range of flight research programs in the next 20 years to benefit the U.S. aviation industry and commercial airline customers. Called ARIES, or Airborne Research Integrated Experiments System, the aircraft is being used to conduct research to increase aircraft safety, operating efficiency and compatibility with future air traffic control systems. It is a vital research tool in support of the agency's Aviation Safety and Aviation Systems capacity programs.

The Flight Instrumentation Branch (FIB) at NASA Langley Research Center is responsible for acquiring, recording and processing the data for over 1000 parameters on the 757 ARIES project utilizing a Data Acquisition System (DAS) developed by FIB and the Aerospace Data Acquisition and Processing Station (ADAPS). Data recorded on research flights can be up to eight hours in length.

The overall objective of this task is to process the data recorded by DAS on the 757 in ADAPS and maintain the data processing equipment in ADAPS.

3. Description of the Work to be Performed (list all Tasks, Deliverables and/or Products, and Performance Measurements):

Subtask 1

1. The Contractor shall process the 757 ARIES DAS data from research flights and ground tests using the Aerospace Data Acquisition and Processing Station (ADAPS) as required for data recorded during scheduled research flight tests. Standard data products produced by the Contractor ~~in~~ ADAPS shall include run summaries, postscript files, data plots, and Excel compatible files of processed DAS data. For each flight test series on the 757, NASA will deliver a list of mission critical DAS parameters to the Contractor. This list shall be referred to as the "Flight Critical Parameter List". The parameters specified in the Flight Critical Parameter List shall be processed within 12 working hours after media with recorded DAS data is delivered to ADAPS. Run summaries of flight data from the Flight Critical Parameter List shall be provided to the DAS Instrumentation Engineer, for data verification, within 12 working hours after media with recorded DAS data is delivered to ADAPS. The Technical Monitor (TM) shall be notified immediately of any ADAPS failures that would delay the processing and delivery of the data in the Flight Critical Parameter List. DAS parameters that are not specified in the Flight Critical Parameter List but are specified in the current version of the Government provided Data Recording List (TRF-023), shall be processed as time permits, not to exceed 8 working days, after media with recorded DAS data is delivered to ADAPS. NASA will also

provide ADAPS a database to process the DAS data. The Contractor shall verify the database is compatible with the ADAPS processing system. The Contractor shall archive all processed 757 data, produce the experimenter's requested data products for NASA's approval, and release the approved products to the experimenter.

2. The Contractor shall maintain the ADAPS data processing and output processing systems. The Contractor may schedule ADAPS equipment repair and calibration through NASA funded services and facilities. The Contractor shall make backups of all ADAPS system hard drives to minimize system down time in the event of a system failure.

3. The Contractor shall be compliant with NASA-LaRC ISO 9001 requirements as applicable to this task.

Note: As part of this subtask, the Contractor should continuously evaluate possible equipment replacement, upgrades and/or process changes that could potentially enhance or improve operations.

Deliverables

1. Verified ADAPS compatible database.
2. Archived 757 processed data.
3. Run summaries, postscript files, and Excel compatible files of processed DAS data
4. Monthly written status reports.
5. Copies of any software or code written by the Contractor to support processing of the 757 data.
6. Notification of any ADAPS failures that would delay the processing and delivery of the DAS data specified in the Flight Critical Parameter List.
7. ADAPS data logs identifying dates, times, flight number, and processed database.
8. ADAPS maintenance logbook.
9. Backups of ADAPS system hard drives.

Performance Standards and Evaluation Criteria

Meets:

1. Parameters specified in the Flight Critical Parameter List are processed within 12 working hours after media with recorded DAS data is delivered to ADAPS.
2. Run summaries of flight data specified in the Flight Critical Parameter List provided to the to the DAS Instrumentation Engineer within 12 working hours after media with recorded DAS data is delivered to ADAPS.
3. DAS parameters not specified in the Flight Critical Parameter List but are specified in the current version of the Government provided Data Recording List (TRF-023), shall be processed as time permits not to exceed 8 working days after media with recorded DAS data is delivered to ADAPS.
4. Standard data products (run summaries, postscript files and Excel compatible files) of NASA approved DAS data are provided to the experimenter within 4 hours after

receiving request.

5. Monthly written status reports.
6. Log Books are maintained complete, as determined by task monitor review, and updated weekly.
7. Backups of ADAPS system hard drives are made following any configuration changes to the system or at 1-month intervals, which ever comes first.
8. Notification of ADAPS failures within 8 working hours.

Exceeds:

1. Parameters specified in the Flight Critical Parameter List are processed within 8 working hours after media with recorded DAS data is delivered to ADAPS.
2. Run summaries of flight data specified in the Flight Critical Parameter List are provided to the to the DAS Instrumentation Engineer within 8 working hours after media with recorded DAS data is delivered to ADAPS.
3. DAS parameters not specified in the Flight Critical Parameter List but are specified in the current version of the Government provided Data Recording List (TRF-023), shall be processed as time permits not to exceed 5 working days after media with recorded DAS data is delivered to ADAPS.
4. Standard data products (run summaries, postscript files and Excel compatible files) of NASA approved DAS data are provided to the experimenter within 2 hours after receiving request.
5. Contractor suggested improvements are accepted (government reviewed and approved) to operating procedures or equipment to decreased turnaround time of processed data.

4. Government Furnished Items

1. DAS data on removable storage media.
2. Flight Critical Parameter List
3. DAS database to process ADAPS data
4. Data Recording List (Document TRF-023)
5. DAS/757 Schedule
6. ADAPS Facility
7. Standard laboratory support equipment (power supplies, multi-meters, oscilloscopes, etc.)
8. Data Simulators
9. Time Code Receivers/Generators
10. Optical recorders, Magnetic tape recorders (DLTs), CD recorders
11. Network Systems
12. Archiving media
13. Printers and plotters
14. Teledyne Controls Real-time Multi-Processing System (RMPS) and flight-test data analysis system (FTDAS) software.
15. PC File and Microsoft access database software.

5. Other information needed for performance of task.

1. Data plots may/should be generated using standard proven software.
2. Run summaries may/should be generated using standard proven software.
3. Excel compatible files may/should be generated using standard proven software.

Year 2000 Compliance: Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the Contractor shall provide documentation, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.

6. Security clearance required for performance of work:

None

8. NASA Technical Monitor: F. Keith Harris
M/S: 257 Phone: 757-864-3824

7. Period of Performance.	
Planned start date: December 1, 1999	Completion date: November 30, 2000