Task Order No./SOW Filename Key	Title	TM's OrgCode	Issued	Completion
01A3	AvSP Schedules Management and Reporting	E1	1/10/2005	12/31/2006
01A4	ETDPO Program and Project Planning and Control Support	A4	4/18/2006	12/31/2006
01AH	Independent Review of Agency Programs	AH	12/29/2000	12/31/2006
01ALA	NESC Support	C101	3/2/2004	12/31/2006
01D1B	FRSD Schedules Management and Reporting	D102	2/3/2005	12/31/2006
01D2A	Digital Signal Processing Software for On-board Prognostics & Failure Mitigation	D201	10/29/2004	12/31/2006
01D2B	CEV-AFT Support	D202	4/27/2006	12/31/2006
01D3	Technical Exhibit Management	D3	9/23/2004	9/30/2006
01D3D	Doppler Global Velocimetry (DGV)	D304	12/21/2004	12/31/2006
01E1A	Programs/Projects Schedules Management and Reporting for ARD	E101	8/16/2005	9/30/2006
01E2A	Algorithm Development for the Systems Analysis Integrated Discipline Team	E501	2/1/2005	2/28/2006
01G1A	Exploration and Flight Projects Directorate (EFPD	E501	8/16/2005	12/31/2006
01H1	Creativity and Innovative Research Support	H1	3/3/2006	12/31/2006
01OA	Implementation Support for SBIR and STTR Programs	H1	5/30/2001	5/6/2002
01OC	X-43A Alternative Booster Study Team Support	E5	11/27/2001	1/31/2002
01OCB	Technology to Support Scramjet-powered Flowpath Development	D306	12/29/2000	12/31/2006
01OCE	NGLT Systems Analysis Project	E501	5/14/2003	11/30/2004
01OJ	Programs/Projects Schedules Management and Reporting	E501	12/29/2000	5/31/2006
01RAC	Advanced Personal Air Vehicle Concep Development and Analysis	E403	4/12/2001	1/31/2002
01RBF	Aircraft Noise Subjective Research Support	D321	12/29/2000	12/31/2006
01RCA	Characterization of Polymers	D307	12/29/2000	9/30/2006
01RDH	Software Development and Integration for Sensors and Sensor Product Development Under Aviation Safety Program	D319	12/29/2000	9/30/2006

01RFH	PICASSCO-CENA, Electro-optics Trade Studies and Design Reviews	D203	12/29/2000	1/15/2003
01RGO	Cryogenic Tunnel Performance Analysis and Operational Enhancements	D401B	9/3/2004	9/1/2006
01SA	OCFO Cost Analysis	B6	4/15/2003	12/31/2006
02D3D	Parachute Imaging System Support Fixture	D304	3/3/2006	12/31/2006
02OCB	Hyper-X Design Evaluation and Flight Dynamics	D306	12/29/2000	6/30/2001
02OJ	Cost Estimation	E501	12/29/2000	6/30/2006
02RAD	Technology and Trade Studies For Advanced Aircraft	E404	12/29/2000	12/31/2006
02RBF	Liner Technology Research Support	D321	12/29/2000	9/30/2002
02RCB	Aeroelasticity	D308	12/29/2000	12/31/2006
02RDI	Electromagnetics Research	D319	12/29/2000	12/31/2006
02RFF	Future X Pathfinder Engineering Services	D202	12/29/2000	9/30/2003
03D3P	Engineering Support for Propulsion Upgrade to NFTP Test Fixture	D316	3/28/2006	9/30/2006
03OCB	SRGULL: Propulsion Design Code Update, Documentation and Distribution	D306	12/29/2000	12/31/2002
03RAA	Advanced Space Transportation Systems Modeling and Structural Analysis	E401	12/29/2000	12/31/2006
03RBJ	Dynamic Data Acquisition and Laser Support	D401	12/29/2000	4/30/2004
03RCF	Advanced Nondestructive Evaluation and Health Monitoring of Aerospace Systems	D313	12/29/2000	12/31/2006
03RDH	Photonics Fabrication, Test, and Characterization for Advanced Sensor Data	D319	12/29/2000	12/31/2006
03RFF	Design and Test of Hardware for Large Space Structures	D202	12/29/2000	5/31/2006
04D3R	Oculometer & Data Archiving Assistance	D318	3/31/2006	8/31/2006
04OCB	Cluster Computing Platform Development for Hypersonic CFD Applications	D306	12/29/2000	2/28/2003
04RAA	Advanced Space Transportation Systems Tool Integration and Interface Development	E401	12/29/2000	11/30/2002
04RBB	Grid Generation Support for Large-Scale Aerodynamic Applications	D301	12/29/2000	12/31/2006
04RCE	Metals and Thermal Structures Research and Technology Development	D312	12/29/2000	4/30/2004
04RDM	Flight Services Office (METRO) Support	D104	12/29/2000	12/31/2006
04RFK	LASE Instrument Electronics Subsystem Changes and Maintenance with Documentation	D209	12/29/2000	10/15/2001

05D3G	Development of Advanced Thermoelectric Materials	D307	3/28/2006	12/31/2006
05OCB	Hyper-X Separation Analysis	D306	1/24/2001	12/31/2002
05RAC	Analysis of Advanced Aircraft Concepts	E403	12/29/2000	12/31/2002
05RBG	Electronically Scanned Pressure Measurement (ESP) Modules	D304	12/29/2000	12/31/2001
05RCC	Analytical and Computational Methods Engineering	D309	12/29/2000	12/31/2006
05RDM	Flight Operations Support Center	D104	12/29/2000	12/31/2006
05RFM	Equipment Manager for the CERES Project/EOS-AM Spacecraft	D210	12/29/2000	7/31/2002
06D3T	Real-Time Software Development for SAFETI Lab	D320	5/30/2006	12/31/2006
06OCB	Wind Tunnel Test of the 1/4 Scale X-43ALS Low Speed Demonstrator Vehicle	D306	7/12/2004	10/1/2004
06RAC	Aircraft Structural Weight Sensitivity Calculation Capability	E403	12/29/2000	12/31/2002
06RBG	Advanced Model Instrumentation System Development	D304	12/29/2000	12/31/2006
06RCD	Material/Structural Mechanics Analysis and Testing	D311	12/18/2001	12/31/2006
06RDM	Flight Operations - Coordination and Implementation	D104	12/29/2000	2/28/2006
06RFM	Conduction of Tests and Instrument Operations for the CERES Project/EOS-PM	D210	12/29/2000	7/31/2002
07RAC	Flight Optimization System (FLOPS) Support	E403	12/29/2000	12/31/2002
07RBL	Blended Wing Body - Low Speed Vehicle Specialized Technical Service	D201	12/29/2000	9/30/2002
07RCG	Structural Dynamics Analysis & Testing	D311	12/29/2000	12/31/2006
07RDE	ATC/NAS Operations Research Support	D318	12/29/2000	6/30/2006
07RFM	Flight Operations Support for the CERES Project's Instruments	D210	12/29/2000	12/31/2006
08RAA	Advanced Space Transportation Systems - Aerodynamics and Aeroheating Analysis	E401	12/29/2000	12/31/2006
08RBJ	National Transonic Facility Improvements	D401	12/29/2000	10/29/2001
08RCE	Testing and Analysis of Advanced Materials	D312	12/18/2001	12/31/2001
08RDB	Support of AirSC Branch Web Sites	D316	12/29/2000	12/31/2004
08RFL	B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System	D203	12/29/2000	12/31/2001
09RAC	SACD Analysis and Model Development	E403	2/23/2001	6/30/2006

09RBL	Experimental Hardware Development and Process Improvement	D201	1/2/2001	12/31/2002
09RCE	Processing of Advanced Metallic Materials	D312	12/18/2001	12/31/2001
09RDB	Support of Turbulance Mitigation for Aviation Safety Program and Simulation Programming Support for Advanced Concepts Vehicles	D316	12/29/2000	12/31/2006
09RFL	Aerospace Data Acquisition and Processing Station (ADAPS) Support for Langley's Research Aircraft	D203	12/29/2000	12/31/2006
10RAA	Advanced Space Transportation Systems Subsystems Technology Development	E401	12/29/2000	12/31/2001
10RBH	Vehicle Aerodynamic Screening and Analysis	D305	12/29/2000	12/31/2006
10RCG	Structural Analysis and Design of Lightweight Antenna Platforms	D311	4/12/2001	12/31/2006
10RDE	Airline, Corporate, General Aviation Technical Expertise and Test Subject Delivery	D318	12/29/2000	12/31/2006
10RFQ	Analytical Laboratory Investigations	D204	12/29/2000	9/30/2006
11RAD	Trade Studies for Advanced Aircraft	E404	12/29/2000	3/30/2002
11RBJ	Implementation of Wall Interference Assessment and Correction Systems	D401	12/29/2000	4/30/2004
11RCB	Operation of Structural Testing Laboratory for the Transonic Dynamics Tunnel	D308	10/19/2001	9/30/2005
11RDH	Radiometer Test Development	D319	12/29/2000	7/31/2003
11RFJ	Gas and Aerosol Monitoring Sensorcraft (GAMS) IIP Technical Support	D208	12/29/2000	5/7/2004
12RAB	Advanced Space Systems Concepts Technical and Analytical Support for the Systems Analysis and Concepts Directorate (SACD)	E402	3/6/2001	12/31/2006
12RBA	Evaluation of Computational Methods for Application to Rotorcraft in the Subsonic Aerodynamics Branch	D301	12/29/2000	11/30/2003
12RCE	Advanced Materials Testing and Analysis	D312	12/28/2001	12/31/2002
12RDA	Handling Qualities and Maneuver Sensitivity Studies for Crew Transfer Vehicle Concepts	D317	12/29/2000	3/31/2002
12RFL	Turbulence Lidar for NASA Aircraft, Weather Accident Prevention Program (WxAP)	D203	12/29/2000	3/31/2005
13RAB	Spacecraft Systems Analysis and TMC (Technical, Management, and Cost) Reviews	E402	12/29/2000	1/14/2005

13RBF	Structural Acoustic Modeling and Laboratory Support	D321		12/29/2000	12/31/2006
13RCE	Processing of Advanced Metallic Materials	D312		12/28/2001	12/31/2002
13RDF	Runway Incursion Prevention System (RIPS) Development and Flight Simulation Support	D320		12/29/2000	12/31/2006
13RFL	Aircraft Acoustic and Dynamics Monitoring System	D203		12/29/2000	12/31/2006
14RAC	Low Speed Wind Tunnel Tests of Engine Thrust Effects on Inboard-Wing Transport Model	E403		8/28/2001	1/31/2002
14RBG	Support for the Development of Optical Measurement Techniques	D304		12/29/2000	3/10/2006
14RCE	Advanced Materials Analysis and Testing	D312		1/2/2003	12/31/2003
14RDD	SVS and Integrated Flight Deck Concept Evaluation and Experiment Support	D318		12/29/2000	12/31/2006
14RFH	Evaluation of Enabling Technology for Electronics Packaging	D203		12/29/2000	12/31/2002
15RAA	Advanced Space Transportation Systems (Performance Analysis)	E401		12/29/2000	12/31/2006
15RBK	Standardization of Wind Tunnel Parameters and Computation Algorithms for Wind Tunnel Balance Measurements and Calculations	D401		12/29/2000	6/30/2002
15RCE	Advanced Metallic Materials Processing	D312		1/2/2003	12/31/2003
15RDE	IDEAS Lab Enhancement	D318		12/29/2000	12/31/2006
15RFH	Engineering and Development of SAGE III Interface Adapter Module and Associated Required Testing	D203		12/29/2000	9/30/2004
16RAB	RASC Visualization and Multimedia Communications Development	E402		12/29/2000	12/31/2001
16RBJ	Data Quality Assurance	D401		12/29/2000	12/31/2001
16RCG	Solar Sail Analysis and Test-Analysis Correlation	D311		7/30/2003	9/30/2005
16RDC	Development of a Distributed Computing Cluster, and Implementation of Standard UNIX Maintenance Procedures on the Computer Equipment Involved	D316		12/29/2000	12/31/2006
16RFF	Test Hardware for Vibration Tests of Gossamer Structures	D202		12/29/2000	12/31/2006
17RAD	Simulation Studies of Advanced Aircraft Configurations	E404		2/22/2001	11/30/2001
17RBJ	Research Facilities Branch Test Support	D401		12/29/2000	11/30/2001

17RCE	Metals and Thermal Structures Research and Technology Development	D312	12/29/2003	12/31/2006
17RDI	Electromagnetics Research Facilities	D319	12/29/2000	12/31/2006
17RFI	DACOM I, DACOM II, and DLH Support for the TRACE-P Expedition	D207	12/29/2000	4/30/2003
18RAC	Automated Package Aircraft Concepts	E403	12/29/2000	6/30/2001
18RBG	Doppler Global Velocimetry (DGV)	D304	12/29/2000	1/30/2004
18RCE	Analysis, Testing, and Surface Preparation of Advanced Materials	D312	12/29/2003	9/30/2006
18RDI	Computational Electromagnetics Research	D319	2/13/2001	12/31/2006
18RFH	General Aviation Data Acquisition Systemt	D203	12/21/2000	12/31/2006
19RAC	Methods for Synthesis and Sizing of BWB	E403	12/29/2000	2/28/2002
19RBA	Mars Exploratory Rover Entry Configuration and Lander	D301	6/1/2001	6/30/2001
19RCE	Characterization and Processing of Advanced Metallic Materials	D312	12/29/2003	12/31/2006
19RDP	Flight Research Systems Development Support	D106	12/29/2000	12/31/2006
19RFM	Pyrovalve Investigation	D210	12/21/2000	6/30/2001
20RAB	GPS Dual RF Board Population and Testing	E402	12/29/2000	9/30/2001
20RBE	Aeroacoustic Experiment and Analysis Support	D314	12/29/2000	12/31/2006
20RDA	Wind Tunnel Test Support for VDB	D317	12/29/2000	12/31/2006
20RFM	Explosive Joining of Shape Memory and Superplastic Alloys	D210	12/29/2000	11/30/2002
21RAB	SEE Enhancements	E402	12/29/2000	12/31/2002
21RBJ	Research Facilities Branch Test Support for the Unitary Tunnel	D401	4/26/2001	11/30/2001
21RDE	Support to Synthetic Vision Systems General Aviation (SVS-GA) Research	D318	12/29/2000	12/31/2006
21RFF	Materials International Space Station Experiment (MISSE) Project Engineering Drawings	D202	12/29/2000	3/26/2001
22RAE	LaRC Launch Vehicle Systems Analysis Process Definition	E405	12/29/2000	2/28/2002
22RBA	SBRT Instrumentation and Drive Integration Support	D301	6/25/2001	9/30/2005
22RDG	Simulate Closed-Loop Operation of Flight Control System Hardware	D320	12/29/2000	12/31/2006
22RFJ	FTS "Testbed," Stationary FTS, and Super Web/THUNDER Linear Motor Projects Engineering Design	D208	12/29/2000	12/31/2006

23RAA	R&M Composite Materials Database	E401	12/29/2000	7/1/2001
23RBH	Wind Tunnel Test of Boeing's SLI Configuration	D305	11/16/2001	1/25/2002
23RDG	Emulate Effects of Controller Malfunctions on Aircraft	D320	12/21/2001	12/31/2006
23RFF	B757 Airborne Research Integrated Experiments System (ARIES) Laboratory Aft Flight Deck (AFD)	D202	12/29/2000	12/31/2001
24RAA	CFD and Propulsion Analysis for Hypersonic Airbreathing Vehicles	E401	12/29/2000	7/31/2003
24RBE	Aeroacoustics Prediction Code Development	D314	12/29/2000	12/31/2002
24RDG	Provide Electronic Cables, Connectors, Troubleshooting, and Electronic Interface Modification for SAFETI Labs Hardware	D320	12/29/2000	12/31/2006
24RFI	Gas Filter Correlation Radiometer (GFCR)	D207	12/29/2000	4/30/2004
25RAA	Airbreathing Launch Vehicle (ABLV) Studies	E401	12/29/2000	3/31/2003
25RBG	Virtual Diagnostics Interface (ViDI)	D304	1/15/2002	12/31/2006
25RDC	Controls Testbed Development and Support	D316	12/29/2000	12/31/2006
25RFL	Blended Wing Body – Low Speed Vehicle Technical Support	D203	1/24/2001	10/31/2001
26RAE	Uncertainty Analysis and Variable-Fidelity Modeling	E405	3/7/2001	3/31/2002
26RBE	Aircraft Noise Predication Program (ANOPP) Development, Maintenance, and Support	D314	12/29/2000	12/31/2006
26RDC	Engineering Services for Safety Related Systems and Controls Research	D316	12/29/2000	12/31/2006
26RFH	Cancer Detection With Passive Microwave Radiometry	D203	3/22/2001	12/31/2002
27RAE	Computational Fluids Laboratory 3-Dimensional (CFL3D) Code Modification	E405	3/8/2001	2/28/2002
27RBG	Global Pressure and Temperature Sensing Paints (PSP/TSP)	D304	12/29/2000	12/31/2006
27RDC	Biomimetic Wing Configuration Study and Off-axis Supersonic Blowing Analysis	D316	12/29/2000	11/30/2004
27RFF	SAGE III ISS Flight Model, Mass Model & GSE Design and Analysis	D202	3/22/2001	4/16/2001
28RAC	Advanced Air Traffic Operations Scenarios	E403	2/12/2002	12/30/2002
28RBG	Oxidation Catalyst Preparation and Testing	D304	12/29/2000	10/31/2004
28RDD	ATOL Enhancement and Simulation Support	D318	12/29/2000	12/31/2006
28RFM	Performance Evaluation of Pyrotechnic Devices	D210	8/13/2001	9/30/2002

29RAA	Advanced Space Systems (Multibody Vehicle Separation Simulation)	E401	8/28/2001	1/15/2002
29RBG	Nanotechnology-based Systems Development	D304	12/29/2000	12/31/2006
29RDD	Update of Operational Performance of Sensor Systems Used to Determine Atmospheric Boundary Layer Properties	D318	6/3/2002	10/31/2002
29RFJ	GAMS SAC-D Radiation Testing Hardware	D208	10/4/2001	12/31/2001
30RAC	Small Supersonic Transport Conceptual Design	E403	9/24/2001	11/15/2002
30RBJ	Research Facilities Branch Test Support (Multiple Tunnels)	D401	9/18/2001	4/30/2004
30RDA	Using Software Engineering Methods and Techniques to Improve V&V in the Simulation Environment	D317	2/13/2001	10/31/2001
30RFH	Acoustic and Dynamics Monitoring System	D203	10/9/2001	12/15/2001
31RAC	Mach 0.98 Transport Design Study	E403	1/31/2002	11/15/2002
31RBJ	Theory of Constraints (TOC)-Compliant Planning, Schedule Management, and Reporting for the Research Facilities Branch	D401	12/29/2000	4/30/2004
31RDA	Facility Support For VDB	D317	3/5/2002	12/31/2006
31RFI	Support for Combustion Water Vapor Sensor Development and Deployment	D207	2/28/2002	2/29/2004
32RAC	Advanced Concepts for the Aerial Exploration of Mars	E403	6/24/2002	9/30/2002
32RBJ	8-Ft. HTT Test Support	D401	12/29/2000	4/30/2004
32RDE	Weather Prototyping Tool	D318	12/3/2002	10/31/2005
32RFF	SAGE III/ISS Payload Contamination Control	D202	7/11/2002	12/31/2002
33RAC	STOL Transport Design Study	E403	2/28/2002	11/15/2002
33RBI	Hypersonic Airbreathing Propulsion	D306	12/29/2000	12/31/2006
33RDC	Test Support for Generic Transport Model	D316	12/6/2002	10/15/2004
33RFM	Assembly, Integration, and Test (AIT) Support for the CALIPSO ProjectSAGE III/ISS Payload Contamination Control	D210	8/2/2002	9/30/2004
34RAE	Uncertainty Quantification and Propagation Analysis	E405	2/26/2002	9/30/2002
34RBM	Image Acquisition Software for an Intelligent Measurement System	D201	12/29/2000	10/31/2004
34RDM	ATC/NAS Operations Research Support for Flight Operations Branch/FRSD	D104	12/30/2002	5/12/2006
34RFG	Cockpit Motion Facility (CMF) Component Stress Analysis	D206	8/29/2002	10/31/2003

35RAB	GPS Dual RF Receiver Board Build and Test	E402	5/2/2002	1/31/2003
35RBG	Measurement Science Support	D304	12/29/2000	12/31/2006
35RDA	Technical Support Services for Computational Methods for Stability and Control (COMSAC)	D317	1/30/2003	11/30/2003
35RFM	Assembly, Integration, and Test (AIT) Support for the CALIPSO Project - Logistics	D210	10/3/2002	9/30/2006
36RAC	Aircraft Design and Technology Studies and Methods Development	E403	11/8/2002	12/31/2006
36RBG	Measurement Technology Support	D304	12/29/2000	12/31/2001
36RDA	Dynamic-Stability and High-Lift Studies for the Computational Methods for Stability and Control (COMSAC)	D317	4/24/2003	11/30/2005
36RFJ	High Power Laser Diode Technology	D208	12/4/2002	12/31/2006
37RAB	Launch Vehicle Design and Analysis to Support Vehicle Analysis Branch	E402	12/6/2002	11/28/2003
37RBE	Wake Flowfield Analysis and Prediction	D314	5/3/2002	12/31/2006
37RDH	MATLAB® Analysis of Tropospheric Airborne Meteorological Data Reporting Sensor	D319	4/29/2003	7/31/2003
37RFJ	DLH and DACOM Support for In-flight Test and Science Missions	D208	12/5/2002	11/15/2006
38RAA	Launch Vehicle Design and Analysis to Support Vehicle Analysis Branch	E401	4/10/2003	11/30/2004
38RBH	Wind Tunnel Test of NASA SLI Identical Vehicle Launch System (IVLS) Configuration	D305	5/9/2002	12/31/2002
38RDO	Small Aircraft Transportation System Higher Volume Operations (SATS-HVO)	D318	1/12/2004	5/7/2004
38RFF	Low Noise Leading Edge Slat Concept Development	D202	2/24/2003	12/31/2006
39RBB	SLI Stage Separation CFD	D301	5/21/2002	11/30/2002
39RDE	WSI InFlight System Functionality for AWIN Lab	D318	4/30/2004	10/15/2004
39RFJ	Diode Laser Hygrometer for New Aircraft Platforms	D208	12/24/2003	12/31/2006
40RBH	Wind Tunnel Test of Boeing’s SLI Configuration (Latest Version)	D305	7/8/2002	12/15/2002
40RDO	Data-link Cockpit Weather Information System for use in the NASA C-206	D318	5/6/2004	4/23/2005
40RFJ	Advanced Etalon Technologies Measurement and Instrument Support	D208	2/27/2004	12/15/2005
41RBB	Wind Tunnel Test of PAVE Tilt-Nacelle Configuration	D301	8/14/2002	1/31/2003

42RBH	Wind Tunnel Test of X-43A/Pegasus Launch Vehicle Configuration (HXLV)	D305	10/11/2002	11/15/2002
43RBL	Experimental Hardware Development and Process Improvement	D201	1/2/2003	12/31/2006
44RBB	Test Advanced Aerodynamic Concepts in the VIGYAN Subsonic Wind Tunnel	D301	2/20/2003	2/29/2004
45RBH	Wind Tunnel Test of Boeing's OSP Configuration	D305	9/15/2003	12/31/2003
46RBC	Mars Science Laboratory Parachute Test Gondola	D302	4/20/2004	4/28/2006

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

The Aviation Safety and Security Program addresses the need for preventing both unintentional and intentional actions that would cause damage, harm, and loss of life, and for mitigating the consequences when these types of situations occur. The AvSSP also develops and integrates information technologies to maximize the effectiveness of information distribution for communications, and for analysis to detect unsafe conditions before they lead to accidents or security incidents.

The Program is managed in full compliance with NASA Procedures and Guidelines 7120.5B which defines the requirements for formulating, approving, implementing, and evaluating Programs and Projects. Effective mechanisms for tracking and maintaining successful performance have been established and include earned value, schedule, and configuration management.

2. **Description of the Work to be Performed:**

General Requirements

The Contractor shall coordinate with AvSSP Program/Project management to develop master and detail schedules to include milestones down to the element level; maintain master and detail schedules; produce and deliver reports; and provide consultation and expert schedule advice. Although the requirements for deliverables may be modified from time to time for individual projects, the following is a generic list of planning and schedule management products required:

- graphic reports (Precedence Logic Network, Gantt – bar and/or milestone charts, resource histograms)
- tabular reports (data lists, tables)
- analytical reports and "white papers"
- management bullet/presentation charts
- WBS dictionary and/or hierarchical graphs
- schedule software code required to provide unique analysis or report formats (ARTEMIS 7000, Primavera, Microsoft Project, etc.)

Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate Program/Project point of contact (POC). The Contractor shall alert the POC should any discrepancies arise involving major milestones. The Contractor shall produce and deliver monthly schedule status reports. When appropriate, provide program or project with earned value data and analysis.

Deliverables:

- Planning and scheduling support shall be provided for weekly and monthly meetings and teleconferences; and planning team meetings shall be attended as necessary.
- Monthly – Program and Project Plan schedules (Primavera Network) showing the level I, II and III milestones
- Monthly – Provide and review with Program personnel Monthly Management Report (MMR) that includes:
  - Actions from previous MMR review
  - AvSSP Acronyms Listing
  - Program and all Projects (LV1 and LV2 milestones) color-coded roll-up chart in Powerpoint format
  - Program-To-Date Milestone Table
  - For each Project, color-coded roll-up chart (ppt) with Program and Project (LV1 and LV2) milestones
  - For each Project, color-coded roll-up chart (ppt) with Program, Project, and all Element (LV1, 2 and 3) milestones
  - For each Project, Primavera chart with Project and all Element (LV2 and 3) milestones for 1 year period and monthly stop-light information (referred to as AvCon chart)
  - For each Project, summary of Project and all Element (LV2 and 3) milestones completed, delinquent, future slipping, and milestones due next month
- Monthly – Upload color-coded roll-up charts, AvCon charts, and Program-To-Date Milestone Table to web-based management information system (Erasmus)
- Monthly – Post entire Monthly Management Report to Postdoc and notify Program personnel of its availability and url location
- Monthly – Update Excel Milestone Data Dictionary
- As Needed –Provide copy of full Data Dictionary to Program personnel
- As Needed – Provide appropriate sections of Data Dictionary to Project Managers for Project Plan updates
- As Needed – Review and analyze updated Project Plans for scheduling conflicts/issues
- Quarterly As Needed – Develop and update milestone Trend charts for Langley-led Projects reporting at Langley CPMC.
- As Needed – Planning and scheduling support shall be provided for the NASA/FAA working groups.
- As Needed – Develop and maintain a detailed scheduling database for the Phase II Safety portion of the Program.
- As Needed – Coordinate with Project Managers to identify and document current FY tasks for the Security and Safety II portions of the Program.
- Monthly – Maintain paper file of all deliverables in location convenient to Program personnel.

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

- Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements.
- Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports.
- Once a baseline has been established, changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database that has not been baselined shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation.
- For new database requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation.
- Once a baseline master schedule has been approved, maintain historical plan/actual data including duration/remaining duration/actual duration at complete and start/finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects will be maintained as part of the schedule database.
- The schedule follows the guidelines established in NPG 7120.5B.

Standard 1: Develop and deliver Monthly Management Report (MMR). The Project/Program MMR follows the project Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis, and Schedule Status Charts.
CUSTOMER SERVICE/RATING:

Excellent: The MRR is delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MMR to review the report.
Very Good: The MMR is delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MMR with project management in a timely manner.
Satisfactory: The MMR is delivered to the customer on the specified due date with minimum errors. Analyst reviews MMR with project management.
Poor: The MMR does not meet requirements of following the WBS. The MMR is not delivered on the specified date and is not reviewed with the project management.

Unsatisfactory: No MMR is delivered to the customer, and the customer has given no waiver.

Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update reports, Delinquency Reports).
CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis.
Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate.
Satisfactory: Analyst is requested by project management to provide schedule reports/plots and does so on a regular basis.
Poor/Unsatisfactory: No schedule reports/plots are recommended or provided.

Standard 3: Produce and deliver accurate adhoc reports in support of management reviews.
CUSTOMER SERVICE/RATING:
Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission.
Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

Standard 4: Provide consultation and expert schedule advice to Program/Projects. This consultation may be in the form of reports or schedule management recommendations.
CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.
Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request.
Poor/Unsatisfactory: When requested, no recommendations are provides to the project management.

3.	**Government Furnished Items:**
4.	**Other information needed for performance of task:** Program/Project will provide funds to cover travel costs. Program/Project will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NAS1-00135.
5.	**Security clearance required for performance of work:** Work under this Statement of Work is unclassified. Security clearances are not required.
6.	**Period of Performance**: Planned start date: 1 Dec 04 Completion date: 31 Dec 05
7.	NASA Technical Monitor: Tamara L. Croom M/S 229 Phone: 757-864-5251

Task Order Number: 01AH Revision: 10 Date of Revision: 7/30/04
Title: Independent Review of Agency Programs

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

Begin R10 block updateThe NASA Headquarters (Code D) Independent Program Assessment Office (IPAO) will conduct a series of Pre-Non Advocate Reviews (PNARs), Non Advocate Reviews (NARs), and Surveillance Reviews of Agency programs and projects. The Contractor will be expected to provide appropriate technical experts to supplement review teams conducting independent reviews of these programs. Although the volume and exact intensity of anticipated reviews for which support is required in the coming year cannot be accurately stated, the Contractor may draw from recent use history and anticipated usage as a planning basis and initiate changes with updated estimates as the actual requirements are more accurately determined through the NOR submissions (see note below). There are approximately 6 reviews anticipated for the extended task order period of performance. ***End R10 block update*** R5The Contractor will be required to R10***assist in performing*** technical and programmatic analysis focusing on one or more of the following areas of interest, appropriate to the particular program R10***or project*** under review: Aerospace Vehicle Design; Propulsion; Power; Guidance, Navigation, and Control; Reliability, Maintainability, and Quality Assurance; Operations; Crew Systems; Safety and Mission Assurance; Risk Management; Project Management; Cost Estimating; and other associated disciplines. R10***The Contractor will also be expected to provide appropriate management support to IPAO and to the Office of the Chief Engineer***.

Begin R5 block addition
Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR requirements to the COTR. The Contractor shall proceed with performing NOR requirements that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports.
End R5 block addition

Revision 1: Adds Subtasks 3 and 4 and travel requirements.
Revision 2: Adds Subtasks 5 and 6 and travel requirements and corrects Subtask 1 deliverable date.
Revision 3: Adds Subtasks 7.0 and 8.0 as well as modifying Subtasks 5.0 to include some expanded requirements.
Revision 4: Adds Subtasks 9.0-13.0, updates technical coordinator, and extends the period of

	performance nine months in continuation of NASA's support requirements. (For details of issued original and revisions 1 through 4 SOWs see ETOS *".doc"* files *01AH, 01AH01, 01AH02v, 01AH03, and 01AH04*, respectively) Revision 5: Redefines requirements to implement (a) the NOR feature for reduced frequency of task order modifications and (b) a Contractor-maintained database of experts for improved competitive procurement practices. Revision 6: Extends Task Order completion date to be compatible with some of the required support. Revision 7: Extends the period of performance through 12/31/03 in continuation of NASA's support with no change in detailed requirements for the new period of performance (see [R7] below). Revision 8: Extends the period of performance through 9/30/04 in continuation of NASA's support with no change in detailed requirements for the new period of performance (see [R8] below). Revision 9: Revises the estimated IPAO review workload to "approximately 12 reviews conducted per year" and changes the technical monitor and coordinator (see [R9] above and below, Section 6). Revision 10: Extends the period of performance one year to September 30, 2005 in continuation of NASA's support requirements, updates background and detailed description, and documents technical monitor and coordinator change (see [R10] above and below).
2.	**<u>Description of the Work to be Performed</u>:** **Begin [R5] block addition** The Contractor shall provide all administrative support (including incidental costs and fees for each expert, as required) necessary for the various teams of technical experts that are required to participate in the [R10]***independent reviews***. *A. Consultant Database* The Contractor shall [R10]***maintain*** a database of potential, current, and past technical experts including the reviews conducted and specific expertise available. This database shall be updated independently by the Contractor and with information provided by the NASA Independent Program Assessment Office. The database shall contain information on a wide source of candidates sufficient to meet FAR guidelines in consultant subcontracting for consultant participation on review teams. This database shall be current enough to enable immediate access to technical experts for continuation of reviews and for establishing reviews of similar nature to those previously conducted. <u>Deliverables</u> The database as it is developed within two business days of receipt of independent or NASA data.

Metrics
MEETS if database is updated on schedule
EXCEEDS if updates delivered within one business day.

B. Cost Reports
The Contractor shall provide cost reporting in sufficient detail to track both individual team members and team total costs, including, planned costs, invoiced costs, and cumulative costs to date for each review conducted. These cost reports shall be provided to the Technical Monitor on a regular monthly basis and as requested for sudden surges in programmatic or review activity. The cost reports shall be assembled and maintained in a format, both written and electronic, that is mutually agreeable between the Contractor and the Technical Monitor.

Deliverables
Cost Reports, monthly and intermediate as required

Metrics
MEETS if cost report is received on a monthly basis
EXCEEDS if cost report is received on a bi-weekly basis or as requested during surge activity.
End [R5] block addition
C. (NOR) Technical and Programmatic Analysis
The Contractor's [R5]technical expert(s) shall provide results of technical and programmatic analysis for [R10]***independent reviews*** of each required program [R10]***or project***, developing a detailed plan to perform the analysis and including schedules of the deliverable products. The primary product for each [R10]***independent review*** shall be a final report summarizing the cost, schedule, and technical analyses conducted. The schedule for final reports and a schedule of meetings to be attended by the technical expert shall be developed by the technical expert in cooperation with the IPAO for each IA, IIR, or NAR undertaken.

During the review, the [R5]technical expert(s)shall provide in-depth cost, schedule, and technical analyses.

Deliverables
The [R5]technical expert(s) shall deliver the final report for each [R10]***independent review*** as specified in the individual NORs.

Metrics
Minimum acceptable performance:
Each 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: Each final report shall be assessed for: • Findings to improve design and development process • Propose alternative concepts that will benefit the government • Recommendations for improving efficiency, capability, cost, and quality • Executive summary identifying risks
3.	**Government Furnished Items**: R5The IPAO will be responsible for generating invitational travel orders for the technical experts for any travel required during the review.
4.	**Other information needed for performance of task**: None
5.	**Security clearance required for performance of work**: R5All work will be unclassified; however, personnel may be required to complete nondisclosure agreements.
6.	**Period of Performance**: Planned start date: January 2, 2001 Completion date: R6~~September 30, 2002~~ R7~~March 31, 2003~~ R8~~December 31, 2003~~ R10~~September 30, 2004~~ ***September 30, 2005***
7.	**NASA Technical Monitor:** R10***Thomas D. Tokmenko*** M/S: 215 Phone: 757-864-***9149*** **NASA Competency/Other Technical Coordinator:** R10***Timothy J. Flores*** M/S: 215 Phone: 757-864--***9154***

Task Order Number: 01ALA Revision: 1 Date of Revision: 4/26/04

Title: NESC Support

1. **Background:**

The NASA Engineering and Safety Center (NESC) was formed to ensure that NASA's safety and mission assurance organizations will have adequate technical expertise and resources for independent, in-depth, technical reviews of NASA's programs. One of the Columbia Accident Investigation Board findings was that the overall safety organizations previously lacked the expertise and resources to adequately conduct independent technical reviews. In order to bring the Country's outstanding technical experts to bear on the problems and challenges of NASA programs, the NESC will be comprised of the best engineering expertise from across the Agency and will include partnerships with expert consultants from other government organizations, National Laboratories, universities, and industry.

The NESC Review Board (NRB) is the primary management and decision-making entity for the NESC and is chartered to review, assess and decide the proper course of action on virtually all issues presented to the NESC.

Once the NRB determines that a technical assessment is needed, an Independent Technical Assessment (ITA) Team is formed to plan the assessment approach and, once the plan is approved by the NRB, conduct the assessment. Current expectations indicate that approximately twenty assessments will be conducted each year. Each assessment is expected to exceed two months in duration and generally last about 4-6 months. In some cases an assessment may last a year. Each ITA team will include experts from across NASA and may include experts and consultants from other government organizations, National Laboratories, universities, and industry.

The NESC currently has [R1]~~twelve~~ ***fourteen*** established Super Problem Resolution Teams (SPRTs), each led by an NESC Discipline Expert (NDE), that provide a pool of technical expertise to the NESC in general and to ITA teams as assessments are planned and conducted. The SPRTs currently supply expertise in the following disciplines: Guidance, Navigation and Control (GNC); Non-destructive Evaluation; Propulsion, Power & Avionics; Mechanical Analysis; Flight Sciences; Mechanical Systems; Human Factors; Materials; Structures; Fluids/Life Support/Thermal; Software; [R1]***Optics; and Statistics***. The SPRTs hold frequent teleconferences and may conduct periodic face-to-face meetings.

*****Begin [R1] block addition*****

To coordinate NESC activities with those of NASA's Office of Safety and Mission Assurance (S&MA), the position of NESC Deputy Director for Safety was created. This position is resident at Langley Research Center. The Deputy Director for Safety will be responsible for tracking S&MA activities across the Agency in search of issues and concerns warranting NESC review. The Deputy Director for Safety also is responsible for identifying appropriate S&MA individuals from NASA centers for participation in NESC assessments. In this and other actions, the Deputy Director for Safety maintains an organization similar to an SPRT.

The NESC maintains a permanent presence at each NASA center through an NESC Chief

Engineer (NCE). Each NCE acts as a conduit for issues and potential assessment activities arising at or identified by their Center. They also coordinate various NESC activities carried out by or at their Center. They are assisted in this activity by center personnel and will, at times, require technical and/or administrative support.
*****End [R1] block addition*****

Purpose of Work to be Performed:
Two purposes are served by the work described in this Task: 1) provide Technical Experts [R1]***and services, including testing and fabrication***, to support NESC ITA teams,SPRTs, [R1]***the Deputy Director for Safety and NCEs***; and 2) provide Project Coordination (Project Planning and Communication) and Document Preparation (including document configuration control) support for the NESC's ITA teams, SPRTs, [R1]***the Deputy Director for Safety and NCEs.***

Note: The support required is, by its nature, indefinite delivery and indefinite quantity. This work cannot be specified in detail very far in advance of the need because of its dependence upon the assessment needs that are identified by the NRB and ITA team leaders. As specific detailed requirements are defined and ready for the Contractor to perform, the Contractor will provide an electronic notice of requirements (NOR) to the Contracting Officer's Technical Representative (COTR). The Contractor will proceed with performing NOR requirements that are within the scope of this task order without waiting for the COTR's concurrence and/or approval. The Contractor will also provide similar notification upon completion of the NOR requirements. The NORs and associated completion notification will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports.

Revision 1: Changes element sequencing from alpha to numeric, adds element 5.0 to include additional support to make available testing and manufacturing services, extends the period of performance thirteen months to December 31, 2005, and updates background info and other details (see [R1] above and below).

2. Description of the Work to be Performed:

1.0 Technical Expertise: The Contractor shall provide appropriate technical experts to participate in and significantly contribute to the findings and operations of NESC ITA teams,SPRTs, [R1]***Deputy Director for Safety and NCEs***. The Contractor shall perform technical analyses in relevant engineering or scientific disciplines, including but not limited to: GNC; Non-destructive Evaluation; Propulsion, Power & Avionics; Mechanical Analysis; Flight Sciences; Mechanical Systems; Human Factors; Materials; Structures; Fluids/Life Support/Thermal; Software; [R1]***Optics; and Statistics***.

Deliverables and Schedule: Each contractor-provided technical expert shall provide written products such as test plans, reports, analysis results, summaries, recommendations, and findings documented in NORs and approved by the ITA leader or NDE. The Contractor shall deliver a brief monthly report outlining ITA and SPRT activities supported and contributions made. All written products are to be delivered as established by NOR.R1 ~~except for the monthly reports due within the first ten working days of the following month.~~

Metrics: The Contractor will warrant a "meets" rating if all written products are delivered complete and on time. The Contractor will warrant an "exceeds" rating if all products are delivered complete and ahead of schedule. R1~~For the monthly report, ahead of schedule means within the first five working days of the following month.~~

2.0 Project Coordination and Planning: The Contractor shall provide appropriate project support to participate in (as non-voting members) and contribute to the operations of NESC ITA teams and SPRTs, R1***including the Deputy Director for Safety and the NCEs***. The Contractor shall complete tasks involving R1***NESC*** projects, beginning in the planning phase, prior to formal approval, and continuing to completion and final disposition as approved by the NRB. Specific activities include the following:

1. The Contractor Project Planner shall provide project planning and coordination in support of the R1***various NESC*** teams throughout the planning and conduct of R1***each activity***. The Contractor shall use planning/scheduling software applications that provide for effective data entry, standard tabular reports and graphics for data output.
2. The Contractor Project Planner shall develop and maintain project schedules. The Contractor Project Planner shall track the team's progress to meet milestones and will prepare standard analytical reports that include critical path analysis, contingency evaluation schedules, status impact assessment, problem analysis, and recommended solutions.

R1~~The Contractor Project Planner shall oversee the Project Communication task and the Document Preparation task (see below). The Project Planner shall discuss and reach agreement on need dates for all project planning products with the appropriate ITA team lead or the NDE (for SPRT support)~~

Deliverables and Schedule: The Contractor shall deliver newly developed or updated project schedules and standard analytical reports in the time frame documented in NORs and approved by the R1***appropriate*** team lead. If not established by NOR, schedules shall be developed or updated and analytical reports delivered within two working days of milestone changes or within two days of a specific request from the team lead.

Metrics: The Contractor will warrant a "meets" rating if all requested products are delivered complete and on schedule. The Contractor will warrant an "exceeds" rating if all requested products are delivered within one working day.

Note: The Contractor Project Planner is a task that requires continuity and intimate knowledge of the plans, activities, accomplishments and status of the ITA or SPRT investigation, as well as a continuing familiarity with the ITA objective and team membership. As such, the

Contractor Project Planner will oversee and coordinate the efforts of Project Communication and Document Preparation where they apply to a specific ITA (or SPRT investigation).

3.0 Project Communication: The Contractor shall provide administrative support for ITA and SPRT meetings, [R1]***as well as for the NESC Deputy Director for Safety and NCEs*** including scheduling, agenda preparation and distribution, recording minutes, recording actions and decisions, and distributing meeting minutes, appropriate notes and action item lists to team or members. The Contractor shall implement and maintain an action item tracking system that captures the actions from each meeting and reflects the status of each action. This tracking system shall include the date the action was assigned, the responsible individual for the action, the status/disposition of the action, and the date the action was completed. The Contractor shall also provide communication support coordination. The Contractor shall be the distribution focal point for any team communication, especially ensuring that all team members are informed of progress and issues related to meeting team milestones. The Contractor shall use the most effective/efficient means possible to accurately and timely communicate information within the team, to other NESC entities and to entities outside the NESC, as appropriate, including web-based support of meetings and remote conferencing. The Contractor is responsible for maintaining control and accountability of all files and is responsible for the accurate filing of all [R1]***associated*** documentation. [R1]***As part of this project communication effort, contractor personnel shall also coordinate the delivery of associated service covered in 2.0 Project Coordination and Planning and in 4.0 Document Preparation.***

Deliverables and Schedule: Meeting agendas shall be distributed two working days before each meeting, or as approved by the team leader. Meeting minutes and action items shall be distributed to team members within two working days of meetings.

Metrics: The Contractor will warrant a "meets" rating if all meeting agendas, minutes, notes and action lists are delivered complete and on schedule. The Contractor will warrant an "exceeds" rating if all requested products are delivered within one or more working days ahead of schedule .

4.0 Document Preparation: The Contractor shall prepare, review, edit, or rewrite, as appropriate, assessment plans, test plans, reports, technical memoranda and presentation slides dealing with advanced technical subject matter, using NESC-provided templates and content. The Contractor shall ensure all documents are written for clarity, grammar, punctuation, spelling, capitalization, usage and format, in accordance with approved publication standards. The Contractor shall produce professional quality photographs using a digital camera and/or software processing,, illustrations, drawings, technical art and scientific figures containing Greek and mathematical notations, as appropriate, and facilitate production and integration of figures into the documents described above. Further, once the team leader approves the final version of relevant documentation, the Contractor shall be responsible for uploading those documentation products to the NESC configuration management tool.

Deliverables and Schedule: Test plans, reports, technical memoranda and presentations shall be delivered according to the schedules approved by the appropriate ITA team or SPRT leaders. If no other agreement is in place, assessment plans, test plans, reports, technical memoranda and presentations shall be delivered within two working days of a specific request from a team leader.

Metrics: The Contractor will warrant a "meets" rating if all test plans, reports, technical memoranda and presentation slides are delivered complete and on schedule. The Contractor will warrant an "exceeds" rating if all requested products are delivered within one or more working days ahead of schedule.

****Begin R1 block addition****

5.0 **Test Support:** The Contractor shall make available appropriate experts to provide testing of hardware components as needed by the NESC teams . The Contractor shall also make available manufacturing services to provide test article hardware fabrication for use in testing and analyses as needed by the NESC teams. These test articles shall conform to the drawings and specifications provided by the NESC.

Deliverables and Schedule: Each Contractor-provided test support shall provide written products such as test plans, reports, analysis results, summaries, recommendations, and findings approved by the team leader. The Contractor-provided test article manufacturer shall provide the test article(s) to the specific team as described by the NASA drawings and specifications. The Contractor shall deliver a brief monthly report outlining NESC activities supported and contributions made. All products are to be delivered as established by NOR.

Metrics: The Contractor will warrant a "meets" rating if all products are delivered complete and on time. The Contractor will warrant an "exceeds" rating if all products are delivered complete and ahead of schedule.

****End R1 block addition****

3. Government Furnished Items:

The NESC will provide templates for required documentation. The NESC will provide access to its internal electronic document configuration control tool for appropriate processing and archiving. NASA will provide appropriate office space, telephone and Internet access, as required.

****Begin R1 block addition****

Quality Management for Articles Authorized to be Procured Under this Task. Because of special circumstances governing the scheduling of work and selection of sources, during the fabrication of articles required under this task order, LaRC will be responsible for all quality assurance monitoring. The quality assurance employed will normally take precedence over the Contractor's quality program unless specified in advance by NOR. Inspection and acceptance of articles under this task order will be the responsibility of NESC.

****End R1 block addition****

4.	**Other information needed for performance of task:** Technical Experts and Project Planning personnel will be required to travel to team meetings and assessment sites. Project Communication and Document Preparation personnel may also be required to travel to team meetings and assessment sites.
5.	**Nondisclosure agreements required for performance of work:** The Contractor and all Contractor personnel, including technical experts (as described in section 2.A.), will be required to complete appropriate nondisclosure agreements.
6.	**Period of Performance:** Planned start date: February 1, 2004 Completion date: ~~November 30, 2004~~ R1 ***December 31, 2005***
7.	**NASA Technical Monitor:** Chris Johansen M/S: 105 Phone: 757-864-6077

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 4 Statement of Work
Task Order Number: 01D1B Revision: 1 Date of Revision: 2-2-05 Title: FRSD Schedules Management and Reporting	

1.	**Purpose, Objective or Background of Work to be Performed:** Flight Research Services Directorate (FRSD) is responsible for providing safe, effective, and cost-competitive flight research services to meet the needs of other units. For these activities FRSD requires Contractor planning and scheduling support to the FRSD/Simulator and Aircraft Service Activity (SASA), Cockpit Motion Facility (CMF), Aft Flight Deck (AFD), and Research Systems Integration Laboratories (RSILs). Revision 1: Although originally planned for two full time schedulers, due to NASA funding constraints the work described herein shall be understood to be for one full time and should be re-planned accordingly.
2.	**Description of the Work to be Performed:** **General Requirements** The Contractor shall provide planning and scheduling support to the FRSD/SASA including aircraft, CMF, AFD, RSILs, software development, and research support as required by using approved software to develop and manage an integrated planning database. Support to special projects such as the AFD shall be provided as requested. **Deliverables:** The Contractor shall deliver master and detail schedules; maintain master and detail schedules; produce and deliver reports; and provide consultation and expert schedule advice. Although the requirements for deliverables may be modified from time to time, the following is a generic list of planning and schedule management products required: *Monthly Gantt chart updates. *Planning and scheduling support shall be provided for weekly and monthly meetings and teleconferences; and planning team-scheduled meetings shall be attended as necessary for performing this subtask. *A weekly analysis of the changes to the baseline schedule, including a critical-path assessment, shall be provided orally when weekly meetings are held, or in writing if a meeting is cancelled. **Metrics:** Minimum performance standards are to deliver all products on time with the following requirements: • The Contractor shall utilize the correct codes and associated attributes, and log these for verifying that the data in the databases are accurate, up to date, and can support all management and working-level reporting and analysis requirements. • The Contractor shall maintain data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports. • Once a baseline has been established, 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, shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation.

- For new database requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation.
- The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.
- Once a baseline master schedule has been approved, the Contractor shall maintain, as part of the schedule database, the historical plan/actual data, including duration/remaining duration/actual duration at complete and start/finish dates that can be analyzed to: (1) determine the accuracy of original estimates; and (2) improve ability to provide accurate estimates for future projects. .
- The schedule shall follow the guidelines established in NPG 7120.5B.

Standard 1: Develop and deliver Monthly Management Report (MMR) for those projects under the purview of the SASA. The SASA MMR follows each project's Work Breakdown Structure, and includes: Status Charts for the SASA Work Requests (LF 444's); Master Schedules for each experiment; current schedules for each experiment; Critical Path Analysis for each project; and CPMC (Center Program Management Council) packages for each applicable project.

CUSTOMER SERVICE/RATING:

Excellent: The MRR is delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MMR to review the report.
Very Good: The MMR is delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MMR with project management in a timely manner.
Satisfactory: The MMR is delivered to the customer on the specified due date with minimum errors. Analyst reviews MMR with project management.
Poor: The MMR does not meet requirements of following the WBS. The MMR is not delivered on the specified date and is not reviewed with the project management.
Unsatisfactory: No MMR is delivered to the customer, and the customer has given no waiver.

Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update

	Reports, Delinquency Reports). CUSTOMER SERVICE/RATING: Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis. Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate. Satisfactory: Analyst is requested by project management to provide schedule reports/plots and does so on a regular basis. Poor/Unsatisfactory: No schedule reports/plots are recommended or provided. **Standard 3: Produce and deliver accurate adhoc reports in support of CPMC and/or management reviews.** CUSTOMER SERVICE/RATING: Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission. Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer. Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy. Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established. **Standard 4: Provide consultation and expert schedule advice to each project. This consultation may be in the form of reports or schedule management recommendations.** CUSTOMER SERVICE/RATING: Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required. Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required. Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request. Poor/Unsatisfactory: When requested, no recommendations are provided to the project management.
3.	**Government Furnished Items:** FRSD will provide office space for the Planning & Control Analysts performing the tasks described in this Statement of Work.

4.	**Other information needed for performance of task:** FRSD will provide funds to cover travel costs if needed. FRSD will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports.
5.	**Security clearance required for performance of work:** none.
6.	**Period of Performance**: Planned start date: January 2005 Completion date: December 31, 2005
7.	**NASA Technical Monitor:** Bruce Fisher **M/S:** 255A **Phone:** 757-864 -3862

	Task Order Number: 01D2A Revision: ____ Date of Revision: Title: Digital Signal Processing Software for On-board Prognostics & Failure Mitigation

1.	**Purpose, Objective or Background of Work to be Performed:** • This task order provides embedded digital signal processing to be interfaced as part of an On-board Prognostic & Failure Mitigation System for Autonomous Remote Air Vehicles (AuRA) Project. Advanced future aircraft will have large-scale distributed systems with thousands of interconnected components: (1) Smart Sensors, (2) Processing Nodes, (3) Smart Actuators, and (4) Data Fusion Centers. The system will incorporate NASA provided algorithms for Failure Detection and Isolation (FDI), self-healing signal conditioning and information fusion of communication channels. The proposed measurement system will be required to operate and support laboratory flight simulation tests as dictated by the project schedule. This work described below is an update of work formerly required under Task Order 34RBM.
2.	**Description of the Work to be Performed:** The Contractor shall perform the following requirements: 1. Provide embedded digital signal processing support for an On-board Prognostic & Failure Mitigation System for application to the AuRA project. Provide data acquisition software that utilizes digital signal processing algorithms in a Field Programmable Gate Array (FPGA) for application to failure detection and isolation in an Unmanned Air Vehicle (possibly the Altair). The Contractor shall modify and test new software in the required data acquisition system using government-supplied equipment. The Contractor shall develop software for a laboratory demonstration model of an FPGA-based acquisition board accommodating several different types of sensors (i.e. accelerometer, strain gage, thermistor, an array of acoustic sensors) providing inputs. Auto gain setting, auto spectrum analysis (for pre-sample filter selection), and self-healing shall be demonstrated. The data acquisition software for the small evolvable instrumentation system shall have the ability to process reconfiguration algorithms dynamically and autonomously in response to changes in task requirements or changes in the environment. This instrumentation shall be capable of measuring pressure, transition, model attitude and deformation, and temperature. The on-board system of instrumentation is made in a small form factor and has an electronic data handling capability accommodating a number of MEMS (Micro-Electro-Mechanical Systems) type sensors. The software for the evolved system shall be capable of performing complex signal processing functions, such as adaptive filtering, randomization, and spectral analyses. The system shall accommodate a variety of serial protocols such as RS-422 and LVDS as required by the project. Data transmitted in blocks shall be stored in FIFOs (first-in-first-out memory) with simultaneous sampling occurring between channels. Interfaces between the FPGA and Digital Signal Processing (DSP) shall be developed. a. Implement simplified system calibration and setup techniques to enable personnel to configure, modify, download and run the software in a Field Programmable Gate

Array as part of a laboratory test model. The system shall provide improved diagnostic information regarding the state of the system.

b. The existing acquisition system shall be enhanced to interface to a variety of sensors.

c. Implement and demonstrate evolutionary algorithms and neural networks that evolve solutions enabling adaptation to occur. The system shall be capable of automatically reconfiguring a signal conditioning analog array using a combination of neural networks and evolutionary computations to perceive sensor failures.

d. Implement a variety of Digital Signal Processing functions (FFTs, fast Fourier transforms) for sensor arrays.

e. Maintain a laboratory record book with available source code (printout and on CD--ROM) as well as records of studies indicating results of testing for each technique developed.

f. These files are to be distributed to customers via diskettes, CD-ROM, local network, internet, etc. The system's current target recognition and processing shall be enhanced to search for and process targets on a sequence of images. Three-dimensional spatial models will be used to visually aid target and pattern recognition techniques.

g. Technical Support for a period of 30 days after completion of individual requirements to resolve any technical problems that may arise (not to exceed task order completion date).

h. Documentation describing a test validation procedure along with the results obtained from the units constructed; all documentation shall be provided both on paper and electronically as an MS-Word file.

i. Implement new techniques for advanced diagnostics and prognostics of structures and a wide variety of data sources and data types.

Deliverables:

1. The Contractor shall provide to the customer an operational software program that meets all the requirements under requirements 1.a through 1.i. This program shall be delivered to the customer in its entirety as an executable file and as source code on CD-ROM with compilation instructions and full documentation both on paper and electronically as an MS-Word file.
2. SPMP (Software Project Management Plan) requirement: The contractor shall comply with the contractor responsibilities for a low control project as described by LMS-CP-5528, LMS-CP-5529 and LMS-CP-5532. Documentation detailing all software developed in accordance with Software Engineering Processing Group (SEPG) procedures outlined in the Langley Management System; all documentation shall be provided both on paper and electronically as an MS-Word file.
3. Any software upgrades required to operate the upgraded system;

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Title: Digital Signal Processing Software for On-board Prognostics & Failure Mitigation

4. Any documentation updates required to describe the proper operation of the code, and data format;
5. Documentation describing a test calibration procedure along with the results obtained from the software units constructed; all documentation shall be provided both on paper and electronically as an MS-Word file.

Schedule of Deliverables: October 31, 2005

Metrics for Performance:

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

- Delivery of fully operational and tested embedded digital signal processor that demonstrates a self-healing capability when exposed to system faults in support of laboratory tests along with diagrams, software, and documentation.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance.

- Deliverables all received meeting specifications, at the contracted cost and with an earlier delivery time by 10% of the total working days in the performance period.

3. **Government Furnished Items:** Access to tunnel and/or data acquisition facilities as required to perform the task order requirements.

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

5. **Security clearance required for performance of work**: None.

6. **Period of Performance**:

Planned start date: November 1, 2004 Completion date: October 31, 2005

7. **NASA Technical Monitor**: Sharon Graves

M/S: 238 Phone: 757-864-5018

NASA Competency/Other Technical Coordinator

M/S: Phone:

Task Order Number: 01D3D Revision: ____ Date of Revision:

Title: DOPPLER GLOBAL VELOCIMETRY (DGV)

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

Doppler Global Velocimetry is a class of flow velocity measurement technologies. It is capable of measuring three-component velocities within a plane, line, or point. The objective of the work to be performed is the development of hardware and software needed to transfer DGV technology from the laboratory to routine operational systems in wind tunnels.

Note: This task order defines some of the work previously performed under closed out task order 18RBG.

2. **The Contractor shall perform the following** requirements:

2.1 *Doppler Global Velocimetry*

1) Provide the following system upgrades / calibrations:

a) Develop four scene / one camera data acquisition software. Deliverables: Software and documentation.

b) Develop data acquisition computer -> data processing computer network. Deliverables: Software, procedures, and documentation.

c) Develop camera alignment/diagnostic software for real-time graphic feedback of the camera images. Deliverables: Software, procedures, and documentation.

2) Conduct comparative DGV testing in the following facilities:

a) 2-inch pipe flow jet (AMDB DGV Laboratory)

Schedule:

1) a) Beta version – 2/05, Final version – 4/05, Documentation – 12/05
   b) Beta version – 2/05, Final version – 4/05, Documentation – 12/05
   c) Beta version – 1/05, Final version – 3/05, Documentation – 12/05
2) a) 2-inch pipe flow measurements – 1/05, Data CDs – 1/05

Standards (meets, exceeds):

1) Standards to meet specifications
   a) Delivery of all deliverables at the contracted cost for Subtask 2.1.
   b) Delivery of the primary deliverables at the schedule listed above for Subtask 2.1. Final documentation to be delivered by December 31, 2005.
2) Standards to exceed specifications. Meeting either of the two standards listed below will constitute exceeding the minimum acceptable performance for Subtask 2.1.

a) Develop user training documentation/help files for the proper operation of the deliverables at the contracted cost at the delivery schedule listed above for Subtask 2.1.
b) 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. Government Furnished Items:

All hardware components needed to construct the above systems will be government supplied. In addition, test facilities, office space, specialized test equipment, and specialized computer systems will be government supplied as needed.

4. Other information needed for performance of task:

Documentation on Doppler Global Velocimetry is available on the NASA Langley Report Server.
All safety procedures for laboratory operation of laser systems are available on the NASA Langley LMS site.

5. Security clearance required for performance of work:

All tasks are unclassified.

6. Period of Performance:

Planned start date: 1/2/04 Completion date: 12/31/05

7. NASA Technical Monitor: James F. Meyers
M/S: 493 Phone: 757-864-4598
NASA Directorate/Other Technical Coordinator:
M/S: Phone: 757-864-

	Task Order Number: 01D3 Revision: 1 Date of Revision: 3/17/05 Title: Technical Exhibit Management

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

Work will support several organizations on Center in the execution of exhibits for professional societies (AIAA, SAE, EAA), other agencies (FAA and DOD), and NASA Headquarters.

Revision 1: Shortens the period of performance six months to March 31, 2005 as an early closeout for NASA's convenience (see [R1] below in Section 6).

2. **Description of the Work to be Performed:**

The Contractor shall manage exhibits for technical audience venues such as AIAA, SAE, EAA, etc. Part-time logistics support shall be provided for NASA Langley Research Center research projects including, but not limited to, projects in the Aeronautics Mission Directorate.

Note: The required support is indefinite delivery and indefinite quantity (IDIQ) by its relationship to NASA mission and research activities. This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic, mission, and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs shall be maintained in the electronic task order system (ETOS) along with other official task order records. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports.

The task monitor will provide specific case-by-case requirements for the Contractor to report as NORs, to be scheduled as much in advance as possible. In general the Contractor shall perform the following requirements:

- Research and recommendations on exhibit hardware purchases
- Maintenance and inventory of exhibit hardware in all project locations
- Oversight and detailed tracking of shipping and receiving for all project exhibits
- Liaison with and negotiation with exhibits venues for all projects, e.g. AIAA, NASTC, SAE, EAA, NASA Headquarters, etc.
- Travel to and from exhibit venues at the expense of the office requiring the travel, to be determined in advance and funded accordingly
- Oversight and supervision of all exhibit venue set up and tear down operations
- Recommendations for equipment for each project on an exhibit-by-exhibit basis
- Maintenance and inventory of equipment for each project
- Research and recommendations on costs by external vendors on an as needed basis

Deliverables: The Contractor shall provide a report, by project and venue, including budget and

	costs, to task monitor within five workdays of NOR completion. Schedule: To be provided by task monitor on case-by-case basis through NORs. Metrics: Report completeness, timeliness, and quality. Standards (meets, exceeds): All exhibit work meets or exceeds government standards for exhibits and within schedule.
3.	**Government Furnished Items:** Lap top computer for travel assignments, LaRCnet account, exhibit hardware, exhibit supplies needed to accomplish stated requirements.
4.	**Other information needed for performance of task:** Travel to exhibit venues as required by subtasks. Known travel for FY 05 is January 05, Reno, NV for the AIAA conference, 6 days hotel, M&IE per diem plus airfare and rental car; March 05, NASA professional educator conference, Alexandria, VA, 3 days hotel, perdiem and pov mileage; July-August 05, Oshkosh, WI for the EAA AirVenture 2005, 10 days hotel, M&IE per diem plus airfare and rental car.
5.	**Security clearance required for performance of work:** Langley issued badge; no other security issues.
6.	**Period of Performance:** Planned start date: November 22, 2004 Completion date: R1 ~~Sept 30, 2005~~ ***March 31, 2005***
7.	**NASA Technical Monitor:** Peter F. Jacobs M/S: 285 Phone: 757-864-2855

Task Order Number: 01E2A Revision: ____ Date of Revision:

Title: Algorithm Development for the Systems Analysis Integrated Discipline Team

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

The Constellation Systems Division's (NASA HQ) Systems Analysis Integrated Discipline Team (SA IDT) is led by NASA Langley Research Center (LaRC). The purpose of the SA IDT is to provide systems analysis to the Exploration Systems Mission Directorate Constellation Systems Division to help them make decisions.

2. **Description of the Work to be Performed:**

2.1. Trade Tree Genetic Algorithm Development

This task will examine the entire Exploration Architecture trade tree using a Genetic Algorithm (GA) approach in order to identify highest potential payoff paths through the trade tree for subsequent analysis by the Constellation IDTs during FY05-06.

2.1.1. A trade tree will be provided to the Contractor for analysis. The Contractor shall develop a Genetic Algorithm that will populate the trade tree as necessary with data needed to characterize the technical aspects (e.g., the FOMs (figures of merit)) using a existing Level 0 analytical fidelity systems analysis tool(s), such as the spreadsheet-based tool developed by D.R. Komar/LaRC, and/or the Envision tool developed by JSC. This Genetic Algorithm will rank the potential pathways through the tree based on maximizing an objective function derived from the Figure of Merit analysis performed under the parallel Constellation Trade Study Evaluation Criteria Development task FY05.P.01.

2.1.2. The Contractor shall work closely with delegated NASA task monitor D.R. Komar/LaRC, and other members of the SAIDT-assigned study team in order to develop the GA and integrate it with the other tools and into the computing environment or wrapping tool (such as Phoenix Integration's Model Center).

Deliverables at end of contract period:
1. Genetic Algorithm.
2. Prioritized list of trade tree options.

2.2. DSM (Design Structure Matrix) Clustering Macro Development

2.2.1. The Contractor shall provide an algorithm to perform clustering of elements in a DSM matrix. This will be used to group highly interactive elements in a DSM matrix. The algorithm shall be developed to run as a macro in Microsoft Excel.

2.2.2. The Contractor shall provide documentation with the DSM clustering macro, either in the form of a standalone "read me" file, or more preferably, as a pop-up "Help" window available to the macro user on-line in Excel. The documentation shall describe the step by step procedure for using the clustering algorithm, as well as some background information on DSM development and citations to some of the relevant literature and URLs.

Deliverables at end of contract period:
1. Clustering macro.
2. User documentation

2.3 Other Requirements:

2.3.1 Monthly Reports.

The Contractor shall submit a monthly technical progress report summarizing all work accomplished during each month throughout the contract period of performance.

2.3.2 Meetings

1. Kickoff Meeting. The Contractor and any subcontract team members shall attend a kickoff meeting to discuss the task with the NASA Technical Monitor. This meeting will be held within one week of task award.

2. Weekly SA IDT Telecons. The Contractor shall participate as requested by the NASA Technical Monitor in the weekly Monday SA IDT telecon, typically held 2:00-3:00 pm eastern time.

3. Delivery Briefing. The Contractor shall deliver the clustering algorithm/Excel macro to NASA at a final delivery briefing, which will include a demonstration of the macro use.

4. Trade Tree Task Meetings. The Contractor and any designated subcontract team members shall support telecons, webcasts, and face to face meetings as requested by the NASA Technical Monitor.

2.3.3 Travel and Other Direct Charges

1. Travel. The Contractor shall develop a reasonable estimate of the required travel based on the support requested herein and coordination with the NASA task monitors. The Contractor's task plan shall provide the basis for the travel cost estimate, to include the number of trips, assumed, the number of days and personnel involved in each trip, and the locations required/assumed.

Task Order Number: 01E2A Revision: ___ Date of Revision:

Title: Algorithm Development for the Systems Analysis Integrated Discipline Team

	2. Other Direct Charges. The Contractor shall include an itemization of any direct charges that are required in the task estimate.
3.	**Government Furnished Items:** (See above)
4.	**Other information needed for performance of task:** (See above)
5.	**Security clearance required for performance of work:** (None)
6.	**Period of Performance:** **Planned start date:** January 2, 2005 **Completion date:** June 30, 2005
7.	**NASA Technical Monitor:** Mr. Vincent Bilardo Email: Vincent.J.Bilardo@nasa.gov M/S: 149 Phone: 757-864-3758 **Alternate**: Mr. Todd Denkins Email: Todd.C.Denkins@nasa.gov M/S: 149 Phone: 757-864-7191 **Subtask Contacts:** Mr. D. R. Komar (for 2.1) Phone: 757-864-9355 Email: d.r.komar@larc.nasa.gov Dr. John J. Korte Phone: 757-864-6920 Email: j.j.korte@larc.nasa.gov

Task Order Number: 01OA Revision: 1 Date of Revision: 2/7/02

Title: Implementation Support for SBIR and STTR Programs

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

The Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) Programs, as implemented by the National Aeronautics and Space Administration (NASA) and as mandated by Congress, provide an opportunity for small, high technology companies and research institutions to participate in Government sponsored research and development (R&D) efforts in key technology areas. The purpose of this task is to provide support for the implementation of NASA LaRC's SBIR and STTR Programs.

Revision 1: Adds multimedia project/product development management to on-going requirement (d). (see R1 below).

2. Description of the Work to be Performed:

The Contractor shall provide the following implementation and support functions for the SBIR and STTR Programs.

(a) The Contractor shall train and support users of the SBIR/STTR Electronic Handbook (EHB) system. The Contractor shall develop and/or update training materials, user guides, or other documentation required and provide on-site or remote assistance to users of the EHB. The Contractor shall provide written and/or verbal answers to questions regarding the use of the EHB.

Deliverables and/or Products: Training material

Schedule(s): Four times annually

(b) The Contractor shall test and evaluate the functionality of the EHB. The Contractor shall exercise, verify, and assess the functionality of the EHB and its ability to properly execute features as designed. The Contractor shall record any discrepancies in functionality and suggest ways to improve EHB use.

Deliverables and/or Products: Written comments

Schedule(s): Two to four times annually

(c) The Contractor shall facilitate and coordinate the assessment and evaluation process for SBIR and STTR submissions. The Contractor shall produce a list and rosters of SBIR and STTR submissions and evaluators. The Contractor shall coordinate the evaluation process, assuring timely delivery and receipt of materials to/from evaluators. The Contractor shall track and account for all outstanding actions and the status of all submissions.

Deliverables and/or Products: Lists/rosters and associated presentation material

Schedule(s): Four times annually

(d) The Contractor shall develop and document company success stories. The Contractor shall maintain a record of SBIR and STTR activities, documenting company activities and achievements as a result of their participation in these programs. The Contractor shall develop and summarize significant company success that results from the SBIR and STTR programs. These success stories shall be written in a format suitable for a press release. [R1]***Additionally, the Contractor shall manage the development of multimedia projects and products that further communicate company achievements as a result of their participation in these programs.***

Deliverables and/or Products: Success stories [R1]***and multimedia products*** approved for release by the featured company and the NASA Langley COTR for the company featured in the write-up
Schedule(s): Bi-monthly, or as required

(e) The Contractor shall develop and design presentations and coordinate their production. The Contractor shall produce presentation materials in support of the SBIR and STTR Programs, focused particularly for information dissemination and documentation of results.
Deliverables and/or Products: Multimedia presentations
Schedule(s): As required, not expected to exceed 4 per year

(f) The Contractor shall provide support to and participate in local and national small business tradeshows. The Contractor shall produce presentation materials and attend tradeshows in an effort to widen company participation in the SBIR and STTR Programs. The Contractor shall be responsible for all aspects of tradeshow materials, including preparation, shipment, set up, distribution, and disassembly.
Deliverables and/or Products: Multimedia presentations, coordinate shipping and set up of displays and handouts
Schedule(s): As required, not expected to exceed 4 per year

Performance Metrics: User feedback, including accurate lists/rosters and presentation material, produced in presentable format and media conforming to normal NASA LaRC practices, and on time delivery.
Performance Standards: Meets - Meets or Exceeds user expectations for 80-90% of user responses. Exceeds - Meets or Exceeds user expectations for greater than 90% of users.

3. Government Furnished Items:

Office space and furniture only.

4. Other information needed for performance of task:

The Contractor shall have familiarity with the following:

	1. U.S. Small Business Administration Policy Directives pertaining to the federal government SBIR and STTR Programs; 2. NASA's Policy Directives that pertain to the SBIR and STTR Programs; and 3. NASA's SBIR and STTR Solicitations. Travel to: 1. NASA SBIR/STTR Program Manager Meetings – 2 trips, 3 days each to discuss the SBIR/STTR programs, EHB, success stories, programmatic changes, etc. 2. National SBIR conferences – 2 trips, 2 days each to introduce small businesses to the NASA Langley SBIR and STTR programs. 3. Company sites – 2 trips, 1 day each to document company commercialization accomplishments.
5.	**Security clearance required for performance of work:** Contractor will have access to company proprietary information and must sign a non-disclosure agreement.
6.	**Period of Performance:** Planned start date: May 7, 2001 Completion date: May 6, 2002
7.	**NASA Technical Monitor**: Robert Yang M/S: 211 Phone: 757-864-8020 **NASA Competency/Other Technical Coordinator:** OA/Preston Carraway M/S: 118 Phone: 757-864-6005

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2

Task Order Number: 01OC Revision: ____ Date of Revision:
Title: X-43A Alternative Booster Study Team Support

1.	**<u>Purpose</u>:** **The purpose of this Task is to provide technical support to X-43A Alternative Booster Study Team aimed at determining the most appropriate choice of booster for the next flight of the X-43A.**
2.	**<u>Description of the Work to be Performed</u>:** The technical support to be provided will require the Contractor to participate in the study activity of the X-43A Alternative Booster Study Team. The work will require the discovery of alternate booster possibilities. Each of these booster possibilities will be assessed to determine their suitability for the intended application as a booster for the X-43A test flight requirements. Those booster alternatives that have promise of being able to meet the requirements will then be evaluated in a detailed technical sense as to their (1.) Performance; (2.) Weights and Mass Properties; (3.) Stability and Control Authority; (4.) Aero/Thermo-dynamics Data Base; (5.) Operational Considerations; (6.) Issues identified by the Team; and (7.) Team Product Integration. The Contractor will not be involved in all the efforts just itemized but shall, in addition to helping the Team to discover alternate booster possibilities, perform the following subtasks: 1. Performance: Each booster judged suitable for the intended application (a booster that may satisfy the X-43A test flight requirements) shall be assessed to determine if it fully meets the performance portion of the requirements. The timely provision of each of these candidate booster Performance assessments meets this subtask expectation. The timeliness requirement is set by the data needs of subtask 4. All work product created in doing this subtask shall be provided to the X-43A Alternative Booster Study Team at task order completion. 2. Weights and Mass Properties: Each booster judged suitable for the intended application (a booster that may satisfy the X-43A test flight requirements) shall be assessed to determine if it fully meets the Weights and Mass Properties portion of the requirements. The timely provision of each of these candidate booster Weights and Mass Properties assessments meets this subtask expectation. The timeliness requirement is set by the data needs of subtask 4. All work product created in doing this subtask shall be provided to the X-43A Alternative Booster Study Team at task order completion. 3. Issues identified by the Team: Each member of the Team will bring to the attention of the Team any issue that may influence the evaluation of an alternative booster. Participation in each Team meeting to include discussion about the appropriateness of each candidate booster that might lead to the identification of an issue meets this subtask expectation. 4. Team Product Integration: The efforts of the entire Team shall be organized and integrated to provide a Power Point presentation of the work outcome of the Team. These presentations shall be based on the work product of the Team and be organized in a way to make the information readily understandable to those who view it. An interim Team Product Integration presentation shall be created the first workweek in December 2001 and a final Team Product Integration presentation shall be created the first workweek in January 2002. There may be the need to also support an update to the final presentation during the

	month of January 2002. The timely error free completion of each of these Power Point presentations and their completeness meets this subtask expectation. The timeliness requirement is to complete the interim presentation on or before the close of business of the last work day of the first workweek in December 2001, complete the final presentation on or before the close of business of the last work day of the first workweek in January 2002 and complete any updates required on or before the close of the last business day in the month of January 2002.
3.	**Government Furnished Items:** X-43A Alternative Booster Study Team meeting places at various Langley Research Center conference room locations will be provided. Access to the X-43A Alternative Booster Study Team's work product will be available as it is created. Access to and use of existing Langley software analysis tools will be provided as needed.
4.	**Other information needed for performance of task:** Travel is not required for the successful performance of this Task.
5.	**Security clearance required for performance of work:** A security clearance is not required for the successful performance of this Task.
6.	**Period of Performance:** Planned start date: First workweek November 2001. Completion date: January 31, 2002.
7.	**NASA Technical Monitor**: Wilson T. Lundy M/S: 117 Phone: 757-864-6092 NASA Competency/Other Technical Coordinator: Carolyn Carey M/S: 104 Phone: 757-864-3783

Task Order Number: 01OCB Revision: 8 Date of Revision: 3/21/05

Title: Technology to Support Scramjet-powered Flowpath Development

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

NASA Langley Research Center (LaRC) has been a major R6***participant*** in the development of scramjet and hypersonic vehicle systems technology since 1960. Over this time, LaRC has developed: ground-based experimental testing; data analysis techniques; and analytical, computational, and design specific methodologies. These design methods, which are specific to airbreathing hypersonic vehicles, scramjet-engine flow path definition, and associated hypersonic aerodynamic performance, loads assessments, 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, specifically, from 1985-1995 on the National Aero-Space Plane (NASP) Program, and currently on the implemented codes utilized to address the numerous hypersonic propulsion design issues. An example is SRGULL which uses an Euler (finite-difference, shock fitting) algorithm on the forebody and inlet, coupled with a boundary-layer solution, to predict the forebody/inlet drag and the flow properties entering the engine. The ramjet/scramjet solution is then completed using a quasi-one-dimensional cycle analysis with equilibrium chemistry through the combustor, for a given fuel mixing distribution, and the nozzle forces are resolved using a multi-dimensional CFD Euler analysis coupled with boundary layer corrections to yield net thrust values. Consistent with the technology requirements of the existing NASA hypersonic program elements, primarily those of the NASA Next Generation Launch Technology activity (NGLT), this task will focus on technology efforts to support scramjet-powered flowpath development.

Relevant Technical Documents/ Bibliography of Reference Material:
(Note: Contact the NASA LaRC Technical Library for copies of 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, 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.

Revision 3: Extends the period of performance through December 31, 2003 in continuation of NASA's support with updated title and requirements including a roll-in of work previously performed under Task Order 03OCB (*SRGULL* propulsion code) and replaces the alternate technical monitor.

For details of 01OCB original, Revision 1, and Revision 2 SOWs see ETOS *doc* files *01OCB, 01OCB01v, and O1OCB02a*, respectively. For details of 03OCB original and Revision 1 SOWs see ETOS *doc* files *03OCB and 03OCB01a*, respectively.

Revision 4: Rolls in portions of work previously performed under Task Order 04OCB (see [R4] below.)

Revision 5: Adds requirements and metrics as new items 2.2.1.5, 2.2.2.5, and 2.2.4.5.A (see [R5] below)

Revision 6: Extends the period of performance 17 months to May 31, 2005, in continuation of NASA's support, redefines/updates the requirements for the new period of performance, and updates other info (see [R6]above and below).

Revision 7: Extends the period of performance four months to September 30, 2005 in continuation of NASA's support with no detailed changes in requirements (see [R7] below, Section 6).

Revision 8: Adds the anticipated requirement to disseminate information at foreign conferences (see [R8] Section 4 below).

2. **Description of the Work to be Performed**:

The Contractor shall perform detailed design and risk reduction analysis efforts for the NASA X-43/A/B/C vehicles. These analyses shall provide sufficient information to allow the government to verify the engine flowpath design, thermal-structural design, and the vehicle model lines, as well as to document vehicle/engine performance and operability. The Contractor will interface with the associated Integrated Product Teams (IPT) via the Hypersonic Airbreathing Propulsion Branch (an entity within the Research and Technology structure of LaRC), in order develop, apply and validate technology required to field future hypersonic, scramjet-powered vehicles. These activities shall include the items listed in section 2.1.1:

2.1.1 Design and analysis of the X-43/A/B/C Scramjet Powered Flight Vehicles [R4]~~and design and construction of BEOWULF clusters:~~

2.1.1.1 The Contractor shall support the X-43/A return to flight activities, [R4]inclusive of work relevant to day-of-flight technical activities, and the 3rd X-43/A vehicle (Mach-10) aerodynamic and aero-thermodynamic analysis effort by conducting

Computational Fluid Dynamic (CFD) analysis. This analysis task includes external and internal airframe calculations using appropriate codes and methodologies. Additionally, the Contractor shall support the X-43/A (Mach-7) efforts; namely, the engine thermal-load analysis (to be delivered both to LaRC and GASL), the fuel sequencing analysis (Mach-10), the flight data acquisition and retrieval quick-look analysis, the HSM [R6]and the NGLT-HySM (Mach-10) CFD analyses associated with the HYPULSE test database, and relevant performance and operability design analysis required to aid in the accomplishment of the task (inclusive of X-43/A flight data – if available).

2.1.1.2 The Contractor shall support X-43/B efforts, as is deemed necessary by the TM. This effort will be negotiated on a case-by-case basis, and is expected to be focussed on CFD analysis, stressing performance and operability flowpath issues, [R6]and transonic PAI (Propulsion Airframe Integration) analysis (valicated using existing PAI data).

2.1.1.3 The Contractor shall support the X-43/C developmental efforts. The task includes: providing a test engineer for the mixing and combustion experimental investigations conducted at the LaRC propulsion complex, in conjunction with propulsion system support in the 8-HTT (specifically the Multi-Flowpath Propulsion Demonstrator test), and associated CFD/experimental coordination activities for the X-43/C inlet redesign effort; as well as, staff to accomplish engine-vehicle integration analysis, flowpath and operability assessment analysis, and complete vehicle CFD analysis, APAS configuration assessment, aerothermal configuration analysis, open-cowl and fuel-on delta force analysis, and an assessment of lessons-learned, as well as relevant performance and operability design analysis required to aid in the accomplishment the task.

2.1.1.4 [R6](Completed).

2.1.2 DELIVERABLES :

2.1.2.1 The X-43/A return-to-flight aerodynamic results shall be presented in the form of integrated force and moment data, component loads, and pressure and thermal loads. All significant subtasks will be documented employing standard NASA reporting mechanisms. Note that informal status reports shall be submitted on a case -by-case basis to supplement the monthly progress reports (if deemed necessary by the TM).

(Completion date: 30 working days after technical subtask completion)

2.1.2.2 The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism.

(Completion date: 30 working days after technical subtask completion)

2.1.2.3 The Contractor shall document all significant findings and results employing a

standard NASA reporting mechanism.
(Completion date: 30 working days after technical subtask completion)
2.1.2.4 R6(Completed)

2.1.3 SCHEDULE:
See section 2.1.2
2.1.4 METRICS FOR DELIVERABLES:
2.1.4.1.A - Meet schedule and cost.
2.1.4.1.B - Comparisons with experimental data to validate solutions (if available).
2.1.4.1.C - Results documented in Contractor Report and/or meeting papers.
2.1.4.2.A - Meet schedule and cost.
2.1.4.2.B - Comparisons with experimental data to validate solutions (if available).
2.1.4.2.C - Results documented in Contractor Report and/or meeting papers.
2.1.4.3.A - Meet schedule and cost.
2.1.4.3.B - Comparisons with experimental data to validate solutions (if available).
2.1.4.3.C - Results documented in Contractor Report and/or meeting papers.
2.1.4.4.A – R6(Completed)
2.1.5 EXCEEDS MINIMUM REQUIREMENTS:
2.1.5.1.A - Perform effort such that a reduction of schedule and cost is achieved.
2.1.5.1.B – Solutions/analysis consistent with standard NASA/Industry procedures and calibration/validation procedures.
2.1.5.1.C - Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.1.5.2.A - Perform effort such that a reduction of schedule and cost is achieved.
2.1.5.2.B - Solution methodology consistent with standard NASA/Industry procedures and calibration/validation procedures.
2.1.5.2.C - Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.1.5.3.A - Perform effort such that a reduction of schedule and cost is achieved.
2.1.5.3.B - Solution methodology consistent with standard NASA/Industry procedures and calibration/validation procedures.
2.1.5.3.C - Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.1.5.4.A – R5(Completed*)*
2.2.1 SRGULL Propulsion Design Code Update, Documentaion and Distribution. (*Previously performed under Task Order 03OCB.)*
2.2.1.1 The Contractor shall R6continue to upgrade the code to efficiently converge the isolator
reattachment model, in the flight Mach 3-7 speed range, utilizing the X-43A/B/C configurations.

2.2.1.2 Review, update and distribute SRGULL code and documentation (consistent with user requirements).
2.2.1.3 Validate code with existing engine data (as it is made available via the on going
NASA hypersonic programs). This shall include both dual-mode scramjet and RBCC data (both with hydrogen and hydrocarbon fuels). This is projected to be primarily X43-C data R6~~generated during GDE-1 testing~~, coupled with well-documented previous NASA hypersonic engine tests.
2.2.1.4 Support external LaRC users as required (with concurrence of LaRC TM).
2.2.1.5 R5Apply SRGULL to generate propulsion datasets/databases for NASA Next Generation Launch Technology program and other historical R6datasets, and initiate the implementation, and application, of finite-rate kinetics analysis methods (for hydrogen and hydrocarbon fuels) within the SRGULL code(with the concurrence of the LaRC TM).

2.2.2 DELIVERABLES
2.2.2.1 R6Continue enhanced documentation for Mach 3-7 isolator model, R6and associated SRGULL code modifications.
(Completion date: 30 working days after technical subtask completion)
2.2.2.2 Document application of SRGULL to the X-43/A/B/C database.
(Completion date: 30 working days after technical subtask completion)
2.2.2.3 Documentation of significant technical findings.
(Completion date: 30 working days after technical subtask completion)
2.2.2.4 Documentation of significant technical findings.
(Completion date: 30 working days after technical subtask completion)
2.2.2.5 R5Documentation of technical results.
(Completion date: 30 working days after technical subtask completion)

2.2.3 SCHEDULE
See section 2.2.2 above.

2.2.4 METRICS FOR DELIVERABLES
2.2.4.1.A Meet schedule and cost.
2.2.4.1.B Solutions/analysis consistent with standard NAO-CSO/CFD procedures and calibration/validation procedures.
2.2.4.1.C Results documented in Contractor Report and/or meeting papers.
2.2.4.2.A Meet schedule and cost.
2.2.4.2.B Results documented in Contractor Report and/or meeting papers.
2.2.4.3.A Meet schedule and cost.
2.2.4.3.B Solutions/analysis consistent with standard NAO-CSO/CFD procedures and calibration/validation procedures.
2.2.4.3.C Results documented in Contractor Report and/or meeting papers.

2.2.4.4.A Meet schedule and cost.
2.2.4.4.B Results documented in Contractor Report and/or meeting papers.
2.2.4.5.A [R5]Meet schedule and cost.

2.2.5 EXCEEDS MINIMUM REQUIREMENTS
2.2.5.1.A Perform effort such that a reduction of schedule and cost is achieved.
2.2.5.1.B Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.2.5.2.A Perform effort such that a reduction of schedule and cost is achieved.
2.2.5.2.B Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.2.5.3.A Perform effort such that a reduction of schedule and cost is achieved.
2.2.5.3.B Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.2.5.4.A Perform effort such that a reduction of schedule and cost is achieved.
2.2.5.4.B Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).
2.2.5.5.A [R5]Perform requirements such that a reduction of schedule and cost is achieved.

3. **Government Furnished Items:**

3.1 Specialized 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
- BEOWULF Cluster

3.2 Available Specialized Software:

- GASP 2.2	- GASP 4.0	- GRIDGEN	- TECPLOT	- GRIDTOOLS	- SHIP3D
- SRGULL	- SCRAM3L	- VULCAN	- USM3D	- PARAFLOW	- POST
- APAS	- PATRAN	- PRO-E	- UG	- SINDA85	- SAM3D
- MSCNASTRAN					
- MSCTHERMAL		- HYPERSIZER	- XESS	- I3G	- ACAD
- [R6]HEFSS					

3.3 Special items:
- Safes for storage of classified material
- Private/secure office for task leader

4. **Other information needed for performance of task:**

4.1 Estimated Travel requirements:

Performance of these tasks may require travel to: Marshall Space Flight Center, Norfolk Va., Kennedy Space Center, Dryden Flight Research Center, Edwards, CA; Glenn Research Center,

Task Order Number: 01OCB Revision: 8 Date of Revision: 3/21/05

Title: Technology to Support Scramjet-powered Flowpath Development

	Cleveland, OH; GASL (Allied Aerospace Inc.), Ronkonkoma, NY; Boeing North American, Seal Beach and Canoga park, CA; Microcraft, Tullahoma, TN and Ontario, CA; Pratt & Whitney, West Palm Beach, FL; Aerojet, Sacramento, CA; and participation in JANNAF Propulsion meetings, and appropriate international forums. R8***Dissemination of information (subject to the NASA-LaRC release authorization procedures) at foreign conferences is an anticipated requirement.***
5.	**Security clearance required for performance of work:** 5.1 Much of the work performed on this work order requires a DOD SECRET clearance. 5.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate. 5.3 Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.
6.	**Period of Performance:** Planned start date: R2~~January/1/2001~~ R3~~January/1/2002~~ R6~~January/15/2003~~ January/01/2004 Completion date: R2~~December/31/2001~~ R3~~December/31/2002~~ R6~~December/31/2003~~ R7 ~~May/31/2005~~ September/30/2005
7.	**NASA Technical Monitor:** NASA TECHNICAL MONITOR: Dr. Aaron Auslender M/S: 168 Phone: 757-864-6545 NASA TM ALTERNATE: Karen Cabell M/S: 168 Phone: 757-864-6267

Task Order Number: 01OCE Revision: 3 Date of Revision: 5/27/04

Title: NGLT Systems Analysis Project

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

Begin R2 block update for option period

1.1 Purpose. The NGLT Systems Analysis Project (SAP) is led by NASA Langley Research Center (LaRC). The purpose of the SAP is to provide the Next Generation Launch Technology (NGLT) Program with technology development recommendations based on rigorous mission-driven systems analysis. R3***The Exploration Task Team is a team within the NGLT Program that was formed to address taskers from Code T.***

1.2 Background. The NGLT program was established in November 2002 as a merger of two previous NASA technology program: the Space Launch Initiative (SLI) and the Advanced Space Transportation Program (ASTP). During FY03, the SAP performed and delivered the results of three major studies of advanced space transportation systems to NGLT: the Tiger Team Study, which examined conceptual hypersonic airbreathing propulsion-based space access systems for Far Term i.e., 2025 initial operational capability) mission applications; the Space Partnership Council (SPC) Blue Team technical support package, which supported a Red Team review of the Near Term (i.e., 2015 IOC) mission potential of hypersonic space access systems; and the Common Booster Preliminary Study Report, which established the feasibility of a rocket-based Common Booster (CB) launch system for Department of Defense (DoD) and NASA Near and Mid Term (i.e., 2020 IOC) spacelift needs. The analytical methods, databases, and tools developed and utilized in FY03 for these studies will continue to be used and improved in FY04, in part under this Scope of Work (SOW). R3***The Exploration Task Team was formed in February 2004 to address the President's initiative to return to the moon and go on to Mars. This Team was formed within the NGLT Program to address taskers from Code T.***

1.3 Process. In fulfilling its purpose for NGLT, the SAP works closely with a sister NGLT project, the System Integration Project (SIP), to execute an Integrated System Engineering and Analysis Process (ISEAP), that is established in a System Engineering Management Plan (SEMP) which is reviewed by the System Engineering and Analysis (SEA) "Segment's" Project Control Board (PCB) and approved by the Program's Engineering Review Board (ERB). The SEMP, together with the parent authorizing requirements in the Program Requirements Document (PRD), authorize SAP to execute three major steps of the ISEAP: System Definition, System Assessment, and Technology Assessment. The key deliverables of these three steps are identified in Appendix, Figure 1.

The work under this task order is R3***planned to be*** in two cycles for FY04. R3***Cycle 1 was completed on*** February R3***13,*** 2004 and Cycle 2 R3~~is completed on September 30 2004~~ ***was canceled***. At the end of R3***Cycle 1*** the data and analysis is to be documented in an Architecture Definition Document on STIN R3~~and a final report is generated in Word format~~.

End R2 block update for option period

	Note: The required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are conveyed to the Contractor as ready to be performed, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. Revision 1: Extends the period of performance of the pre-option phase one month to November 30, 2003 and adjusts the option to begin December 1, 2003 for NASA's convenience. *Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as doc files 01OCE and 01OCE01.* Revision 2: Extends the period of performance one year to November 30, 2004 in continuation of NASA's support requirements for the option period, extensively redefines the requirements for the new period of performance, adds a new primary technical monitor, and updates other info (see [R2] above and below). Revision 3: Includes ETT support, deletes and updates Cycle 1 requirements, and cancels Cycle 2 (see [R3] above and below).
2.	**Description of the Work to be Performed:** **Begin [R2] block update for option period** The Contractor shall provide support to one or more of the working teams shown in the SAP's organization structure in Appendix, Figure 2 [R3]***or support any areas in the Exploration Task Team Organization***. **2.1 Program and Project Integration Support** Reserved **2.2 Focused Analysis Team [R3]*and Exploration Task Team (ETT)* Support** Effort under the Focused Analysis team shall provide Level 0 trade study data and support Program requests for quick response analysis. Specific technical direction shall be provided by FAT Co-leads [R3]***or ETT Leads***. In addition, planned Level 0 trades shall be specified in the FY04 Architecture Study Plan. 2.2.1 Program Requested Taskers Program requested taskers are quick response answers to questions from the Program office. The support for this will be provided by the contractor as directed by the Focused Analysis Team Co-Leads [R3]***or ETT Leads***. The resources to answer these program taskers will be moved

from the Level 0 trades analysis as needed.

Deliverables: Reports in Powerpoint format for each Tasker.

2.2.2 Conduct Level 0 Trade Studies
The Contractor shall execute Level 0 trades and other analysis as requested and prioritized by the Focused Analysis Team co-leads, and in accordance with the prioritized plan of Level 0 trades established in the NGLT-board approved FY04 Architecture Study Plan.

Deliverables: Trade study report at the conclusion of each requested trade study.

2.2.3 Focused Analysis Team R3***and ETT*** Final Report briefing preparation
Prepare a PowerPoint presentation that compiles products generated for the Focused Analysis Team during this contract period.

Deliverable: Summary PowerPoint briefing of products provided to Focused Analysis Team R3***or ETT*** NLT 11/30/04.

2.2.4 Focused Analysis Team meetings and coordination
Participate in all team telecons, attend all face-to-face meetings, and support all program meetings and telecons.

Deliverables:
· Presentation at Mid Cycle 1 Review Meeting in R3~~January~~ ***February*** of 2004
· R3~~Presentation at End Cycle 1 Review Meeting in March 2004~~
· Provide input materials needed for Cycle 1 final report (in Powerpoint with Facing page text descriptions) in R3~~March~~ ***February*** 2004 and upload to Architecture Definition Document
*****Begin R3block deletion*****
~~· Presentation at Mid Cycle 2 Review Meeting in July of 2004~~
~~· Presentation at End Cycle 2 Review Meeting in September 2004~~
~~· Provide input materials needed for Cycle 2 final report (in Powerpoint with Facing page text descriptions) in September 2004 and upload of Architecture Definition Document~~
*****End R3block deletion*****
2.2.5 Focused Analysis Team R3***and ETT*** task management
Provide task management function to provide desired products within the available resources; maintain a task schedule; and provide monthly project reports summarizing progress to date, effort expended, any issues, and planned effort for the coming month.

Deliverables: Monthly task report NLT the 6th working day after the end of the calendar month.

2.3 Architecture Task Team A (Rocket) Support

2.3.1 Architecture Design and Technology Selection Optimization. The Contractor shall perform up to 100 hours of independent analysis using analytical tools and methods of their choice in order to develop recommendations for Architecture Task Team A (ATT-A) consideration. These recommendations will outline specific design features that, if incorporated in the end-to-end architecture, will significantly improve the ability of the architecture to satisfy one or more of the key Figures of Merit (FOMs) and other requirements established at the start of the analysis execution cycle. These recommendations shall encompass both key enabling and enhancing technologies as well as intelligent architecture design features. These recommendations shall be presented no later than at the "Architecture Design and Technology Integration Workshop" tentatively planned for December 8-12, 2003 at LaRC.

2.3.2 System Design and Optimization. The Contractor shall provide performance, level 2 fidelity design and discrete-event-simulation analysis in support of the in-depth analysis of common booster architecture with a focus on design for operability. This analysis will include, but not be limited to, design option identification and trade studies of the vehicle structures, thermal protection system, and propellant tanks and any other subsystem requested by the Team Lead. Health monitoring requirements and characteristics for the subsystems analyzed will be developed. The Contractor shall support life cycle cost assessments of the common booster architecture. The subsystems to be designed and analyzed shall not overlap or duplicate work being performed by the other contractors supporting ATT A, unless explicitly directed by the ATT A technical co-leads.

2.3.2.1 Common Booster integrated structures, tanks and TPS Level 2 design and analysis
Define material and concept options and perform trades (ex. insulated vs. hot structure) for the Case 2 Common Booster launch vehicle system. Develop design load cases as a function of mission phase. Define instrumentation and IVHM concepts and requirements. Identify probabilistic failure rates for components. Link solutions to program groundrules and assumptions, system requirements, and vehicle configuration.

Deliverables:
R3 ~~· Case 2 Common Booster integrated structures, tanks and TPS Level 2 definition and analysis for at least one complete design (1st priority - hot structure) including; schematics; DES Models and/or data; NLT end of February 2004~~.
· Case 2 Common Booster integrated structures, tanks and TPS Level 2 definition and analysis for at least a second design including; schematics; DES Models and/or data; NLT end of August 2004.

2.3.2.2 MPS Integration and Vehicle Hold-down Feasibility Study
Conduct a detailed (level 2 fidelity) design study of main propulsion system integration

concepts for the Case 2 Common Booster comparing system impact. Concepts shall include trades on area ratio, engine packaging, engine gimbal approaches and address accessibility issues for rapid turnaround. Hold down and on-pad support systems shall also be designed.

Deliverables: MPS Integration study results with recommended solution NLT end of February 2004.

2.3.3 Architecture Task Team A Final Report briefing preparation
Prepare a PowerPoint presentation with facing page text descriptions that compiles products generated for Team A during this contract period.

Deliverable: Summary PowerPoint briefing of products provided to ATT A NLT 11/30/04.
2.3.4 Architecture Task Team A meetings and coordination
Participate in all team telecons, attend all face-to-face meetings, and support all program meetings and telecons.

Deliverables:
· Presentation at Mid Cycle 1 Review Meeting in R3~~January~~ ***February*** of 2004
R3~~· Presentation at End Cycle 1 Review Meeting in March 2004~~
· Provide input materials needed for Cycle 1 final report (in Powerpoint with Facing page text descriptions) in March 2004 and upload to Architecture Definition Document
*****Begin R3block deletion*****
~~· Presentation at Mid Cycle 2 Review Meeting in July of 2004~~
~~· Presentation at End Cycle 2 Review Meeting in September 2004~~
~~· Provide input materials needed for Cycle 2 final report (in Powerpoint with Facing page text descriptions) in September 2004 and upload of Architecture Definition Document~~
*****End R3block deletion*****

2.3.5 Architecture Task Team A task management
Provide task management function to provide desired products within the available resources; maintain a task schedule; and provide monthly project reports summarizing progress to date, effort expended, any issues, and planned effort for the coming month.

Deliverables: Monthly task report NLT the 6th working day after the end of the calendar month.

2.4 Architecture Task Team B (Hybrid) Support

2.4.1 Architecture Design and Technology Selection Optimization. The Contractor shall perform up to 300 hours of independent analysis using analytical tools and methods of their choice in order to develop recommendations for ATT-B consideration. These recommendations will outline specific design features that, if incorporated in the end-to-end architecture, will significantly improve the ability of the architecture to satisfy one or more of the key Figures of Merit (FOMs) and other requirements established at the start of the analysis execution cycle. These recommendations shall encompass both key enabling and enhancing technologies as well as intelligent architecture design features. These recommendations shall be presented no later than at the "Architecture Design and Technology Integration Workshop" planned for December 8-12, 2003 at LaRC. The subsystems to be designed and analyzed shall not overlap or duplicate work being performed by the other contractors supporting ATT B, unless explicitly directed by the ATT B technical co-leads.

Deliverables:
· Monthly task report NLT the 6th working day after the end of the calendar month.
· Presentation at Mid Cycle 1 Review Meeting in R3~~January~~ ***February*** of 2004
R3~~· Presentation at End Cycle 1 Review Meeting in March 2004~~
· Provide input materials needed for Cycle 1 final report (in Powerpoint with Facing page text descriptions) in March 2004 and upload to Architecture Definition Document
*****Begin R3block deletion*****
~~· Presentation at Mid Cycle 2 Review Meeting in July of 2004~~
~~· Presentation at End Cycle 2 Review Meeting in September 2004~~
~~· Provide input materials needed for Cycle 2 final report (in Powerpoint with Facing page text descriptions) in September 2004 and upload of Architecture Definition Document~~
*****End R3block deletion*****

2.5 Architecture Task Team C (Hypersonics) Support

2.5.1 Architecture Design and Technology Selection Optimization. The Contractor shall perform up to 100 hours of independent analysis using analytical tools and methods of their choice in order to develop recommendations for ATT-C consideration. These recommendations will outline specific design features that, if incorporated in the end-to-end architecture, will significantly improve the ability of the architecture to satisfy one or more of the key Figures of Merit (FOMs) and other requirements established at the start of the analysis execution cycle. These recommendations shall encompass both key enabling and enhancing technologies as well as intelligent architecture design features. These recommendations shall be presented no later than at the "Architecture Design and Technology Integration Workshop" planned for December 8-12, 2003 at LaRC.

*****Begin R3block deletion*****
~~2.5.2 System Design & Optimization~~

~~The objective of this effort is two-fold. In an initial 6 month effort (Cycle 1), explore the broad trade space for hypersonic airbreathing boosted space access systems that leverage existing or~~

~~near-term, low risk technologies to identify options that satisfies a near-term military reference mission delivering small payloads at high flight rates. In addition, interest in each system's evolvability will be investigated to determine which architectures are capable of satisfying a broad range of customer needs. Secondly, in a follow-on 6 month effort (Cycle 2), mature an advanced technology hypersonic TSTO designed to support the far-term commercial design reference mission (DRM) to a higher level of design fidelity, increase the level of design certainty, and support the evaluation of advanced hypersonic technologies.~~

~~Tasks 1-5 are planned for Next Generation Launch Technologies (NGLT) Systems Analysis Project (SAP) Cycle 1 (October 2003 – March 2004), while Tasks 6-12 are planned for Cycle 2 (April 2004 – October 2004). The subsystems to be designed and analyzed shall not overlap or duplicate work being performed by the other contractors supporting ATT C, unless explicitly directed by the ATT C technical co-leads.~~

~~2.5.2.1 Task 1 – Engine Performance Data Development~~

~~Work in conjunction with the Architecture C team to develop installed performance & configuration databases consistent with the inlet & nozzle concepts for the various airbreathing booster configurations and the various turbine & turboramjet engine trade options. Task includes compiling existing data & generating new data, as applicable, to enable the timely delivery of installed performance & configuration data.~~

~~Deliverable: Establish & execute process to generate the appropriate installed performance & sizing databases & models that support the Cycle 1 propulsion installations for each of the vehicle configurations.~~

~~Date: No later than January 16, 2003~~

~~2.5.2.2 Task 2 – Airbreathing Booster Structural Weight Database Development~~

~~Work in conjunction with the Architecture C team to define the structural architecture and establish a structural unit weights database consistent with state-of-the-art and near-term technology options. Task includes compiling existing data from applicable references and previous studies and conducting engineering analysis (if appropriate) consistent with the pre-conceptual level of fidelity to maximize the data certainty.~~

~~Deliverable: Establish structural architecture and technical performance data for state-of-the-art, enabling & enhancing technology suites in support of the Cycle 1 tasks.~~

~~Date: No later than January 16, 2003~~

~~2.5.2.3 Task 3 – Airbreathing Booster Thermal Protection System Weight Database Development~~

~~Work in conjunction with the Architecture C team to define the TPS architecture and establish a TPS unit weights database consistent with state-of-the-art and near-term technology options. Task includes compiling existing data from applicable references and previous studies and conducting engineering analysis (if appropriate) consistent with the pre-conceptual level of fidelity to maximize the data certainty. Envisioned product is a parametric equation set or model that quantifies the TPS & insulation unit weight, thickness and acreage (coverage fraction) as a function of maximum airbreathing Mach number or other appropriate independent system variables.~~

~~Deliverable: Establish TPS archtitecture and technical performance data for state-of-the-art, enabling & enhancing technology suites in support of the Cycle 1 tasks.~~

~~Date: No later than January 16, 2003~~

~~2.5.2.4 Task 4 – Configuration Development & Aerodynamic Performance~~

~~Develop geometric configuration and generate appropriate aerodynamic performance databases for a blended wing body TSTO system (Option D) designed to satisfy the appropriate design reference mission(s) provided by the NGLT SAP and to support the various system level trade studies.~~

~~Deliverable: Establish & execute design & analysis process to generate vehicle geometry & aerodynamic performance for the blended wing body configuration.~~

~~Date: No later than January 16, 2004~~

~~2.5.2.5 Task 5 – System Level Performance Trades~~

~~Work with the Architecture C team to develop a prioritized matrix of trade study options for a blended wing body TSTO system (Option D). Conduct prioritized trades and document results.~~

~~Deliverable: Prioritized trade study matrix; Establish & execute process to complete systems trade studies for the blended wing body configuration.~~

~~Date: Prioritized matrix no later thasn December 12, 2003; System trade study results no later than January 16, 2004~~

~~2.5.2.6 Task 6 – As Drawn Subsystem Analysis – Structures & TPS Sizing~~

~~Work with various NASA field centers to develop the aerothermal & mechanical loads needed for airframe structural & thermal protection system (TPS) sizing & analysis of the booster, orbiter & mated TSTO configurations. Conduct structure & TPS sizing (weight & volume) of baseline technology suite for the booster & orbiter.~~

~~Deliverables: Mechanical & aerothermal loads database in a format compatible with appropriate structural & TPS sizing models; Airframe structural & TPS sizing results (weight & volume) for the booster & orbiter.~~

~~Date: No later than June 6, 2004~~

~~2.5.2.7 Task 7 – As-Drawn Subsystem Performance – Airframe Subsystem Functional Design~~

~~Work with NASA's Vehicle Systems Research & Technology (VSR&T) Project and the Architecture C team to perform initial subsystems functional design and layout for the booster & orbiter. Functional design & layout is needed for propellant feed systems; pressurization & purge systems; vehicle thermal management & control systems; OMS & RCS subsystems; electrical power generation (APUs, fuel cells, batteries, etc…); power conversion & distribution; actuation systems (hydraulics, EHAs, EMAs); adaptive flight & control systems; and IVHM.~~

~~Deliverables: Functional description of each airframe subsystem for each stage including schematics, block diagrams & assessmewnt of functional performance, and required redundancy. Provide inputs to the life cycle analysis team (LCAT) & support the LCAT in the initial estimate of subsystem life cycle cost, inherent subsystem reliability & catastrophic failure probability.~~

~~Date: No later than June 6, 2004~~

~~2.5.2.8 Task 8 – As Drawn Subsystem Analysis – Airframe Subsystem Performance & Sizing~~

~~Work with NASA's Vehicle Systems Research & Technology (VSR&T) Project and the Architecture C team to perform airframe subsystem performance & sizing for both the booster & orbiter stages based on the functional design developed in Task 3b. Airframe subsystem performance & sizing is needed for propellant feed systems; pressurization & purge systems; vehicle thermal management & control systems; OMS & RCS subsystems; electrical power generation (APUs, fuel cells, batteries, etc…); power conversion & distribution; actuation systems (hydraulics, EHAs, EMAs); adaptive flight & control systems; and IVHM.~~

~~Deliverables: Performance evaluation & sizing (weight & volume) of each airframe subsystem~~

~~for each stage. Provide inputs to the life cycle analysis team (LCAT) & support the LCAT in the determination of subsystem life cycle cost, inherent subsystem reliability & catastrophic failure probability updates.~~

~~Date: No later than June 6, 2004~~

~~2.5.2.9 Task 9 – System FOM & Technology Assessment~~

~~Assist SAIC and NASA Marshall in developing an integrated concept model (ICM) for the updated configuration and assessing the system architecture design against the FOM's. Support development of probabilistic life cycle assessment model, including quantifying TPM uncertainty and developing trajectory response surface models. In addition, provide support for the Architecture C Value Stream activity currently planned for August 2004.~~

~~Deliverable: Technology & performance inputs for ICM model.~~

~~Date: No later than June 20, 2004~~
*****End R3 block deletion*****

2.5.2.10 Task 10 – Technical Reporting

Participate in all team telecons, attend all face-to-face meetings, and support all program meetings and telecons.

Deliverables:
· Monthly task report NLT the 6th working day after the end of the calendar month.
· Presentation at Mid Cycle 1 Review Meeting in R3 ~~January~~ ***February*** of 2004
R3~~· Presentation at End Cycle 1 Review Meeting in March 2004~~
· Provide input materials needed for Cycle 1 final report (in Powerpoint with Facing page text descriptions) in March 2004 and upload to Architecture Definition Document
*****Begin R3 block deletion*****
~~· Presentation at Mid Cycle 2 Review Meeting in July of 2004~~
~~· Presentation at End Cycle 2 Review Meeting in September 2004~~
~~· Provide input materials needed for Cycle 2 final report (in Powerpoint with Facing page text descriptions) in September 2004 and upload of Architecture Definition Document~~
*****End R3 block deletion*****

2.6 Non-Architecture-Specific Discipline Team Support

2.6.1 Aerodynamics Discipline Team.

2.6.2 Propulsion Discipline Team.

2.6.3 Structures Discipline Team.

2.6.4 Vehicle Systems Discipline Team.

2.6.5 Performance Discipline Team.

2.6.6 Life Cycle Analysis Discipline Team.

2.6.7 Organization Discipline Team.
The Contractor shall provide discipline expertise to support process development, ground rules and assumptions documentation development, discipline tool development conceptualization and prioritization, and team meetings and teleconferences support.

2.6.7.1 Baseline Future Space Transportation System (STS) Organization Model
The Contractor shall support the design, development, and documentation of an analytical (math) model for a baseline future space transportation system organization. This model will be documented and developed in accordance with NPG 7120.5 and SP610S. The completed analytical (math) model and data package are due NLT 31 March 2004. The analytical model will be integrated by the contractor into the LCA process model.

2.6.7.2 Alternate Future STS Organization Model
The Contractor shall support the design, development, and documentation of an analytical (math) model for a baseline future space transportation system organization. This model will be documented and developed in accordance with NPG 7120.5 and SP610S. The completed analytical (math) model and data package are due NLT 30 June 2004. The analytical model will be integrated by the contractor into the LCA process model.

2.6.7.3 Future STS Organization Best Practices and Expert Recommendations Report
The Contractor shall support development of the final report by producing briefing inputs and attending meetings as required to support delivering the final report NLT 30 September 2004.

2.6.7.4 Analytical Consistency Plan Update
The Contractor shall support the development and production of the Analytical Consistency Plan on a bi-annual basis. The plan updates are due NLT 30 April 2004 [R3]~~and 31 October 2004~~.

End [R2] block update for option period

3. <u>Government Furnished Items</u>:

4. **Other information needed for performance of task:**

Begin R2 block update for option period

4.1 Monthly Reports. The Contractor shall submit a monthly technical progress report summarizing all work accomplished during each month throughout the contract period of performance. These reports shall be electronically distributed by email to the Project Manager, Deputy Project Manager, Task Team Leads, Discipline Team Leads and Focused Analysis Team Co-Leads. Reports shall be in narrative form, brief and informal in content. Reports shall include, at a minimum:

1. A quantitative description of overall progress split out by Focused Analysis Team (Section 2.2), ATT A (Section 2.3), ATT B (Section 2.4), ATT C (Section 2.5) and Discipline Teams (Section 2.6); including hours used and status of work. This report shall also include a running total of hours billed to date and hours remaining by Focused Analysis Team (Section 3.2), ATT A (Section 3.3), ATT B (Section 3.4), ATT C (Section 3.5) and Discipline Teams (Section 3.6).

2. Status of deliverables with explanation of late deliverables.

3. An indication of any current issues or problems, which may impede performance and proposed corrective action;

4. A discussion of the work to be performed during the next monthly reporting period.

4.2 Meetings

4.2.1 Weekly SAP Telecons. The contractor shall have a minimum of one designated representative participate in the weekly Monday SAP telecon, typically held 1:00-3:00 pm eastern time.

4.2.2 Team Telecons and Meetings. The contractor shall support the various task and discipline team meetings scheduled by the task and discipline team leads over the course of FY04 as requested.

4.2.3 Architecture Design and Technology Initialization Workshop. The contractor shall send the appropriate personnel to attend this Workshop, tentatively scheduled for December 1-5, 2003 at LaRC.

4.2.4 Quarterly Reviews. The contractor shall support the periodic SAP review meetings, tentatively scheduled as follows:

Cycle 1 Mid-Term Review: R3~~January 12-16~~ ***February***, 2004
*****Begin R3block revision*****
Other reviews for the Exploration Task Team
~~Cycle 1 Final Review: March 8-12, 204~~
~~Cycle 2 Mid-Term Review: July 14-18, 2004~~
~~Cycle 2 Final Review: September 7-11, 2004~~
*****End R3block revision*****

4.3 Travel and Other Direct Charges

4.3.1 Travel. The contractor shall develop a reasonable estimate of the required travel based on the support requested herein. The contractor's proposal shall provide the basis for the travel cost estimate, to include the number of trips, assumed, the number of days and personnel involved in each trip, and the locations required/assumed.

4.3.2 Other Direct Charges. The contractor shall include an itemization of any direct charges that are allowed under the base contract in the proposal. At a minimum, the contractor shall provide no more than ten scale models of the various advanced architecture launch vehicles via stereo lithography or other low-cost model fabrication means. The specific vehicles and model scales shall be proposed by the contractor and approved by the Technical Monitor in advance of fabrication. The contractor shall spend no more than $20,000 on these models.

4.4 Optional Tasks

The following are priced optional tasks that may be exercised at the Contracting Officer's discretion any time during FY04.

4.4.1 Option Task 1. (360 hrs) The Contractor shall provide a 3-D graphical concept-of-operation simulation covering ground operations, mission operations (ascent, ISS docking, re-entry, landing) and the turnaround processing using ATT-A DES results. The simulation will be provided to NASA via CD for use during NGLT SAP presentations as a means of describing the ATT-A system concept.

4.4.2 Option Task 2. (200 hrs) The Contractor shall plan, organize, and conduct an on-site presentation of a state-of-the-art aircraft program (JSF, Skunkworks approach) to provide NASA insight to the program structure, lessons learned, organizational approaches, life cycle cost methodologies, etc. to assist NASA in ATT-A architecture definition.
Begin R2 block update for option period

5.	**Security clearance required for performance of work:**
6.	**Period of Performance:** **Planned start date:** May 1, 2003 **Completion date:** R1 ~~October 31, 2003~~* November 30, 2003* ***Option period planned:** R1 ~~November 1, 2003~~ December 1, 2003 – R2 ~~February 28, 2004~~. November 30, 2004
7.	**NASA Technical Monitor:** R2 Vincent Bilardo M/S: 353X Phone: 757-864-3758 **NASA Technical Monitor:** Todd C. Denkins M/S: 353X Phone: 757-864-7191

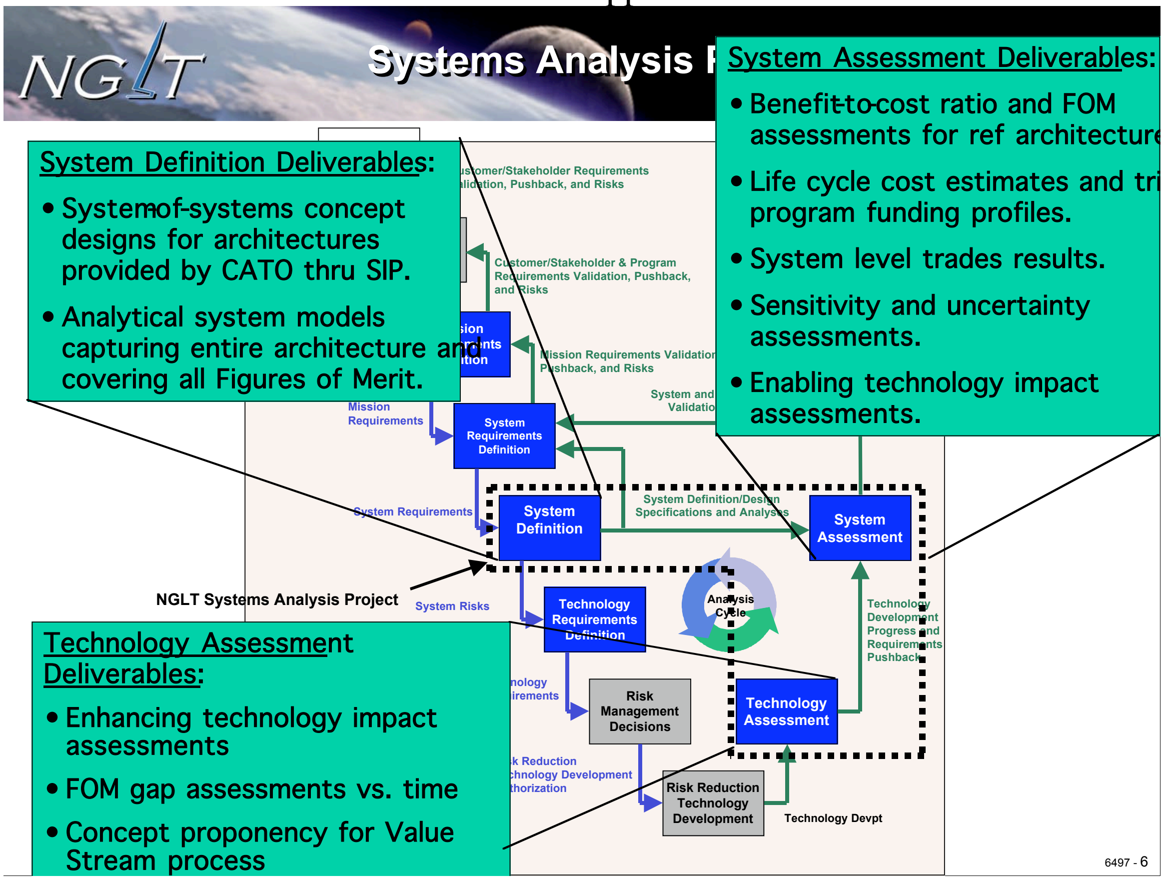

Figure 1. Integrated System Engineering & Analysis Process and Deliverables of System Definition, System Assessment, and Technology Assessment steps assigned to SAP.

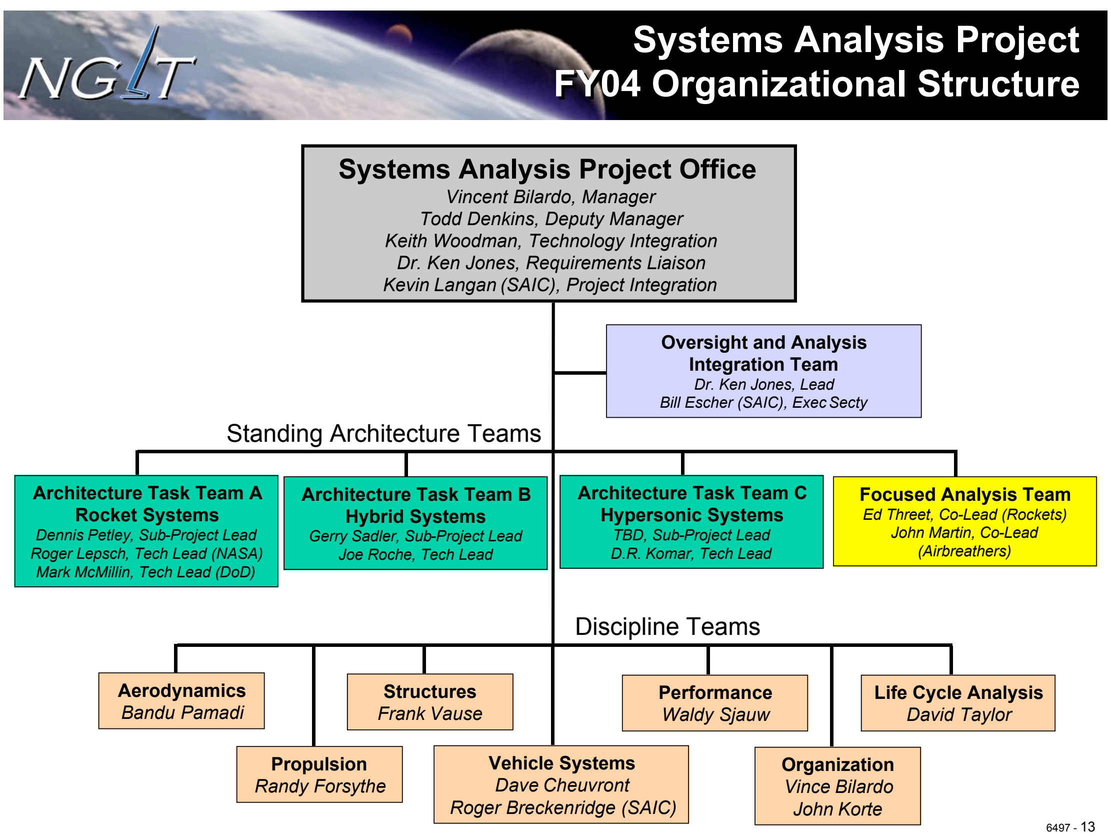

Figure 2. FY04 NGLT Systems Analysis Project organizational structure.

Task Order Number: 01OJ Revision 17 Date of Revision: 3/18/05

Title: Programs/Projects Schedules Management and Reporting

1. **Purpose, Objective or Background of Work to be Performed:** (GK03, NAS1-96013)

Note: Subtask 14 (Proposal Teams, New Programs, and Projects) is by its nature, indefinite delivery and indefinite quantity (IDIQ). [R2] This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. Each NOR will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Terminates Subtask 3 and clarifies IDIQ note (see [R1] above and below).

Revision 2: Updates NOR note, redefines Subtasks 2, 5, 6, adds deliverable to Subtask 8, notes termination of AGATE requirement in Subtask 9, updates Subtasks 10 and 11, and adds new Subtask 15 (see [R2] above and below).

Revision 3: (see [R3] below).

(1) Subtask 2/AvSP - requirement for level 4 (sub-element) milestone tracking has been eliminated.

(2) Subtask 4/MISSE - subtask terminated (project completed).

(3) Subtask 6/GIFTS - slight modification to requirement and corrected name.

(4) Subtask 7/TCPO - subtask terminated (requirement eliminated).

(5) Subtask 10/CALIPSO - project name changed from ESSP3.

(6) Subtask 12/BWB - subtask to be terminated as of April 30, 2002 (project replanned); requirements redefined for remaining months.

(7) Subtask 14/NOR - Clarification of work to be conducted for Mars Airplane Proposal Team.

Revision 4: Adds new requirements (subtask 16 and foreign travel) and 2nd Technical Monitor (see [R4] below).

Revision 5: Updates subtask 5 wording, adds requirements as new subtasks 17-19, and deletes 2nd technical Monitor added in Revision 4, and terminates subtask 15 (see [R5] below).

Revision 6: Adds new and/or updates existing requirements in Subtask 2 / Aviation Safety Program. Documents addition of a new technical monitor (see [R6] below).

Revision 7: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements except Subtask 13 title update (see [R7] below).

Rev. 8: (See [R8] below):

Task Order Number: 01OJ Revision 17 Date of Revision: 3/18/05

Title: Programs/Projects Schedules Management and Reporting

(1) Subtask 5/2GRLVPO – subtask set to terminate (project replanned)
(2) Subtask 8/SAGE III – subtask set to terminate (project completed).
(3) Subtask 10/Calipso – subtask set to terminate (requirement eliminated).
(4) Subtask 18/ASTPO – subtask terminated (project replanned).
(5) Add Subtask 20 Next Generation Launch Technology (NGLT) Program.
(6) Add Subtask 21 Orbital Space Program (OSP).
(7) Change Subtask 13 title.
(8) Update metrics section.

Rev 9: (See R9 below):
(1) Correct typo's in Standards #2 and #3.
(2) Subtask 2/AvSPO – updates subtask wording for new "Security" activities
(3) Subtask 9/General Aviation (SATS) – subtask terminated (requirements eliminated)
(4) Subtask 13/UEET– subtask terminated (requirements eliminated)
(5) Add Subtask 22: Thrust Project Plans
(6) Permanently reassign all TM duties to one TM.

Revision 10: Extends the period of performance one year to 12/31/04 in continuation of NASA's support with no change in detailed requirements and documents addition of 2nd Technical Monitor (see R10 in Sections 6 and 7 below).

Revision 11: (see R11 in Section 2 below)
(1) Add Subtask 23: Airspace Systems: Thrust A: Air Transportation System Innovation
(2) Add Subtask 24: Vehicle Systems Program (VSP)/Programmatic Data Integration Working Group
(3) Add Subtask 25: A-76 Competitive Sourcing of Metallic Test Articles and General and Precision Fabrication
(4) Adjust "General Requirements" to include Earned Value Analysis.

Revision 12: (see R12 below):
(1) Adds Subtask 26: Space Shuttle Return to Flight/Service Life Extension Program Office
(2) Updates Subtask 20 to reflect termination of a subproject.
(3) Updates Subtask 21 to reflect name change and termination of a subproject.
(4) Updates Subtask 19 to reflect name change to Efficient Acrodynamic Shapes and Integration Project (EASI)
(5) Deletes details of previously terminated subtasks.

Revision 13: (see R13below):
(1) Deletes Effie Nicosia and adds Kate Spruill as the NASA Technical Monitor
(2) Subtask 1: deletes X-43B support.
(3) Adds Subtask 27: Vehicle Systems Program

(4) Adds Subtask 28: Center Reorganization Kick-Start Team
(5) Terminates Subtask 19: EASI. These requirements are now included in the new Subtask 27.
(6) Subtask 21: X-37 – Change Monthly Management Report due date to the 10^{th} of every month.
(7) Subtask 25: Adds "sensitive…" marking requirement for all reports and changes delivery schedule.
(8) Subtask 26: Space Shuttle Return to Flight – Change Monthly Management Report due date to the 10^{th} of every month.

Revision 14: (see R14below):
(1) Adds subtask 29: Exploration Kick Start Team and Exploration Systems and Space Operations Technology Directorate for continuation of work performed under Subtask 17.
(2) Terminates Subtasks 1, 6, 17, 21, 22, and 23 on September 30, 2004.
(3) Adds Technical Monitor (subtask 29 and continuation of task order).
(4) Updates name of Subtask 11.
(5) Notes completion of Subtask 16 July 31, 2003 and continuation of Subtask 24 under Subtask 27 and inadvertently omitted in Revisions 10 and 13, respectively.

Revision 15: (see R15 below):
(1) Adds Technical Monitor for Subtask 14 – (NOR item) Proposal Teams, New Programs, and Projects – David Wall(2) Extends Period of Performance to December 31, 2005.

Revision 16: (see R16 below):
(1) Notes Termination of Subtask 2 on February 28, 2005 and Subtask 11 on February 18, 2005.

Revision 17: (see R17 below):
(1) Six-month Subtask 30 – with David Wall as Technical Monitor.

2. **Description of the Work to be Performed:**

General Requirements

Description: Unless otherwise specified, the Contractor shall develop and maintain the upper level schedules for programs and projects as described below in subtask detail. The Contractor shall also develop and maintain detailed schedule and shall coordinate the development and integration of schedules and work breakdown structures at levels established by program management. Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate program/project point of contact (POC). The Contractor shall alert the POC should any discrepancies arise involving major milestones. At all schedule levels supported, the critical path shall be identified. The Contractor shall produce and deliver periodic schedule status reports and provide consulting and expert advice on schedules to the program or project management. R11When appropriate, provide program or project with earned value data and analysis.

Deliverables: The Contractor shall develop master and detail schedules; maintain master and detail schedules; produce and deliver reports; and provide consultation and expert schedule advice as specified in the subtask statements of work. Although the requirements for deliverables may be modified from time to time for individual projects. the following is a generic list of planning and schedule management products required:

- graphic reports (Precedence Logic Network, Gantt – bar and/or milestone charts, resource histograms)
- tabular reports (data lists, tables)
- analytical reports and "white papers"
- management bullet/presentation charts
- WBS dictionary and/or hierarchical graphs
- schedule software code required to provide unique analysis or report formats (ARTEMIS 7000, Primavera, Microsoft Project, etc.)

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

- Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements.
- Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports.
- Once a baseline has been established, 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, shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation.
- For new database requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation.
- The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.
- Once a baseline master schedule has been approved maintain historical plan/actual data

including duration/remaining duration/actual duration at complete and start/finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects R8 will be maintained as part of the schedule database.

- R8 The schedule follows the guidelines established in NPG 7120.5B.

** Begin R8 Metrics Update**

Standard 1: Develop and deliver Monthly Management Report (MMR) for all Subtask Elements. The Project/Program MMR follows the project Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis, and Schedule Status Charts.

CUSTOMER SERVICE/RATING:

Excellent: The MRR is delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MMR to review the report.
Very Good: The MMR is delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MMR with project management in a timely manner.
Satisfactory: The MMR is delivered to the customer on the specified due date with minimum errors. Analyst reviews MMR with project management.
Poor: The MMR does not meet requirements of following the WBS. The MMR is not delivered on the specified datae and is not reviewed with the project management.
Unsatisfactory: No MMR is delivered to the customer, and the customer has given no waiver.

R8 Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update reports, Delinquency Reports

CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis.
Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate.
Satisfactory: Analyst is requesed by project management to provide schedule reports/plots and does so on a regular basis.
Poor/Unsatisfactory: No schedule reports/plots are recommended or provided.

R8 Standard 3: Produce and deliver accurate adhoc reports in support of CPMC and/or

management reviews.

CUSTOMER SERVICE/RATING:

Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission.
Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

R8**Standard 4: Provide consultation and expert schedule advice to projects identified in the task order as subtasks. This consultation may be in the form of reports or schedule management recommendations.**

CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.
Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request.
Poor/Unsatisfactory: When requested, no recommendations are provides to the project management.
** End R8 Metrics Update**

Subtask 1 R14Terminated September 30, 2004– **Hyper-X Program Office (requires Secret Clearance)**

Subtask 2 – ***R16Terminated February 28, 2005*** - **Aviation Safety** R9 **and Security Program (AvSSP)**

Subtask 3 R1 Terminated April 30, 2001– **Intelligent Synthesis Environment (ISE) Program**

Subtask 4 – R3Terminated February 28, 2002 **- Materials International Space Station Experiment (MISSE)**

Subtask 5 – R8 Terminated April 25, 2003 **- 2nd Generation RLV Program Office (2GRLVPO)**

Subtask 6 - [R14]Terminated September 30, 2004 [R3]**Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS)**
End [R2] block

Subtask 7 – [R3]Terminated February 28, 2002 **- Technology Commercialization Program Office (TCPO)**

Subtask 8 – – [R8] Terminated April 25, 2003 **- SAGE III ISS**

Subtask 9 – [R9] **General Aviation (SATS) terminated April 25, 2003 /** [R2] **AGATE** terminated December 31, 2001

Subtask 10 – [R2] [R3]– [R8] Terminated April 25, 2003 **-Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)**

Subtask 11 – ***[R16]Terminated February 18, 2005*** - [R14,R2] **Flight Research Services Directorate (FRSD)**

Subtask 12 – [R3]Terminated April 30, 2002 **- Blended Wing Body (BWB)**

Subtask 13 – – [R8 R9] Terminated April 30, 2003 **- Ultra Efficient Engine Technology (UEET)**

Subtask 14 – (NOR item) Proposal Teams, New Programs, and Projects
The Contractor shall provide planning and scheduling support for the Center's new business proposal development activities and for new program/project start-up activities. Since this work emerges throughout the year, the Contractor shall plan to support approximately four new proposal efforts per year and two new start efforts per year which shall require, as a minimum, development of master project schedules and expert advice to proposal development teams.

Begin [R3] block addition
Provide support and deliverables to the Mars Airplane Proposal Team during the proposal development period between February 2002 and December 2002:

Deliverables:

- Near term schedule for development and trade studies (now through June 2003).
- Overall program schedule for design, development, implementation (now through end of Mission in September 2009).

- Planning and scheduling support shall be provided for proposal team meetings and teleconferences, as necessary to perform this activity.

End R3 block addition

Subtask 15 – R5 (Terminated) **Aerospace Systems, Concepts & Analysis Competency (ASCAC)**

Begin R4 block addition
Subtask 16 – R14Completed July 31, 2003 **Integrated Financial Management Program (IFMP)**
End R4 block addition

Begin R5 block addition
Subtask 17 – R14Terminate September 30, 2004 and continue thereafter under new Subtask 29**: Space Access and Exploration Program Office (SAEPO)**

Subtask 18 — R8 Terminated April 25, 2003 **- Advanced Space Transportation Program Office (ASTPO)**

Begin R12 block update
Subtask 19 – R13Terminated June 18, 2004 (Requirements now included in Subtask 27)
Efficient Acrodynamic Shapes and Integration Project (EASI)
End R5 block addition

Begin R8 block addition
Subtask 20 - Next Generation Launch Technology (NGLT) – Vehicle Systems Research and Technology (VSR&T) Office
The Contractor shall provide planning and scheduling support to develop and manage master and detailed project-level schedules for the Next Generation Launch Technology (NGLT) – Vehicle Systems Research and Technology (VSR&T) Project. Since the program is sponsored by Marshall Space Flight Center (MSFC), schedules shall be developed in Microsoft Project. The schedule development and maintenance shall include directing and working with all NGLT – VSR&T Project, Subproject, and Element managers from LaRC, MSFC, ARC, GRC, JSC, KSC, DFRC, GSFC, and JPL. The schedule shall be integrated to include contractor, NASA led, and Government task agreement schedules.

R12 Requirement to support the Aerosciences subproject is terminated as of March 31, 2004.

Deliverables:

- Monthly Management Report—the contractor shall analyze all schedule information submitted by the contract and government sources and submit a monthly report by the 25th of every month.
- Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary.
- Participate in the NGLT Schedule Working Group telecons and meetings.
- Monthly schedule updates to the NGLT – VSR&T project.
- Post updated master and subproject/element schedules to the Space Transportation Information Technology (STIN) system monthly by the 20th of every month.
- Provide schedule Gantt Charts for Monthly/Quarterly Reviews
- Provide monthly a quarterly timeline schedule of major NGLT and VSR&T events.
- As needed – Analyze schedules for conflicts and issues.
- As needed – Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate.
- As needed – Advise the management team on development of the critical path and resource-loaded schedules.

Subtask 21 - R14Terminated September 30, 2004 **X-37 Program Office**

Orbital Space Plane Program Office support terminated as of April 9, 2004.

End R12 block update
End R8 block addition
Begin R9 block addition

Subtask 22 - R14Terminated September 30, 2004 **Thrust Project Plans**
End R9 block addition
Begin R11 block addition
Subtask 23 - R14Terminated September 30, 2004 **Airspace Systems: Thrust A: Air Transportation System Innovation**

Subtask 24 - R14Continued under Subtask 27 **Vehicle Systems Program (VSP)/Programmatic Data Integration Working Group**

Subtask 25 - A-76 Competitive Sourcing of Metallic Test Articles and General and Precision Fabrication

The Contractor shall provide senior analyst planning and scheduling support to develop and manage master and detailed project-level schedules for the A-76 Competitive Sourcing of Metallic Test Articles and General and Precision Fabrication Integration Team. The schedule shall be developed and maintained in Microsoft Project with capability to export data suitable for presentation. The schedule development and maintenance shall include working with the appropriate supporting teams (e.g., Most Efficient Organization (MEO) and Performance Work Statement (PWS)).

Sensitivity: The Contractor will need to support the A-76 Competitive Sourcing Integration Team with complete confidentiality by signing a Non-Disclosure Agreement.

Deliverables:
R13 All reports shall be marked "sensitive information – not to be disseminated" at the request of the Chief Counsel.

(a.) Monthly Management Report: the Contractor shall analyze all schedule information submitted by the MEO and PWS teams and submit a monthly report by the R13 ~~30th~~ third Monday of every month.

(b.) Provide planning and scheduling support for weekly meetings and teleconferences; attend other meetings as necessary to perform this subtask.

(c.) Weekly schedule updates to the A-76 Integration Team.

(d.) Provide schedule Gantt Charts for Weekly/Monthly Reviews

(e.) As needed, analyze schedules for conflicts and issues.

(f.) As needed, provide Project Plan schedules showing Level I, II, and other level milestones (as deemed appropriate).

(g.) As needed, provide consultation and expert advice on development and maintenance of the schedule, critical path, etc.
End R11 block addition

Begin R12 block addition
Subtask 26 - Space Shuttle Return to Flight/Service Life Extension Program Office
The Contractor shall provide planning and scheduling support to develop and manage master and detailed project-level schedules for the Space Shuttle Return to Flight (RTF) and Service Life Extension Program (SLEP). Schedules shall be developed in Microsoft Project and Fast Track. The schedule development and maintenance shall include directing and working with all

RTF/SLEP Project, Subproject, Task Managers, the Competencies, and the Orbiter (JSC) and External Tank (MSFC) Project Offices and Space Shuttle Systems Integration Office (JSC), or as required. The schedule shall be integrated to include contractor, NASA led, and Government task agreement schedules, as required.

Deliverables:

- Monthly Management Report—the contractor shall analyze all schedule information submitted by the contract and government sources and submit a monthly report by the R13~~25th~~ 10th of every month.
- Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary.
- Participate in the RTF/SLEP telecons and meetings as needed.
- Monthly schedule updates to the RTF/SLEP project.
- Post updated master and subproject/task schedules to the Space Transportation Information Technology (STIN) system monthly by the 20th of every month.
- Provide schedule Gantt Charts for Monthly/Quarterly Reviews
- Provide monthly a quarterly timeline schedule of major RTF and SLEP events.
- As needed – Analyze schedules for conflicts and issues.
- As needed – Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate.

As needed – Advise the management team on development of the critical path and resource-loaded schedules
End R12 block addition

Begin R13 block addition
Subtask 27 – Vehicle Systems Program (VSP)
The Contractor, using Vehicle Systems Program (VSP) approved scheduling software, shall be responsible to develop (as required) and integrate the detailed schedules for the task level activities for the major projects in VSP as well as a rolled-up, level I program level product. The projects to be supported are VISTA, QAT, AuRA, EASI, and ITAS. This would include interfacing with NASA HQ and other NASA centers including Ames, Glenn, Dryden. The Contractor shall also integrate and maintain an overall VSP master schedule containing all major tests and deliverables as well as level I milestones. The Contractor shall establish and maintain baselines for each of these products. The Contractor shall establish logic networks and identify the critical path between the projects and the program. The Contractor shall, as requested, document resource loading at the task level. The Contractor shall work with the project managers to establish and maintain Facility Utilization Data and Facility Schedule for the VSP Projects and prepare a rolled-up program level Facility Schedule. Contractor shall work to maintain data integrity between the master schedules and presentation materials for the projects and program. Travel would be required at a level of approximately one week out of a quarter

and an additional requirement of two days a month for the program level (HQ) work.

The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the VSP Program, upon request, such requests should be for the sole purpose of subsequent benefits to the VSP Program.

Deliverables:

- Monthly - Management report
- As Needed - Deliver hardcopy of logic network plots and/or gantt charts as needed
- As Needed - Project Plan schedules showing the level II, III, and IV milestones for each project and color-coded to show lower-level roll-ups following the schema provided
- As Needed - Program Plan schedules showing level I, II, and III milestones
- As Needed - Update Facility Utilization and Schedule Report
- As Needed - Update Resources Utilization and Schedule Report
- Monthly - Provide color copies of all deliverables to each Project Manager and the Program Manager
- As Needed - Post all deliverables on identified web based sight for the Projects and Program
- As Needed - Attendance for weekly and monthly meetings and teleconferences; and planning team scheduled meetings

Subtask 28 – Center Reorganization Kick Start Team

The Contractor shall provide senior analyst planning and scheduling support to develop and manage master and detailed schedules for the LaRC Reorganization Kick Start Team. The schedule shall be developed and maintained in a schedule tool with capability to export data suitable for presentation. The schedule development and maintenance shall include working with members from the Kick Start Team and any supporting subteams.

Deliverables:

- Monthly Management Report—the Contractor shall analyze all schedule information submitted by the Center Reorganization Kick Start Team and submit a monthly report by the 30th of every month.
- Provide planning and scheduling support for weekly/bi-weekly meetings and teleconferences; attend other meetings as necessary.
- Provide bi-weekly schedule updates to the Center Reorganization Kick Start Team.
- Provide schedule charts suitable for presentation in Weekly/Monthly reviews and reports
- As needed – Analyze schedules for conflicts and issues.
- As needed – Provide consultation and expert advice on development and maintenance of the schedule, critical path, etc.

**End R13 block addition

Begin R14 block addition

Subtask 29: Exploration Kick Start Team and Exploration Systems and Space Operations Technology Directorate

The Contractor shall provide planning and scheduling support to develop and manage master and detailed level schedules for the Exploration Kick Start Team that will transform into the Exploration Systems and Space Operations Technology Directorate (ESSOTD). The ESSOTD is comprised of programs, projects, elements and tasks within the Agency's Exploration Systems Mission Directorate, Science Mission Directorate, and Operations Mission Directorate (Project Constellation, Project Prometheus, Exploration Systems Research and Technology, Exploration Systems Human Research, Space Science Projects, and Operations Projects). The schedule development and maintenance shall include directing and working with all ESSOTD Project, Subproject, Element, and Task managers from LaRC and other NASA centers as appropriate. The schedules shall be resource loaded, suitable for earned value management, and integrated as appropriate to include contractor, NASA led, proposals, and Government task agreement schedules.

Deliverables:

- Monthly Management Report—the contractor shall analyze all schedule information submitted by the contract and government sources and submit a monthly report by the 15th of every month.
- Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary.
- Monthly schedule updates.
- Post updated master and subproject/element/task schedules to an electronic data storage system by the 15th of every month.
- Provide schedule Gantt Charts for Monthly/Quarterly Reviews
- Provide monthly and quarterly timeline schedule of major events.
- As needed – Analyze schedules for conflicts and issues.
- As needed – Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate.
- As needed – Advise the management team on development of the critical path and resource-loaded schedules.

End R14 block addition

Begin R17 block addition

Subtask 30: ESMD Support for Earned Value Management Systems

Period of Performance: April 1, 2005 – September 30, 2005

The National Aeronautics and Space Administration (NASA) is organized into a number of Mission Directorates which function as primary business areas for implementing NASA's mission and serving its customers. Each Directorate has a unique set of strategic goals, objectives, and implementation strategies that establish and address the requirements of the Agency's primary customers with specific emphasis on customer satisfaction.

The Contractor shall provide Earned Value Management Systems (EVMS) implementation support to NASA's Exploration Systems Mission Directorate (ESMD) This support will be assistance to the Associate Administrator at the strategic level, while also providing direct support to the Development Programs Division and the Requirements Division, and will include the development of the ESMD guidelines. The Contractor's inputs on EVMS shall include the management control systems including policies, procedures, and methods that are designed to ensure that all programs meet the required ESMD guidelines.

Specifically, the Contractor shall support the overall implementation of earned value management on all programs within ESMD. This shall include all aspects of the implementation process to include support for Training, Implementation, Analysis and overall support, strategic and tactical aspects of the full implementation and use of Earned Value Management. Additionally the Contractor shall support the agency implementation of Earned value when appropriate to ensure efficiencies are realized and use of all team assets to ensure a smooth transition into a project management environment.

Deliverables and Schedule:

- Monthly Management Report—the contractor shall analyze assigned EVM analysis data submitted by the contract and government sources and submit a monthly report by the 15th of every month.
- Provide periodic "Best Practices" information on EVM implementation from industry and government.
- Monthly project implementation status updates.
- As needed – Analyze project plans for conflicts and issues.
- Formal training sources for EVM training and certification
- Participation in conferences and workshops to provide expert knowledge of EVM process

Metrics (minimum acceptable level):

- Delivery of or demonstrable accomplishments towards ESMAD EVM project implementation milestones one month prior to ICP/ECP contract reporting.
- Identification of at least two sources of valuable "best practices" EVM implementation to include processes and tools.
- At least one briefing on the Contractor's intended implementation approach.
- At least one report to the task monitor on deliveries and supporting activities.

Metrics (above minimum acceptable level):

	• Delivery of completed milestones on due dates for EVM implementation plan • More frequent relevant interaction with cognizant NASA officials, such as advisory meetings on design parameters and suggestions for improvements to processes related to ESMD Programs. *****End R17 block addition*****
3.	Government Furnished Items:
4.	Other information needed for performance of task: Each organization, program or project will provide funds to cover travel costs. Each organization, program or project will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NAS1-00135. R4 SAGE III/ISS: One to Two weeks travel in mid-May to Turin, Italy, for Technical Interchange Meeting (TIM) with European Space Agency (ESA) and Alenia reprensentatives.
5.	**Security clearance required for performance of work:** As defined at the subtask level.
6.	**Period of Performance**: Planned start date: 1 Jan 01 Completion date: R7 ~~31 Dec 02~~ R10 ~~31 Dec 03~~ R15 ~~31 Dec 04~~ 31 Dec 05
7.	R9 ~~**NASA Technical Monitor**: Virginia B. Marks~~ ~~M/S: 268 Phone: 757-864-1714~~ R4 R5 ~~NASA Technical Monitor: Virginia M. Cordle~~ ~~M/S: 268 Phone: 757-864-2915~~ R6 **NASA Technical Monitor:** Kathryn C. Ferrare M/S: 356 Phone: 757-864-3776 R13R10 ~~**NASA Technical Monitor:** Effie L. Nicosia~~ ~~M/S: 202 Phone: 757-864-2394~~ **NASA Technical Monitor:** Karen S. Spruill M/S: 200 Phone: 757-864-1808 R14 **NASA Technical Monitor:** Cheryl L. Harrell M/S: 173 Phone: 757-864-3223 R15 **NASA Technical Monitor:** L. David Wall (Subtask 14, NORs) M/S: 162 Phone: 757-864-2944

Task Order Number: 01RAC Revision: ____ Date of Revision:

Title: Advanced Personal Air Vehicle Concept Development and Analysis

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

The purpose of this task order is to solicit the development and analysis of **fixed wing** air vehicle concepts, for the purpose of **identifying critical technologies and vehicle configurations**, that enable a near-door-to-door, airborne, personal transportation capability.

The goal of the concept development and analysis is to identify candidate vehicle concepts capable of satisfying basic mission requirements (provided by NASA-LaRC below.) The measures of merit for these concepts will include: ability to satisfy mission performance requirements, vehicle affordability, vehicle operational noise, vehicle operational safety, and ease of vehicle operation and control

2. **Description of the Work to be Performed**:

Task A: The Contractor shall develop baseline fixed wing, air vehicles, consisting of currently available or near term (available in the marketplace within three years) technology, capable of satisfying the mission requirements provided below. ***NOTE*** *– some baseline vehicles may be incapable of satisfying the mission performance requirements using current or near-term available technology. In such instances, the baseline concept developed should most nearly satisfy the requirements among the alternatives. Baseline vehicles will be used to assess the technology gaps that* ***will enable*** *satisfying the mission requirements and constraints.*

Task B: The Contractor shall develop advanced technology fixed wing air vehicle concepts that satisfy the following mission performance requirements matrix:

MISSION	RANGE	PAYLOAD	OPERATING FIELD LENGTH (OFL)	CRUISE SPEED	MAX. CRUISE ALTITUDE
A	400 nMi	1 PAX	≤ 1000 FT	> 100 kt	Propeller: 10K FT
			≤ 500 FT	> 250 kt	25K FT
					Turbine: 10K FT
					25K FT
					50K FT
B	400 nMi	2 PAX	≤ 1000 FT	> 100 kt	Propeller: 10K FT
			≤ 500 FT	> 250 kt	25K FT
					Turbine: 10K FT
					25K FT
					50K FT
C	400 nMi	4 PAX	≤ 1000 FT	> 100 kt	Propeller: 10K FT

			≤ 500 FT	> 250 kt	25K FT
				Turbine:	10K FT
					25K FT
					50K FT
D	400 nMi	8 PAX	≤ 1000 FT	> 100 kt Propeller:	10K FT
			≤ 500 FT	> 250 kt	25K FT
				Turbine:	10K FT
					25K FT
					50K FT

Task Requirements:

1. Concepts shall be sized to provide 100 feet per minute or greater climb-rate at the design cruise altitude
2. Vehicle design load factor shall be per FAR Part 23 Requirements
3. Demonstrate that mission performance requirements are satisfied by modeling each concept using a credible mission sizing and performance program (e.g. FLOPS or ACSYNT)
4. Develop a group-level weight estimate for each baseline, and advanced technology concept (Re MIL STD 1374A format.)
5. Develop summary descriptions of the relevant vehicle characteristics impacting performance (e.g. wing & tail sizes, airfoil sections, powerplant sizes, etc.)
6. Develop a summary of mission performance data including block time, block fuel, cruise speed/altitude
7. Generate aerodynamic data including:
   a. low speed drag polar (T/O, Ldg, and cruise configurations)
   b. Drag Buildup
9. Develop a dimensioned three-view of each concept
10. Complete an assessment (**quantitatively where possible, qualitatively otherwise**) of the overriding issues impeding public acceptance of each concept, in the areas of noise, ease of operation, and safety. Constraint values and/or assessment guidance shall be as follows:

noise: **For Propellers:** 75PNdb sideline takeoff measured at 500 feet (using General Aviation Synthesis Program (GASP) noise modeling or equivalent (equivalent noise code must be supplied to NASA-LaRC)

For Turbojet/fan Propulsion: 75PNdb sideline takeoff measured at 500 feet; noise modeling tool TBD.

ease of operation: Provide a first-order assessment of the complexity of each concept's flight control system. Do this by assessing the open-loop stability properties and the nature of the available control power for critical operating conditions, and determine the degree of stability (or instability) and the effectiveness of the available control effectors.

Safety: Qualitatively discuss safety issues, concerns and possible remedies distinct to each developed concept

11. Compile a list of technology development, corresponding to each concept, that either enables the required mission performance, and/or satisfies the public acceptance constraints.
12. Complete a sensitivity assessment showing the robustness, with respect to the limiting design variables, of each concept in satisfying the performance requirements and public acceptance constraints
13. Show growth factor trends (Lb gross vehicle wt. Increase per Lb. Payload increase) for each concept type for the one and eight passenger missions.
14. Generate plots of rate of climb versus speed at altitudes of: 0, 2500, 5000, 7500, and 10000 feet.
15. Generate a list of references to support the basis of design and analysis assumptions used (if available, provide a copy of the reference document to NASA-LaRC.)

Deliverables; Tasks A & B:

1. The monthly progress reports shall be submitted to the Technical Monitor via e-mail and shall include statistics that illustrate percent of task complete, funds status, and note any issues that could delay the completion of the task.
2. The Contractor shall participate in monthly telecons with representatives of LaRC for the purpose of coordinating the design and analysis efforts of each task.
3. The Contractor shall schedule a midterm presentation (at or around the midpoint of the time available to complete the study) to review task progress
4. The Contractor shall schedule a final presentation at per the date below, to orally present the results of the study
5. The Contractor shall deliver a concisely formatted final report containing the information requested under item 2, "**Description of the Work to be Performed",** above per the date below.

Schedule: The deliverable due dates for the five deliverables above are:

1. Monthly report due monthly beginning the end of the first month after contract award.
2. Monthly telecon participation beginning the first month after contract award.
3. Midterm Presentation scheduled on or about the midpoint of the allotted time, to be agreed mutually by the Contractor, and NASA-LaRC Task Monitor.
4. Final Oral Presentation of the study results to be conducted on or by 11/30/01
5. Final Report will be due on or before 1/31/02

Performance Metrics: The following will be used to determine the quality of Contractor task performance, relative to the task requirements:

A. **Timeliness**: Contractor progress reported monthly, tracked against the scheduled time allotted will be used to monitor the Contractor's timeliness
B. **Quality of work**:
   1. Concepts are composed of state of the art, current and near-term (see above) technology
   2. Proper enabling technology focus (highest benefit/cost) for advanced vehicle concepts has been achieved
   3. Concepts satisfy mission requirements or most nearly satisfy the requirements in cases where a technology gap precludes them from being satisfied (baseline vehicles only.)
   4. Analyses in response to the requirements above, exhibits competent use of the proper tools for each corresponding requirement (e.g. performance analysis, noise analysis, etc.)
C. **Presentation and Participation**:
   1. Telecon participation is active and reflects proper preparation
   2. Oral presentations are concise and with proper focus
   3. Written presentations and reports, clearly and concisely demonstrate task requirements have been satisfied

Performance Standards: See Performance Metrics above.

3. Government Furnished Items: The following will be provided by NASA to the Contractor:

A. **Vehicle performance, sizing & optimization software** (access to) –
   1. FLight OPtimization System (FLOPS)
   2. AirCraft SYNThesis (ACSYNT)
B. **Vehicle cost modeling** (access to) – Tailored Cost Model (TCM)

	C. Propulsion engine (intermittent combustion, and turbine) deck files will be provided to the Contractor for use with the vehicle sizing programs
4.	Other information needed for performance of task: **None**
5.	Security clearance required for performance of work: **N/A**.
6.	Period of Performance: Planned start date: 3/26/01 Completion date: 1/31/02
7.	NASA Technical Monitor: Mr. Kurt W. Neitzke M/S: 348 Phone: 757-864-4917 NASA Competency/Other Technical Coordinator: Ms. Rita Verlander M/S: 327 Phone: 757-864-1975

Task Order Number: 01RBF Revision: 6 Date of Revision: 3/3/2005

Title: **Aircraft Noise Subjective Research Support**

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

The Structural Acoustics Branch has a continuing responsibility to conduct human response studies of aircraft interior and community noise. The purpose of this task is to provide human subjects to take part in laboratory and in-home studies in which people are exposed to and make judgments on noise stimuli representative of noises heard in aircraft interiors and in communities exposed to aircraft flyover noise.

Note: As each specific study requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designation below in Subtask 2.)

Revision 1: Limits current scope of Subtask 2 (see [R1] below).
Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and reduces scope of Subtask 2 (see [R2] below).
Revision 3: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements (see [R3] below).
Revision 4: Extends scope of Subtask 2 to cover proposed test to take palce within the preiod August-October 2003 (see [R4] below).
Revision 5: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements (see [R5] below).
Revision 6: After a short period of inactivity, extends the period of performance to 12/31/05 in continuation of NASA's support with some change in detailed requirements of Subtask 2 (see [R6] below).

2. Description of the Work to be Performed:

The Contractor shall perform the following task:

Establish and maintain a pool of test subjects for human response testing and provide groups of test subjects for human response testing. Such will involve the solicitation, screening, calibration, selection, remuneration and delivery of test subjects to the experiment sites as scheduled. The requirements for this task are detailed as follows:

1. Interview and recruit potential subjects and maintain a pool of subjects for participation in experiments in which people rate the acceptability, annoyance or other characteristics of sounds. The pool of prospective test subjects shall be

established and maintained in such a way as to meet the following requirements:

a. Potential test subjects shall be required to complete a medical questionnaire provided by NASA and administered by the Contractor. The completed questionnaires shall be forwarded by the Contractor to an authorized NASA medical officer who will determine the suitability of each candidate for participation in the experiments. This requirement may be waived by NASA for certain test subjects.

b. Subjects shall be over 18 years of age. Subjects shall be cataloged by the Contractor according to name, age, sex, geographic location, and occupation. This information becomes the property of the US Government.

Potential subjects must submit to audiograms before and after the test, and occasionally during the test. These audiograms (administered by the Contractor) will be performed under supervision of a State Certified audiologist in a soundproof test room with calibrated equipment according to standard procedures. Those with hearing loss (in either ear) greater than 40 dB (ISO Standards, 1964) over the frequency range of 500 Hz to 6,000 Hz will not be permitted to participate in the experiments. This requirement may be waived in special circumstances as required by NASA. Occasionally subjects with a hearing loss no greater than 20 dB may be required. The pre-test audiogram shall be performed within two weeks of the experiment, preferably on the same day in which the subject participates, and the post-test audiogram should be performed immediately following the experiment. Audiometric records shall be maintained by the Contractor and made available to NASA on request. Any test subject who is found to have an excess of 5 dB threshold shift between pre- and post-audiograms shall be rechecked to ensure a return to pretest hearing levels. This requirement for pre- and post-test audiograms may be waived by NASA for certain test subjects. The occurrence of any audiograms required during the experimental test period will be defined by NASA on a case by case basis.

2. (NOR controlled subtask) Deliver up to 12 subjects per day to the NASA Langley Research Center test site on two weeks prior notice of requirement (NOR). An average of 12 subjects per month will be required, although the requirements during some months may be greater or less than the average of 12 per month. No more than 60 subjects per month will be required. All transportation shall be coordinated and provided by the Contractor. The times for delivery to and pickup from the test site shall be met by the Contractor with an allowable tolerance of +20

minutes. Of the total number of subjects delivered per month, about half may be required to be previously unused in other experiments conducted at LaRC, depending on the nature of the particular experiment. Some subjects may be required for two days at a time and/or for subsequent testing during the year. The normal testing period will be between 8:00 a.m. and 5:00 p.m. The normal test site will be Building 1208 at the NASA Langley Research Center. Subjects generally will participate in experiments for periods up to four hours on any given day. [R1]During the current period of performance of this task**,** [R2]~~one experiment is planned for the period of May/June 2001, using a maximum of 75 subjects~~ [R3]~~no experiments are presently planned~~ [R4]~~one experiment is planned for the period of August-October 2003, using a maximum of 75 subjects~~ [R5]~~no experiments are currently planned.~~ [R6]***One experiment is planned for the period of June 2005 using a maximum of 40 subjects, and another experiment is anticipated in November 2005.***

Metric: Number of test subject no-shows; tardiness in subject delivery and/or pickup time.

Standards: Maximum acceptable number of test subject no-shows is 5% over the applicable period of performance of the task. Maximum acceptable tardiness in subject delivery and/or pickup time is 20 minutes. Accurate records of audiometric tests and documentation are required. Lesser numbers of no shows and more timely delivery and pick up of subjects will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Test subjects delivered to test site on specified dates and times; audiograms, audiometric records, and documentation of classification of subjects.

3. Government Furnished Items: Audiometric booth and audiometer.

4. Other information needed for performance of task:

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

6. Period of Performance:

Planned start date:	[R2]~~January 2, 2001~~	Completion date:	[R2]~~January 1, 2002~~
	[R3]~~January 2, 2002~~		[R3]~~January 1, 2003~~
	[R5]~~January 2, 2003~~		[R5]~~January 1, 2004~~
	[R6]~~January 2, 2004~~		[R6]~~January 1, 2005~~
	April 1, 2005		***December 31, 2005***

Task Order Number: 01RBF Revision: 6 Date of Revision: 3/3/2005

Title: **Aircraft Noise Subjective Research Support**

7. NASA Technical Monitor: Brenda M. Sullivan
   M/S: 463 Phone: 757-864-3585
   NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth
   M/S: 285 Phone: 757-864-8265

Task Order Number: 01RCA Revision: 5 Date of Revision: 2/11/05

Title: [R5]Characterization of Polymers

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

The objective of this task is the [R5]***support of*** research and technology development of advanced materials for aerospace applications.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and makes some minor wording adjustments for performance-based contracting (PBC) considerations (see [R1] below).

Revision 2: Extends the period of performance 9 months in continuation of NASA's support requirements and updates some of the work description (see [R1] below).

Revision 3: Extends the period of performance 12 months in continuation of NASA's support requirements and redefines and/or updates some of the description for the new period of performance (see [R3] below).

Revision 4: Extends the period of performance 6 months to 3/31/05 in continuation of NASA's support requirements and updates some of the work description (see [R4] below).

Revision 5: Extends the period of performance 6 months to 9/30/05 in continuation of NASA's support requirements, reduces the work description, updates the task order title and other info, and adds some limited synthetic and graphics requirements (see [R5] above and below). Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files *01RCA, 01RCA02, 01RCA03, and 01RCA04.*

2. Description of the Work to be Performed:

*****Begin [R5]block rewrite*****

In order to meet the requirements for the development of high performance polymers with specified properties to satisfy the requirements of the [R3]ITAS, [R4]RTF AvSec, and other aerospace programs, the Contractor shall synthesize and characterize novel monomers, polymers, and hybrid polymers. The Government will provide the materials that will primarily be organic, although other materials may be included on a limited basis. Specific activities and quantities are detailed below:

- The Government will submit no more than five synthesis requests per month for monomers and polymers until the end of the contract period.
- The Government will submit no more than 120 characterization requests for polymers during a twelve-month period. The Contractor shall characterize these polymers using techniques such as [R2]UV-Visible-Near-Infrared Spectroscopy, Gel Permeation Chromatography, [R2]High Performance Liquid Chromatography, TGA(thermogravimetric analysis)-Mass Spectrometry, Gas Chromatography, Differential Scanning Calorimetry, to obtain information related to chemical composition, molecular weights and thermal properties of polymers (up to 24).
- The resulting data shall be analyzed, tabulated, graphed, charted, etc. as necessary by the Contractor for evaluation by the Government.
- The Contractor shall also provide graphics support as necessary in the creation of technical slides and figures for AMPB (up to 10 per month.) This activity will only be required until

Task Order Number: 01RCA Revision: 5 Date of Revision: 2/11/05

Title: R5 Characterization of Polymers

4/30/05.

Deliverables:

- When individual synthesis or characterization projects are completed, the Contractor shall submit a summary report to the Requester and LaRC Technical Monitor within one week. The report shall include a brief description of the synthetic or chrarcterization activity, analyses and interpretation of results.
- For each graphics request, the Contractor shall provide the completed graphs or slides within three working days of the work request.

Performance Standards:

MEETS:

- Adherence to ASTM or other relevant standards
- Efficiency (time to complete, with complexity and competing requests accounted for)
- Work requests completed by requested due date
- Cost

*****End R5 block rewrite*****

EXCEEDS:

- 75% of work requests completed at least 25% ahead of requested due date, as calculated by work days, or
- Quantity of work requests exceeds expectations by more than 25%.

3. Government Furnished Items:

Equipment in the Advanced Materials and Processing Laboratory (Building 1293), including chromatographs, spectrophotometers, thermal analyzers, DTA and DSC systems, chemical reaction equipment, computer systems, specimen preparation equipment, all chemicals and supplies.

4. R5 Other information needed for performance of task:

All synthesized materials will be Government property and shall be used exclusively in the R3 ITAS, R4 RTF, AvSec and other NASA programs.

5. Security clearance required for performance of work:

None

6. Period of Performance:

Task Order Number: 01RCA   Revision: 5   Date of Revision: 2/11/05

Title: R5 Characterization of Polymers

	Planned start date: 1/2/2001	Completion date:	R1 ~~12/31/01~~ R2 ~~12/31/2002~~ R3 ~~09//30/03~~ R4 ~~09/30/04~~ R5 ~~3/31/05~~ ***09/30/05***
7.	**NASA Technical Monitor**: James F. Dezern M/S: 226 Phone: 757-864-4263 NASA Directorate/Other Technical Coordinator Laurie Johansen M/S: 162 Phone: 757-864-1757		

Task Order Number: 01RDH Revision: 7.1 Date of Revision: 2/18/05
Title: Software Development and Integration for Sensors and Sensor Product Development Under the Aviation Safety Program

1. **Purpose, Objective or Background of Work to be Performed:** (DI19, NAS1-96014) R2The R7***Electromagnetics and*** Sensors Research Branch (***ESRB***) has the responsibility for the development, assessment and flight evaluation of radar and R5Electro-Optic sensor systems and sensor products in support of the Aviation Safety R7***and Security*** Program (AvSSP). The purpose of this task is to provide technical support in the research and development of these systems. The highly specialized performance-based nature of the support needed for the ***ESRB*** mission requires experience and familiarity with RF/R5Electro-Optic systems and software development for these systems.

   Note: As they become defined, specific requirements will be communicated to the Contractor in informal weekly meetings that will also serve as a forum for the discussion of progress, problems, and solutions. R2 This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. Each NOR will be subject to the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to respective Subtasks defined below.

   Revision 1: Adds travel requirement and extends the completion date in the work description to reflect NASA's need for continued support (see R1 in file *01RDH01.doc*, electronic task order system [ETOS]).

   Revision 2: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the new period of performance, and changes the Technical Monitor (see R2 above and below).

   Revision 3 Adds two new subtasks that are immediately fundable through a recent programmatic augmentation (see R3 below).

   Revision 4: Extends period of performance two months for NASA's convenience (see R4 below).

   Revision 5: Extends the period of performance one year in continuation of NASA's support with added travel requirements and some clarifications (see R5 above and below).

   Revision 6: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see R6, Section 6 below).

   Revision 7: Extends the period of performance nine months to September 30, 2005, in continuation of NASA's support with updated organizational data and no changes in detailed requirements for the new period of performance (see R7 above and below).

Change 7.1: Off site travel requirement noted in Section 4, below (see R7.1).

2. **Description of the Work to be Performed:** (See file *01RDH01.doc*, electronic task order system [ETOS] for January through October, 2001 requirements)
Begin R2 block

The Contractor shall develop, modify, execute, and document software for the purpose of collecting, analyzing, and visualizing data in support of the research and development of the sensors systems being investigated by R7***ESRB***. In order to facilitate the implementation of this task, it has been broken into R5multiple subtasks (each with it own deliverables, schedule, and performance metrics) as are described below.

A. (NOR) The Contractor shall develop software for the purpose of analyzing and visualizing the performance of the data recording subsystem, the sensor system, and the state/dynamics of the platform (e.g., aircraft, spacecraft, or other vehicle) on which the sensors are mounted. These tools will be used to investigate advanced signal/data processing techniques and assess the performance of sensor concepts being developed by R7***ESRB*** researchers. It is anticipated that approximately 4 cases per month and not to exceed 50 total cases for the period of performance will be required.

Deliverables: The Contractor shall provide source code, output examples, analysis results, and present these results regularly to R7***ESRB*** team members.

Schedule: To be determined by appropriate program milestones.

Metrics: Demonstrations and timely delivery of results.

Meets Standard: The Contractor consistently provides results per agreed upon schedule with suitable tables, plots, and descriptive information.

Exceeds Standard: Consistently provides results one to two weeks ahead of schedule and/or the quality of the presentation of results are exceptional.

B. The Contractor shall design, organize, and maintain the growing data archive created by current R7***ESRB*** projects and previous investigations. The Contractor shall develop a design for the archive, organize the data, provide a means for locating data within the archive, and provide a means for maintaining the data, its distribution media, and the archive in general (including provisions for PROPRIETARY data).

Deliverables: The Contractor shall provide a detailed design for the R7***ESRB*** database archive, set-up the facility, and demonstrate its operational status.

Schedule: The Contractor will present an archive design within 30 days after this task is activated; subsequent iterations (if necessary) shall be delivered within 30 days after receipt of reviewer's comments and a request for a design modification. The government will be responsible for the procurement of any hardware (e.g., shelving, cabinets, etc.) and its installation (if required). The Contractor will set-up and organize the archive and demonstrate its operational status within 30 days after the installation of all hardware.

Metrics: Schedule and operability with minimal modification.

Meets Standard: The Contractor delivers a design that requires little modification to implement and demonstrates operational status on schedule.

Exceeds Standard: The Contractor delivers a design that requires no modifications and demonstrates operational status more than a week early.

C. The Contractor shall develop/maintain electronic versions of all documentation associated with the software developed under Subtask A and/or their maintenance of the [R7]***ESRB*** data archive established under Subtask B. The document(s) shall describe the basic function and operation of the software/processes and provide sample outputs of each of the major data products/operations.

Deliverables: An informal, electronic document describing the major software packages developed and their operation.

Schedule: Emailed delivery of significant changes along with reference to their associated version according to the schedule metrics stated below.

Metrics: Documentation completeness and delivery schedule.

Meets Standard: The Contractor provides the documentation within 30 days of software delivery.

Exceeds Standard: The Contractor provides the documentation concurrent with the software delivery.

End [R2] block

Begin [R3] block

D. The Contractor shall provide operator support for the [R7]***ESRB*** Data Archive delivered under subtask B. This support will take the form of data reproduction, administration of a firewall and data server systems, and coordination of on-line data between the varied [R7]***ESRB*** projects. In order to facilitate its operation, the Contractor shall develop and maintain an operating plan, any electronic logs, data request forms, or other documentation/processes required to operate the archive efficiently.

Deliverables: The Contractor shall provide an informal record of the data archive's operations and report quarterly on any lessons learned regarding its operation.

The Contractor shall provide copies of data from sensor tests.

Schedule: As required to meet each program's milestones.

Metrics: Timely completion of data requests.

Meets Standard: The Contractor consistently provides all deliverables on schedule.

Exceeds Standard: The Contractor exceeds the "Meets Standard" by also providing recommendations that allow for improved operation of the data archive.

E. (NOR) The Contractor shall reestablish the RF laboratories used by [R7]***ESRB*** (e.g., the "roof-top" radar lab (rm 204), the "systems integration" lab (rm 142), the "mobile research" lab (RV), the "radiometer" labs, etc.). These labs already exist but have not been utilized much over the past 3-5 years and therefore require an assessment of the equipment and a rebuild/reinstallation of some systems to meet current and future research goals.

Deliverables: The Contractor shall provide a work plan, which describes the salient processes to bring these labs back "on-line". As a minimum, the plan shall require:

- An itemized list of current lab hardware, along with a recommendation to keep/survey each component.
- A design/layout for each lab area along with a buy list.
- A schedule with decision points and major milestones.

Schedule: Negotiated based upon lab assessment, program requirements, hardware and software procurements, and available funding.

Metrics: Achievement of operational status for each laboratory and capability of the lab measured against the program requirements.

Meets Standard: At least two [R7]***ESRB*** labs are updated on schedule and sufficient to meet current program requirements.

Exceeds Standard: More than two [R7]***ESRB*** labs are updated on schedule and sufficient to meet current program requirements.

End [R3] block

3. **<u>Government Furnished Items</u>**:
[R2] The Contractor will be given access to any specialized [R7]***ESRB*** computer hardware/software required to perform this task.

4. **<u>Other information needed for performance of task</u>**:
Year 2000 Compliance: Any information technology (IT) provided under this task must be Year

Task Order Number: 01RDH Revision: 7.1 Date of Revision: 2/18/05
Title: Software Development and Integration for Sensors and Sensor Product Development Under the Aviation Safety Program

	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. **Begin R5 block** (NOR) The Contractor will be required to travel in support of project deployments in the performance of this Task. For budgetary purposes, the Contractor shall include a travel estimate that will allow the continued support by this Task for three (3) weeks in Reno, NV during July 2003. **End R5 block** R7.1 ***Some off site travel may be required in support of radar installation.***
5.	**Security clearance required for performance of work**: All work will be unclassified however all personnel will be required to agree to protect the confidentiality of any company proprietary information to which access may be required in the performance of this task through a signed non-disclosure agreement.
6.	**Period of Performance**: Planned start date: January 2, 2001 — Completion date: R2~~October 31, 2001~~ R2November 5, 2001 — November 1, 2002 R3February 4, 2002 — R4~~November 1, 2002~~ R5~~December 31, 2002~~ R5January 2, 2003 — R6~~December 31, 2003~~ R7~~December 31, 2004~~ ***September 30, 2005***
7.	**NASA Technical Monitor**: R2Steven D. Harrah M/S: 473 Phone: 757-864-1805 NASA Competency/Other Technical Coordinator: M/S: Phone: 757-864-

Task Order Number: 01RFH Revision: 1 Date of Revision: 2/26/01

Title: PICASSO-CENA, Electro-Optics Trade Studies and Design Reviews

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

The PICASSO-CENA (Pathfinder Instruments for Cloud and Aerosol Spaceborne Observation-Climatologie Etendue des Nuages et des Aerosols) project is a collaboration between NASA Langley Research Center (LaRC), the French Centre National D'Etudes Spatiales (CNES), Hampton University (HU), the In-stitut Pierre Simon Laplace (IPSL), and Ball Aerospace and Technologies Corporation (Ball). The spacecraft bus is one of the PROTEUS series and is supplied by CNES. A SELV-II B-class launch vehicle is used to insert the spacecraft into a formation orbit with EOS-PM.

The PICASSO-CENA mission provides crucial measurements in a timely and cost-effective manner. It combines a 3-channel lidar with carefully selected passive sensors to obtain unique data on aerosol and cloud vertical structure and optical properties. A key aspect of PICASSO-CENA is flying in formation with EOS PM to produce a coincident, 3-year, global data set that is essential for accurate quantification of aerosol and cloud radiative effects.

This task involves conducting trade studies and performing design reviews.

Revision 1: Revises the schedule and completion date, adds Subtask 2, and revises other wording in Subtask 1 for performance-based contracting concerns (see [R1] below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. [R1] Provide systems engineering support to the PICASSO payload development team on spaceflight optical, electro-optical, and detector issues. This support shall include:
   (a) Exploring redundancy options and lens design issues, gathering information on and evaluating related lidar design options, and providing written reports that document options and issues applicability to PICASSO-CENA.
   (b) Evaluating the candidate lidar optical flight design and providing a written report that assesses the capability of the design to meet performance requirements.

   Deliverables: Design Assessment Reports, Review Reports.

   [R1] Schedule: Design Assessment Reports shall be due monthly. Review Reports shall be due 30 days subsequent to the following reviews:

Payload Critical Design Review: August 2001
Payload Test Readiness Review: September 2002
Payload Pre-Ship Readiness Review: February 2003
Satellite Pre-Ship Review: December 2003
Mission Readiness Review: March 2004

Metrics: Monthly reports shall be provided to identify issues being worked, progress, and status.

Meets Standards:
1. Deliver Design Assessment Reports by the end of each month.
2. Deliver Review Reports within 30 days after completion of the Review.

Exceeds Standards:
1. Deliver additional Design Assessment Reports at times when more frequent (more than once/month) identification of any design options/issues may save time and/or reduce overall cost of the lidar instrument and/or the Payload.
2. Deliver Review Reports within 15 days after completion of the Review.

[R1] 2. Develop electronics and electronic packaging (mechanical) designs for the 532-micron photomultiplier tube (PMT) front end. Develop PMT detector packaging requirements and design definition. Develop PMT module packaging design. Prepare the PMT module mechanical design. Develop PMT module ground support equipment (GSE). Assemble the PMT module engineering unit. Prepare PMT module flight assembly procedure. Assemble the electronics flight box.

Deliverables and Schedule:

1. PMT detector packaging requirements and design definition – March 14, 2001.
2. PMT module packaging design – May 4, 2001.
3. PMT module GSE development – May 23, 2001.
4. PMT module engineering unit assembly – June 15, 2001.
5. PMT module flight assembly procedure development – August 13, 2001.
6. Flight Board assembly – December 5, 2001.

All deliverables are contingent upon the timely provision of any required GFE, GFI, or Government-furnished designs or design specifications.

Meets Standards:
1. Deliverables completed per schedule.

Exceeds Standards:

	Task Order Number: 01RFH Revision: 1 Date of Revision: 2/26/01 Title: PICASSO-CENA, Electro-Optics Trade Studies and Design Reviews

	1. Contractor-initiated design enhancements that result in improved PMT performance or development schedule time reductions.
3.	Government Furnished Items: Laboratory facilities to support any trade studies will be available in room 300 of building 1202. Access to standard tools and lab test equipment will be available for trade studies.
4.	Other information needed for performance of task: Travel: One 2-day trip to GSFC and three 3-day trips to Ball Aerospace and Technologies Corporation in Boulder, CO. Travel is required to support design reviews. Data rights: The Contractor shall not disclose PICASSO-CENA project information to anyone outside the project without the written approval of the Technical Monitor. 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.
5.	Security clearance required for performance of work: Contractor must be able to review ITAR restricted information (i.e. must be a US citizen).
6.	Period of Performance: Planned start date: January 2, 2001 Completion date: [R1] April 30, 2004
7.	NASA Technical Monitor: David M. Rosenbaum M/S: 488 Phone: 757-864-1800 NASA Competency/Other Technical Coordinator (above branch level): Debra Dajon M/S: 435 Phone: 757-864-4663

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 3 Statement of Work

Task Order Number: 01RGO Revision: ____ Date of Revision:

Title: Cryogenic Tunnel Performance Analysis and Operational Enhancements

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

The National Transonic Facility (NTF) and 0.3-Meter Transonic Cryogenic Tunnel (0.3M TCT) are two unique and world-class cryogenic wind tunnel facilities located at NASA Langley Research Center. Current and future testing demands at these facilities requires advanced experimental research techniques and operations. The performance of these facilities and their systems require frequent analysis with a view to improve and/or increase operational capabilities.

This task deals with innovative research and developmental support needed to analyze current aerodynamic, structural performance of these cryogenic tunnels to improve, optimize and enhance their current operational limits.

2. Description of the Work to be Performed:

1. NTF Support:

a) The NTF Air mode Mach number is presently limited to 1.08 and the desire is to obtain a higher Mach number limit of M=1.2. The Contractor shall analyze the current performance limitations imposed by fan pressure ratio and test section geometry using operational data and recommend methods and engineering solutions for realizing M=1.2 in Air mode.

b) The NTF currently has two modes of operations (Air and Cryo). A new mode is need called Mixed mode that allows the NTF to operate the existing cooling coil while operating in a warm nitrogen environment. The Contractor shall analyze the current operational modes and recommend methods and engineering solutions for realizing Mixed mode operations.

c) The NTF currently has a Model Protection and Safety System (MPSS) as its primary tunnel/model safety interlock system. The current MPSS estimates in near real time corrected balance loads and shuts the tunnel down when pre set load limits are obtained. The Contractor shall enhance the operation of MPSS to include a safety interlock based on the frequency domain (to recognize wing buzz and buffet onset). The Contractor shall provide design specifications and implementation requirements for review by the Facility prior to implementation.

d) The NTF is a high dynamic pressure facility with many structural vibration problems. The NTF model support system and its diffuser are prone to very large levels of vibration. This is known to affect the data quality. The Contractor is required to analyze the existing wide band acceleration and pressure signatures of NTF and recommend methods for improving diffuser performance as well as reducing the model support system vibrations.

e) The NTF flow angularity is known to vary as a function of temperature. The Contractor shall analyze a large body of data from the tunnel to understand the mechanism, which controls the flow angularity.

Deliverables:
The deliverables for the tasks are design and analysis documents, cost estimates and performance/cost trade offs for the proposed designs and tunnel improvements.

Minimum acceptable performance

Task Order Number: 01RGO Revision: ____ Date of Revision:

Title: Cryogenic Tunnel Performance Analysis and Operational Enhancements

Deliverables for the tasks are available in documented form with sufficient detail for implementation at NTF.

Exceeds acceptable performance
Deliverables for the tasks are implemented and the analyses are documented showing desired results/improvements in NTF operations.

2. 0.3M TCT Support:

a) The 0.3M TCT has a newly installed 38-actuator wall control system. The Contractor shall optimize and document the performance of the wall control system as well as the Wall Adaptation Algorithms to provide wall interference free aerodynamic results for the test object. This work will require the Contractor to work closely with the Research teams at the 0.3M TCT to interpret and analyze the effectiveness of the Wall Adaptation Algorithms on test results.

b) The 0.3M TCT turbulence (unsteady pressures) has not been characterized. The Contractor shall propose and implement a scheme for measuring the unsteady pressures with a view to provide and document the 0.3M TCT test section turbulence levels.

Deliverables:
The deliverables for the task are design and analysis documents, rough cost estimates and performance/cost trade offs for the proposed designs and tunnel improvements.

Minimum acceptable performance
Deliverables for the tasks are available in documented form with sufficient detail for implementation at 0.3M TCT.

Exceeds acceptable performance
Deliverables for the tasks are implemented and the analyses are documented showing desired results/improvements in 0.3M TCT operations.

3. Government Furnished Items:

Access to the following Bldgs. 1242, 1236, 12,12, 1146, 1251, 582:

1. Office space, phone, and LaRC network connection
2. Model build up areas, wind tunnel model hardware and documentation
3. Access to wind tunnel support hardware and documentation, wind tunnel test instrumentation and documentation
4. Access to the the NTF's Dynamic Data Acquisition Unit., uncertainty analysis software and documentation, MatLab Software from Mathwork for data analysis.

4. Other information needed for performance of task:

1. Additional specific NTF test reports, equipment manual and facility related documents will be provided by the Government as requested by the Contractor.
2. The NTF operates on two shifts so the Contractor may be required to work second shift.

5. Security clearance required for performance of work:

Work on classified projects may be required.

6. Period of Performance:

	Task Order Number: 01RGO Revision: ____ Date of Revision: Title: Cryogenic Tunnel Performance Analysis and Operational Enhancements

	Planned start date: 07/15/2004 Completion date: 12/31/2005
7.	**NASA Technical Monitor:** W. Allen Kilgore M/S: 267 Phone: 757-864-5033 **NASA Competency/Other Technical Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 01SA Revision: 3 Date of Revision: 9/27/2004
Title: OCFO Cost Analysis

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

The LaRC Office of the Chief Financial Officer (OCFO) Cost Analysis Office reviews and approves all estimates for proposals and external agreements prepared by Center organizations, performs independent cost validations for ongoing and new programs or projects as required, and validates all Center program, project and other cost estimates to ensure consistency and integration with other Center financial information.

There are approximately twelve programs/projects that will require some level of review or cost analysis each year by the OCFO Cost Analysis Office. The Contractor will be expected to provide appropriate technical experts to assist the OCFO Cost Analysis Office in reviewing, evaluating, and validating program/project cost estimates. The Contractor will be required to perform technical and programmatic analysis focusing on one or more of the following areas of interest, appropriate to the particular program under review: Aerospace Vehicle Design; Propulsion; Power; Guidance, Navigation, and Control; Reliability, Maintainability, and Quality Assurance; Operations; Crew Systems; Safety and Mission Assurance; Risk Management; Project Management; Cost Estimating; and other associated disciplines.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR requirements to the COTR. The Contractor shall proceed with performing NOR requirements that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports.

Revision 1: Extends the period of performance 9 months to September 30, 2004, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R1] below, Section 6).
Revision 2: Extends the period of performance 6 months to March 31, 2005 to re-phase the current anticipated work without changing detailed requirements (see [R2] below, Section 6).
Revision 3: Extends the period of performance 6 months to September 30, 2005 to further re-phase the current anticipated work without changing detailed requirements (see [R2] below, Section 6).

2. Description of the Work to be Performed:

The Contractor shall provide all administrative support (including incidental costs and fees for each expert, as required) necessary for the various teams of technical experts that are required to participate in the OCFO reviews, cost estimates, and cost validations.

A. Consultant Database
The Contractor shall establish and maintain a database of potential, current, and past technical experts including the reviews conducted and specific expertise available. This database shall be updated independently by the Contractor and with information provided by the Langley OCFO Cost Analysis Office. The database shall contain information on a wide source of candidates sufficient to meet FAR guidelines in consultant subcontracting for consultant participation. This database shall be current enough to enable immediate access to technical experts for continuation of reviews and for establishing reviews of similar nature to those previously conducted.

Deliverables
The database as it is developed within two business days of receipt of independent or NASA data.

Metrics
MEETS if database is updated on schedule
EXCEEDS if updates delivered within one business day.

B. Cost Reports
The Contractor shall provide cost reporting in sufficient detail to track both individual team members and team total costs, including, planned costs, invoiced costs, and cumulative costs to date for each review conducted. These cost reports shall be provided to the Technical Monitor on a regular monthly basis and as requested for sudden surges in programmatic or review activity. The cost reports shall be assembled and maintained in a format, both written and electronic, that is mutually agreeable between the Contractor and the Technical Monitor.

Deliverables
Cost Reports, monthly and intermediate as required

Metrics
MEETS if cost report is received on a monthly basis within one week of month end.
EXCEEDS if cost report is received on a bi-weekly basis or as requested during surge activity within two days of biweekly end.

C. (NOR) Technical and Programmatic Analysis
The Contractor's technical expert(s) shall provide results of technical and programmatic analysis of each required program/project, developing a detailed plan to perform the analysis

	and including schedules of the deliverable products. The primary product for each analysis shall be a final report summarizing the cost, schedule, and technical analyses conducted. The schedule for final reports and a schedule of meetings to be attended by the technical expert shall be developed by the technical expert in cooperation with the OCFO Cost Analysis Office for each program/project evaluated. During the review, the technical expert(s) shall provide in-depth cost, schedule, and technical analyses. Deliverables The technical expert(s) shall deliver the final report for each program/project evaluated. Metrics Minimum acceptable performance: Each 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: Each final report shall be assessed for: • Findings to improve design and development process • Propose alternative concepts that will benefit the government • Recommendations for improving efficiency, capability, and quality; and for reducing cost, schedule, and technical risks • Executive summary identifies critical risks
3.	**Government Furnished Items:** The OCFO Cost Analysis Office will be responsible for generating invitational travel orders for the technical experts for any travel required during the review.
4.	**Other information needed for performance of task:** None
5.	**Security clearance required for performance of work:** All work will be unclassified; however, personnel may be required to complete nondisclosure agreements.
6.	**Period of Performance:** ***Planned start date:*** March 17, 2003 ***Completion date:*** R1 ~~December 31,~~ 2003

		R2 ~~September 30, 2004~~ R3 ~~March 31, 2005~~ ***September 30, 2005***
7.	**NASA Technical Monitor:** Kerry L. Christian M/S: 109 Phone: 757-864-3264 **NASA Competency/Other Technical Coordinator:** M/S: Phone:	

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 02OCB Revision: Date of Revision:

Title: Hyper-X Design Evaluation and Flight Dynamics

1. 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.

HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT

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
3/16/99	FDR for Mach 10 flight vehicle
1/15/00	Mach 7 vehicle test flight
10/00	CDR for Mach 10 flight vehicle
2/6/00	Complete risk reduction for flight 1
8/1/01	2nd Mach 7 flight
3/1/02	3rd flight (Mach 10)

2. DESCRIPTION OF THE WORK TO BE PERFORMED

2.1.1 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 shall 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. Therefore, the contractor shall provide assessment of flight data, comparisons with design predictions/expectations, and upgrade models for subsequent flights. Specific areas design predictions/expectations, and upgrade models for subsequent flights. Specific areas and anticipated levels of effort are described as follows:

2.1.1.1 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. Evaluate flight trajectory and loads data to establish/validate loads methods and/or guide upgrade to methods, and upgrade loads for subsequent flights.

2.1.1.2 Airframe/Adapter Structural Design –Provide continuous 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. Review/develop strain gage instrumentation requirements to validate structural design methods, review flight data and validate methods with flight data.

2.1.1.3 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. Support flight instrumentation definition and evaluation of results to validate thermal design of flight vehicles.

2.1.1.4 Engine Structural Design – Review and assess structural and mechanical evaluations of the Hyper-X engine designs to be flown at Mach 7 (two flights) and Mach 10. Review/develop instrumentation requirements to validate thermal/structural design methods, review flight data and assess methods with flight data.

2.1.1.5 Engine Thermal Design – Review and assess detailed thermal analysis performed by the Hyper-X contractor studies of the Hyper-X engine system to be flown at Mach 7 (two flights) and Mach 10. Compare thermal measurements from flight with design predictions, and recommend additional thermal analysis required to understand measurements, if required.

2.1.1.6 Launch Stack Dynamics –Evaluate available flight data for frequency content to establish actual free flight modal frequencies for comparison to predicted values from previous Nyma dynamics modeling

2.1.1.7 Evaluate results from flight test and identify limitations and/or update analysis methods for stage separation simulation as required.

2.1.1.8 Propulsion Performance Analysis –Support flight data analysis, and ground to flight comparisons, upgrade methods if required..

2.1.1.9 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, including flight data.

2.1.2 DELIVERABLES

Dates presented below are consistent with current NASA Hyper-X schedules, which may change (be extended).

2.1.2.1 Loads Development –

2.1.2.1 Final design loads for the Mach 10 mission. 3/15/01

2.1.2.2 Airframe Structural Design –

2.1.2.2.A Final airframe structural design assessment for the Mach 10 mission. 1/15/01
2.1.2.2.B Update Mach 7 airframe structural assessment including flight data 5/1/01

2.1.2.3 Airframe Thermal Design and Analysis –

2.1.2.3.A Update airframe thermal design assessment for the Mach 10 mission 2/15/01
2.1.2.3.B Update Mach 7 airframe thermal assessment including flight data 5/1/01

2.1.2.4 Engine Structural Design –

2.1.2.4.A Updated engine structural design assessment for Mach 10 mission 2/15/01
2.1.2.4.B Update to Mach 7 engine structural design assessment for flight data 5/1/01

2.1.2.5 Engine Thermal Design –

2.1.2.5.A Updated engine thermal design assessment for the Mach 10 mission. 2/15/01
2.1.2.4.B Update to Mach 7 engine thermal design assessment for flight data 5/1/01

2.1.2.6 Launch Stack Dynamics –

2.1.2.6 Document requirement for updated Mach 7 launch stack dynamic analysis, based on first flight data 2/15/01

2.1.2.7 Separation Mechanism and Systems –

2.1.2.7 Review and update Mach 7 stage separation analyses to account for flight #1 data 5/1/01

2.1.2.8 Propulsion Performance Analysis –

2.1.2.8 Doc. Code modifications and/or validation using flight #1 data. 6/1/01

2.1.2.9 Aerothermal analysis –

2.1.2.9 Complete assessment of aerothermal methods validation for Mach 7 flight data 12/1/01

2.1.2.10 Mission Planning and Trajectory –

2.1.2.10 Review trajectory development and guide loads definition for design.
As required, until 12/31/01

2.1.3 SCHEDULE
(See section 2.1.2)

2.1.4 METRICS

2.1.4.1 Meet schedule and cost.

2.1.4.2 Analysis performed with state-of-the-art methods and documented in presentations to IPT and copy in Hyper-X official files.

2.1.4.3 Quality of analysis documented by reference to previous work or new validation performed.

2.1.5 EXCEEDS MINIMUM REQUIREMENTS

3.1.5.3 Methods utilized exceed standard and/or that requested by contractor team members.

2.1.5.2 Results presented in NASA contractor reports

3.1.5.3 Documentation includes assumptions, models and/or inputs to programs required to produce results

3. <u>Government Furnished Items</u>:

3.1 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
- BEOWULF Cluster – 32 Processor

3.2 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, etc.

3.3 Special furniture
- Safes for storage of classified material

4. <u>Other information needed for performance of task</u>:

4.1 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), West Palm Beach, FL and Cleveland, OH.

5. Security clearance required for performance of work:

5.1 Much of the work performed on this work order requires a SECRET clearance.

5.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

5.3 Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.

6. Period of Performance:

Planned start date: Jan. 1, 2001 Completion date: Dec. 31, 2001

7 . NASA TECHNICAL MONITOR: Charles R. McClinton M/S: 353X Phone: 864-6253
NASA TM ALTERNATE: R. T. Sherrill M/S: 430 Phone: 864-7085

Task Order Number: 02OJ Revision: 7 Date of Revision: 11/15/04

Title: Cost Estimation and External Business Agreement Project Planning

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

NASA Langley' [R7]***Incubator Institute***, 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 [R7]***basic research and technology development***, 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"). Cost estimates for on-going projects are for mid course review or for updates to projects which were less defined in earlier analyses and should take into account all completed work and incurred costs. Completed project [R7]***costs are used*** 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.

[R7]***The Incubator Institute is the External Business Agreement Process Owner responsible for helping bring market intelligence, new opportunities, efficient and effective proposal development for future business, and funding dollars to the Center.***

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements with some clarifications (see [R1] below).
Revision 2: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements for the new period of performance (see [R2] below).
Revision 3: Extends the period of performance one month to January 31, 2004, and documents the technical monitor change (see [R3] below, sections 6 and 7)
Revision 4: Extends the period of performance two months to March 31, 2004 for NASA's convenience (see [R4] below).
Revision 5: Extends the period of performance six months to September 30, 2004 in continuation of NASA's support with no changes in detailed requirements (see [R5] below, Section 6)
Revision 6: Extends the period of performance three months to December 31, 2004 in continuation of NASA's support with no changes in detailed requirements (see [R6] below, Section 6)
Revision 7: Adds a new subtask 3 and extends the period of performance one year to December 31, 2005 in continuation of NASA's support with some requirement clarifications (see [R7] above and below).

2. Description of the Work to be Performed:

Sub-Task 1 - Deliverable Parametric and Grassroots Cost Estimates:

The Contractor shall perform parametric and grassroots cost [R7]***estimates and*** analyses on new, on-going or completed projects [R1]to include [R7]***external business*** agreements. The NASA task monitor will identify those projects to be estimated. Each parametric cost estimate should include the following products, services and activities:

Deliverables:

- 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.

- 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 shall 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.

Sub-Task 2 - Cost Model and Technique Development:

The Contractor shall investigate new cost modeling tools and techniques and make specific recommendations to the NASA Langley Technical Monitor. Further, the Contractor shall 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 shall 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 broad relevancy requirement can be waived by the task manager when the improvement can be shown to be a significant enhancement to a narrower spectrum of high-priority cost estimates.

- Meetings to discuss proposed or planned improvements and progress on current improvements shall occur with the task monitor or other designated NASA personnel on at least a quarterly basis.

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 judgment 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.

*****Begin R7 block addition*****

Sub-Task 3 – External Business Project Planning:

The Contractor shall provide project planning guidance for external business agreements. The Contractor shall provide guidance on the appropriate process, organization, and personnel required to conduct external business agreements. The Contractor shall collect and compile process metrics for external business agreements. Further, the Contractor shall provide process improvement recommendations to the NASA Langley Technical Monitor.

Deliverables:

- A report that incorporates a summary of the relevant external business process metrics; total number of agreements processed, number of agreements by organization, total dollar value, summary of waived costs, processing time per agreement, internal customer survey results, and external customer survey results.
- Meetings with the NASA task monitor to discuss ideas for needed improvements. The meetings will also provide a forum for describing the status of on-going efforts.
- Documentation of the improvement, including impacts to the process and potential benefits

Metrics (minimum acceptable level):

- A report summarizing the relevant external business process metrics shall be submitted quarterly.
- At least one improvement, including documentation shall 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 external business process for Langley Research Center.
- Meetings to discuss proposed or planned improvements and progress on current improvements shall occur with the task monitor or other designated NASA personnel on at least a quarterly basis.

Metrics (above minimum acceptable level):

	• Meetings to discuss proposed or planned improvements and progress on current improvements to the task monitor at a rate that exceeds one in each three month period. • Improvements, including documentation submitted to the task monitor at a rate that exceeds one in each six month period. *****End R7 block addition*****
3.	**Government Furnished Items:** The Government will provide R1two network connections with electronic mail, and World-Wide Web navigation capabilities. Also available R1is one non-networked IBM Pentium compatible personal computer outfitted with R1specialized (NAFCOM, SEER SEM, SEER H, Price H, Price M, and Price HL cost modeling) and R1other software. Appropriate printer is included for this stand alone work station.
4.	**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.
5.	**Security clearance required for performance of work:** In most cases, no security clearance is required. However, approximately R7***10 to 20***% 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.
6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3~~12/31/03~~ R4~~1/31/04~~ R5~~3/31/04~~ R6~~9/30/04~~ R7~~12/31/04~~ ***12/31/05***
7.	**NASA Technical Monitor:** R3Christopher Chromik M/S: 268 Phone: 757-864- R37208

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

The NASA Advanced Aircraft Program performs system-level studies and research and development work related to [R4]advanced vehicle concepts and the technology needed to ensure the survivability of [R4]such aircraft. The Advanced Aircraft Branch is directing a NASA program aimed at investigating novel high-risk / high-benefit advanced aircraft technologies. Vehicle concepts are considered in the context of requirements established by [R4]Integrated Product Teams (IPTs) composed of Industry, Government, and end-user technical focal points. Key technology development [R4]issues will be identified and addressed through analysis and/or ground and flight-testing. Trade studies will be conducted to define the appropriate vehicle performance parameters and investigate the impact of these parameters on the vehicle characteristics. [R8]More specific descriptions of the tasks involved in the Work to be Performed are delineated in a Classified Statement of Work.

Revision 1: Extends the period of performance through 12/31/01 to allow current work to continue while planning for the coming year (see [R1] below).

Revision 2: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the new period of performance with a roll-in of Task Order 11RAD as Subtask 2 and various clarifications, and adds replacement Technical Monitors (see [R2] below).

Revision 3: Provides for a detailed design of a cryogenic vacuum pump (see [R3] below).

Revision 4: Extends the period of performance one year in continuation of NASA's support with updated, clarified, and/or new (Subtask 4) requirements, annotates Subtask 3 as completed, and adds other clarifications (see [R2] above and below).

Revision 5: Provides for the design of an aerodynamic test model as well as design and fabrication support for a cryogenic pump system (see [R5] below).

Revision 6: Extends the period of performance 12 months in continuation of NASA's support requirements and updates/redefines some requirements for the new period of performance (see [R6] below).

Revision 7: Provides for continued design and fabrication support for a cryogenic pump system including additional drawing deliverables (see [R7] below).

Revision 8: Annotates completed work in Subtask 1 and provides for extended support for the cryogenic pump system in Subtask 1 and support for a new wind tunnel test covered under Subtask 2; adds general and contextual references for details included in the classified SOW (see [R8]above and below).

Revision 9: Extends the period of performance one year to December 31, 2005, annotates completed items, adds/updates items in Subtasks 1 and 2, eliminates Subtask 3, and renumbers subsequent Subtasks accordingly (see [R9] below).

2. **Description of the Work to be Performed:**

Begin [R2] block requirements redefinition

There will be [R4]~~two~~ distinct subtasks required to satisfy the work specified in this Task Order. For [R4]applicable subtasks, specific work elements will be defined in the classified subtask descriptions [R4]dated November 14, 2002, that will be provided by the NASA Technical Monitor. The Contractor(s) will be responsible for developing subtask plans, recommending the appropriate analyses and experimental investigations, meeting milestones associated with the program, and reporting any problems that will impact team milestones or completion of the subtasks. The Contractor(s) shall document any methods that are developed as a result of conducting the studies.

Subtask 1 – Technology Development: The Contractor will participate as part of an IPT, and shall perform appropriate technology studies, theoretical analyses, experimental testing and data analysis, and informal/formal documentation and presentations. The Contractor will lead his designated portion of the program and interface as required with the IPT members.
Begin [R5] block addition
[R6]Completed - ~~The Contractor shall produce detailed design drawings from the existing design files for the cryogenic pump. The Contractor shall also make engineering modifications to improve the existing design and document changes in the drawings as necessary. Additionally, the Contractor shall provide consultative support to the shop during the fabrication process to ensure compliance with design specifications.~~
**End [R5] block addition **
Begin [R6] block addition
[R7]Completed - ~~A cryogenic pump has been designed and fabricated. The Contractor shall make engineering modifications to improve the existing design and document changes in the drawings as necessary. Additionally, the Contractor shall provide consultative support to the shop during the fabrication process to ensure compliance with design specifications.~~
End [R6] block addition
Begin [R7] block addition
[R8]Completed - ~~A cryogenic pump has been designed and fabricated. The Contractor shall make engineering modifications to improve the existing design and document changes in the drawings as necessary. Additionally, the Contractor shall provide consultative support to the shop during the fabrication process to ensure compliance with design specifications.~~
End [R7] block addition
Begin [R8] block addition
[R9]***Completed*** - ~~The cryogenic pump has been designed and fabricated and is currently being made operational. As part of Revision 8, the Contractor shall provide support during the testing phase and will provide consultation for the pump to attain operational status. Further details are available in Subtask 1.8 in the Classified Statement of Work.~~
End [R8] block addition
[R9]***The Contractor shall provide (1.9) Engineering support for Vacuum System and (1.10) Engineering support for Alignment Device.***
Subtask 2 – (Formerly task Order 11RAD) [R4]System Study: The Contractor, as part of an IPT,

shall conduct trade studies of integrated advanced concept vehicles. The Contractor shall assemble the tools and expertise required in conducting the classified system level studies. Appropriate vehicle performance parameters will be investigated to determine their impact on vehicle characteristics. The Contractor shall develop sets of evaluation metrics to be used as criteria for concept assessment and/or reduction in number and may be asked to conduct studies to a greater level of detail for the most promising concepts. Since a major part of this phase of the effort will be the identification of the key enabling technologies, the Contractor shall be responsible for plans that focus on the development, cost, risk reduction, and validation of these technologies. [R9]***Further details for Revision 9 are available in Subtasks 2.1-2.4 in the Classified Statement of Work.***

End [R2] block requirements redefinition

Begin [R5] block addition

The Contractor shall evaluate recent TDT test data on the ACB-228 model and design additional model components for future testing.

**End [R5] block addition **

Begin [R3] block addition

[R9]***Deleted Subtask, subsequent subtasks renumbered***. ~~Subtask 3 –~~ [R4]Completed- ~~The Contractor shall perform a detailed design of a cryogenic vacuum pump. The Contractor shall attend design reviews scheduled by the government, for which he shall prepare and present pertinent material. The Contractor shall incorporate all design changes requested by the government and also conduct fabrication liaisons as required to provide design clarification.~~

End [R3] block addition

Begin [R4] block addition

Subtask 3 - Methodology: The Contractor shall identify deficiencies in current system analysis tools and shall recommend a plan to address these deficiencies whether they be improvements to analytical tools or databases.

End [R4] block addition

Deliverables:

[R2]For [R4]~~both~~ applicable subtasks the classified subtask description will clearly specify the deliverable items ([R2]appropriate systems studies, evaluation metrics/figures-of-merit,, informal and formal documentation, and presentations). The Contractor shall submit bimonthly technical progress [R2]reports describing the progress on each subtask. The bimonthly reports shall address any problems that will impact completion of the subtasks. Timely communication of technical progress is desired and should not be limited to the bimonthly reports.

[R4]Completed [R3]~~Five (5) sets of detailed drawings to the fabrication shop, as well as one (1) set of detailed drawings in pdf format to Mike Alexander at m.g.alexander@larc.nasa.gov. CAD files to be archived by the government.~~ [R7R8]Completed ~~Three (3) sets of detailed drawings to the fabrication shop. CAD files to be archived by the government.~~ [R8]For

	Revision 8 in Subtasks 1 and 2, Deliverables are specified in the appropriate Subtask in the Classified Statement of Work. Schedule: R2For applicable subtasks, the classified subtask descriptions will clearly specify critical path schedules or milestone events. R4Completed R3~~The five (5) sets of detailed drawings are due at the shop no later than August 9, 2002, with the remainder of the deliverables due on a date TBD by the government.~~ R7R8Completed ~~The three (3) sets of detailed drawings are due no later than June 25, 2004.~~ Metrics & Standards: The Contractor shall meet the critical path elements and provide the deliverables as specified by the R2subtask descriptions. If the R2efforts result in savings (milestones accomplished early, money saved) to the NASA program, then the expected performance R2will have been exceeded. Specific metrics and standards will be called out in the classified subtask descriptions.
3.	**Government Furnished Items:** Subtask 1: 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. R2Subtask 2: NASA FLOPS code for conducting system level studies. Pro-E and ACAD graphics software for configuration development, Macintosh, PC, and graphics workstations for program development, planning, analysis, and reporting. **Begin R4 block addition** Subtask 3: 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. **End R4 block addition**
4.	**Other information needed for performance of task:** A R2moderate amount of travel is anticipated for the subtasks. IPT members presently are located at R4or near LaRC, GRC, R2Washington, D.C., Los Angeles, R2St. Louis, Cincinnati, and Atlanta. Interface with and participation in the team program R2may require multiple day trips to these locations.
5.	**Security clearance required for performance of work:** Top Secret Required
6.	**Period of Performance:**

	Planned start date:	R2 ~~01/01/01~~	Completion date:	R1 ~~10/31/01~~
		R4 ~~01/01/02~~		R2 ~~12/31/01~~
		R6 ~~01/01/03~~		R4 ~~01/01/03~~
		R9 ~~01/01/04~~		R6 ~~01/01/04~~
		01/01/05		R9 ~~12/31/04~~
				12/31/05
7.	**NASA Technical Monitor:** R2 Steven F. Yaros / William J. Small R4 M/S: 411 Phone: 757-864-5292 NASA Competency/Other Technical Coordinator: Willard R. Weaver, Jr. M/S: 328 Phone: 757-864-6053			

	Task Order Number: 02RBF Revision: 3 Date of Revision: 11/09/01 Title: Liner Technology Research Support

1.	Purpose, Objective or Background of Work to be Performed: The Structural Acoustics Branch has a continuing responsibility to develop advanced liner technology to achieve community noise reduction goals under the Quiet Aircraft Technology Program. In support of this mission, it is necessary to maintain state-of-the-art facilities for investigation of advanced liner concepts. The purpose of this task is to provide technical support for the development of prediction and measurement methods for conducting laboratory investigations of advanced duct liner concepts [R1] **Note**: For the required data sets in Subtasks 3 through 6, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and becomes part of the official task requirements and records. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. Revision 1: Subtask 1 requirements, deliverables/schedule revised to accommodate technical complexity greater than anticipated and/or delays in Government fabrication and acquisition and instrumentation failures; clarification of NORs (see [R1] above and below). Revision 2: Subtask 1 requirements, deliverables/schedule revised to accommodate technical complexity greater than anticipated and/or delays in Government fabrication and acquisition; Subtask 2 completed; Subtask 3 eliminated due to DWNIT not yet completed; Subtasks 4 through 6 schedules revised to accommodate delays in Government analysis, fabrication and acquisition. Revision 3: Subtask 1 requirements, deliverables/schedule revised to accommodate technical complexity greater than anticipated and/or delays in Government fabrication and acquisition and instrumentation failures; Subtask 4 requirements extended to later date; Subtasks 5 and 6 requirements revised to accommodate reduced frequency of need, and requirements extended to later date.
2.	Description of the Work to be Performed: The Contractor shall perform the following requirements/subtasks: 1. The Contractor shall provide design [R3] ***and material specifications, assembly and*** fabrication oversight, and software support for Flow Impedance Facility upgrades. Specific upgrades include a Pulse Impedance Tube (PIT), a new Flow Impedance Tube (FIT) test window and a Dual-Waveguide Normal Impedance Tube (DWNIT) with multiple traversing probes under stepping motor control. Design guidelines (sketches, dimensions, instrumentation choices) will be provided by the government. [R1] A critical design requirement for the DWNIT will be a Constrained Layer Damping Partition (CLDP), with a goal of providing at least 40 dB acoustic isolation between the two adjacent channels of the DWNIT. The Contractor shall perform a validation test of a

prototype CLDP in the FIT facility. Software requirements include instrument and test control and data acquisition capabilities. Specific requirements (algorithms, equations, measured quantities) will be provided by the government.

Metrics:
Progress toward completion of deliverables will be assessed on a monthly basis.

Acceptable Performance Standard:
Completion of deliverables by the required dates.

Exceeds Performance Standard:
1. Completion of the deliverables at least one month before the required dates
2. Implementation of significant facility enhancements beyond those included in government furnished guidelines
3. Development of software with capabilities significantly exceeding those included in government furnished guidelines

Deliverables:
1. Demonstration of automated software control system for new FIT test window by R1 ~~March 5~~ May 15, 2001.
2. User's Manual for software code used to control multi-port test window for Flow Impedance Tube by R1 ~~April 30~~ May 31, 2001.
3. R1 Status report of design and analysis of CLDP by September 30, 2001.
4. R1 Status report for automated DWNIT by R1 ~~September~~ November 30, 2001.
5. R3 ***Demonstration of operational DWNIT by July 31, 2002.***
6. R3 ***User's manual for software code used to control DWNIT by September 30, 2002.***

Schedule: Subtask 1 is to be completed by R3 ~~R1 September November~~ ***September 30, 2002.***

2. R2 (Completed)

3. R2 (Deleted)

4. The Contractor shall analyze complex acoustic pressure data collected with the Flow Impedance Tube (FIT) using the large-array microphone approach. This data will be compared with corresponding data acquired using the traversing bar (dual microphone) approach to determine validity of the new approach.

Metrics:

Percentage of successfully completed responses to requests (RTR) will be assessed on a monthly basis

Standard: Acceptable performance on this task shall be the timely assessment of two data acquisition approaches. Minimum acceptable performance is response within two weeks for 80% of NORs. An average of 4 data sets per month will be required, although the requirements during some months may be as high as 8 data sets. Greater percentage of RTR within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverables:
1. Documented data analysis by charts and annotated electronic data files within 2 weeks of receipt of NOR
2. Report documenting comparisons of two data acquisition approaches by R3 ~~R2~~ ~~September~~ ~~November~~ ***August 30, 2002***

Schedule: Subtask 4 is to be completed by R3 ~~R2~~ ~~September~~ ~~November~~ ***August 30, 2002.***

5. The Contractor shall acquire complex acoustic pressure data using the Pulse Impedance Tube (PIT). This data shall be processed such that it is suitable for usage in a time-domain analysis to be provided by the government.

   Metrics:
   Percentage of successfully completed RTR's will be assessed on a monthly basis

   Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response within two weeks for 80% of NOR's. R3 ***The number of data sets required is expected to be between 2 and 8 per month.*** Greater percentage of RTR within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

   Deliverable: Documented data charts and annotated electronic data files within 2 weeks of receipt of request

   Schedule: Subtask 5 is to be completed by R3 R2 ~~September~~ ~~November~~ ***September 30, 2002.***

6. The Contractor shall acquire flow resistance data using the Raylometer. In addition, the Contractor shall provide oversight for usage, maintenance and analysis of data for the Raylometer.

	Metrics: Percentage of successfully completed RTR's will be assessed on a monthly basis Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response within two weeks for 80% of NOR's. R3 ***The number of data sets required is expected to be between 1 and 4 per month.*** Greater percentage of timely responses will be the basis used to assess the level of performance exceeding the acceptable level. Deliverable: Documented data charts and annotated electronic data files within 2 weeks of NOR Schedule: Subtask 6 is to be completed by R3 ~~R2~~ ~~September~~ ~~November~~ ***September 30, 2002.***
3.	Government Furnished Items: a) Flow Impedance Test Facility (including FIT, NIT, PIT, Raylometer) b) Design guidelines for modifications to Flow Impedance Test Facility. c) Test specimens for testing in the FIT under Subtask 4. d) Test specimens for testing in the PIT under Subtask 5.
4.	Other information needed for performance of task: a) Documents on flow impedance facilities, impedance measurement methods and instrumentation, and liner impedance models will be made available on an as needed basis at Langley Research Center or from other appropriate organization. b) Any data, test procedures, test methods, or inventions generated, produced or implemented by the Contractor shall be the sole property of the Government. However, the Contractor shall be free to publish non-proprietary data in the public domain. c) One 3-day trip to a NASA-sponsored workshop to present data acquired in this task. The location of the workshop is TBD. d) 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.
5.	Security clearance required for performance of work: a) Contractor shall sign a nondisclosure statement prohibiting disclosure of Government or private company information to third parties including other divisions of the Contractor's parent organization.

6.	Period of Performance: 21 months Planned start date: January 02, 2001 Completion date: R3 R2 ~~September 30, 2001~~ ~~November~~ ***September 30, 2002***
7.	NASA Technical Monitor: Michael G. Jones M/S: 463 Phone: 757-864-5272 NASA Competency/Other Technical Coordinator Bob Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 02RDI Revision: 6 Date of Revision: 01/26/2005

Title: Electromagnetics Research

1. **Purpose, Objective or Background of Work to be Performed**: (DI18, NAS1-96014)

The Contractor is to perform hardware modifications, R3~~software development and enhancements~~ and data reduction for the High Intensity Radiated Fields (HIRF) Lab. The Contractor is to configure and integrate existing resources to accommodate the diverse requirements of various experiments conducted in the HIRF Lab. Reports and presentations are to be generated periodically.

Note: For required hardware modifications, R3~~software development and enhancements~~, and data reduction not specified below, the Technical Monitor will provide notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will include test schedules as applicable, will require the same concurrence and/or approvals as the rest of the task order flow process, and becomes part of the official task requirements and records. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports.

Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by removing the requirement for software support and enhancing the Electrical Engineering support. (For this revision see R3 above and below. For details of issued original, revision 1, and revision 2 SOWs see ETOS *doc* files *02RDI, 02RDI01,* and *02RDI02*, respectively).

Revision 4: Extends the period of performance 12 months to 12/31/04 in continuation of NASA's support requirements with no changes in the detailed description except that some work will be classified (see R4 below).

Revision 5: Extends period of performance two months to March 1, 2005 to accommodate delays in acquiring the necessary test equipment and deletes RAV program from consideration in subtask 2.1 (see R4 below).

Revision 6: Extends the period of performance 10 months to December 31, 2005 in continuation of NASA's support with no change in detailed requirements (see R6 below, Section 6).

2. **Description of the Work to be Performed**:

Begin R3 block requirements redefinition

2.1 The Contractor shall provide Electrical Engineering support for various experiments to be conducted in the HIRF Lab. This support shall include the development of experiment interfaces and test plans. This support shall also include the conduct of said experiments for the Aviation safety and Aviation security R5~~and RAV~~ programs at NASA/ LaRC. Experiments shall also be conducted under agreements with the Major Airlines, Air-framers and the FAA.

Deliverables: Experiment interfaces and test plans as required. (Scheduled to be provided by NASA Task Monitor) Data reduction, report generation and presentation.

Minimum Performance Standards: Experiment interface and test plans at inception of any scheduled HIRF tests. Test schedule to be provided by Technical Monitor 30 days before test inception. Reduction and reporting of data generated by said experiments.

Exceed Performance Standards: Recommend and implement time saving modifications to test procedures. Optimize or upgrade performance capability of existing RF systems. Conduct EMI/EMC tests independent of NASA personnel.

2.2 The Contractor shall design and develop mechanical, electrical, and electronic interfaces and components for experimental Devices Under Test (DUTs). This shall facilitate instrument control, data acquisition, and DUT monitoring while in the EMI/EMC test environment. The Contractor shall develop test systems for the analysis of PED'S (Personal Electronics Devices) emissions in support of NASA/LaRC FAA Cooperative agreement.

Deliverables: Mechanical, Electrical, and Electronic interface to HIRF/EMI/EMC tests and experiments. Test system for analysis of PED'S. December [R4]~~2003~~ 2004

Minimum Performance Standards: Experiment interface and hardware functional at inception of any scheduled HIRF tests. Test schedule to be provided by Technical Monitor 30 days before test inception.

Exceed Performance Standards: Optimize or upgrade performance capability of existing RF systems. Conduct EMI/EMC tests independent of NASA personnel.
End [R3] block requirements redefinition

3. Government Furnished Items:

For the convenience of the Government access will be provided to computer equipment, software, materials, facilities and office space, and government data. These computers are instrument controllers integrated into the HIRF Lab (special test equipment and workstations). The software is Agilent Visual engineering environment and is licensed to the instrument controllers (specialized software).

4. Other information needed for performance of task:

The performance of this task requires High Intensity Radiated Fields Radiation workers certification card.
No more than [R3]three trips per year will be required.

5. Security clearance required for performance of work:

Some work will be classified under the Aviation Safety and Security Programs requiring personel to maintain a secret clearance., personnel may also be required to complete

	nondisclosure agreements with laboratory customers.
6.	**<u>Period of Performance</u>**: Planned start date: R3 ~~01/02/2001~~ R4 ~~01/02/2003~~ 03/01/2005 Completion date: R3,R4 ~~12/31/2003~~ R5 ~~12/31/2004~~ R4 ~~03/01/2005~~ ***12/31/2005***
7.	**NASA Technical Monitor**: Reuben A. Williams M/S: 130 Phone: 757-864-6212 **NASA Competency Technical Coordinator**: RTD M/S: 162 Phone: 757-864-

Task Order Number: 02RCB Revision: 13 Date of Revision: 2/17/05
Title: Aeroelasticity

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

The objective of this task is to provide research support to foster a better understanding of aeroelastic phenomena and the creation and refinement of aeroelastic prediction capabilities for the solution of relevant aeroelastic problems of current and future aircraft designs. The Contractor will be expected to perform the following general requirements as applicable to specific subtasks:

- Develop fundamental knowledge and an understanding of aeroelastic phenomena and complex steady and unsteady aerodynamic flow phenomena, especially in the transonic speed range;
- Develop analytical methods that accurately predict aeroelastic phenomena including flutter, buffet, buzz, limit cycle oscillations, and gust response, and steady and unsteady aerodynamic flow phenomena that include viscous effects, vortex flows, separated flows, transonic nonlinearities, and unsteady shock motions;
- Develop efficient methods that result in the mathematical models required for performing structural dynamic, aerodynamic, aeroelastic, aeroservoelastic studies;
- Apply analytical methods to solve structural dynamic, aeroelastic, and performance issues related to both fixed- and rotary-wing vehicles;
- Develop and validate advanced control concepts that employ smart materials or aerodynamic control surfaces for suppressing aeroelastic response and alleviating loads and vibrations;
- Provide technical expertise to support simulations, ground testing, wind-tunnel tests, and flight experiments of current and future flight vehicles;
- Participate in flutter prevention programs for new vehicles by use of analyses and wind-tunnel tests in the Transonic Dynamics Tunnel and in the Rotorcraft Hover Test Facility.

Revision 1: Adds Subtasks 2 and 3 with respective subtask technical monitors and expands GFI section.
Revision 2: For NASA's continuing support requirements, the task completion date is extended to accommodate scope extension in Subtask 1. Deleted previously defined requirements have been retained in strike-through format for completeness. Subtask 2 schedule is extended through mutual agreement.
For requirements and details of Revisions 1 and 2, see ETOS file *02RCB02u.doc.*
Revision 3: Requirements redefinition under Subtask 1, adds development of an optimization tool, along with a resulting FEM of the AAW wind-tunnel model baseline wing center panel, deletes previous Subtasks 2 and 3, adds new Subtask 2 which provides for the hardware design of the AAW wind-tunnel model baseline wing; and extends the period of performance one month into FY03. (See R3 below.)
Revision 4: Adds subtask 3 that provides gust analyses for an ERAST aircraft.
Revision 5: Adds detailed design of the control surface actuators as part of subtask 2 (see R5 below).

Revision 6: Extends Deliverables 6) and 7) due dates and completion date for subtask 1, adds subtask 4 which provides for hardware design of the High-Speed Slotted Wing (HSSW) flutter model, extends the task order completion date, (see [R6] below) and corrects minor 'typos' in revision 5 (superscript corrected from [R2] to [R5]).
Revision 7: Subtask 1 placed in final documentation status pending funding, subtasks 2 and 4 are continued with schedule adjustments, subtask 3 is annotated as complete, new subtask 5 noted in "placeholder" status for possible definition later, and the completion date is extended eleven months (see [R7] below).
Revision 8: Extends the period of performance to December 30, 2003 with Subtask 5 detailed requirements added and Subtask 1 annotated as complete (see [R8] below).
Change 1: Delivery schedules and requirements are updated for Subtasks 2 and 4 to reflect modified design requirements (see [R8.1] below).
Revision 9: Extends the period of performance to March 30, 2004 with Subtask 6 requirements added, extends liaison support for Subtask 2, and changes the technical monitor (see [R9] below).
Revision 10: Extends the period of performance to January 28, 2005, in continuation of NASA's support with added requirements (new Subtask 7) and updated deliverables/schedule (Subtask 5) for the new period of performance (see [R10] below).
Change 1: Delivery schedule updated for Subtask 6 due to unscheduled design changes (see [R10.1] below).
Revision 11: Extends Task 2, Deliverable 4 (Continued liaison support) to June 30, 2004, to allow support in resolving fabrication issues and leakage of actuator seals (see [R11] below).
Revision 12: Extends the period of performance one month to February 28, 2005 in consideration of current funding constraints (see [R12] Section 6, below).
Revision 13: Deletes complete/discontinued (sub)task detailed descriptions (1-6), modifies the type of configurations to be analyzed and extends the period of performance to November 30, 2005. (see [R13] below).

2. Description of the Work to be Performed:

*****Begin [R13] block deletions for completed/discontinued requirements*****

Subtask 1: Development of wind tunnel model concepts for aeroelastic studies:

Subtask 2: Hardware design for AAW wind-tunnel model baseline wing:

Subtask 3: Power Spectral Density Gust Analyses of an ERAST Aircraft:

Subtask 4: Hardware design for HSSW wind-tunnel model:

Subtask 5: [R8]Aeroelastic Tailoring Investigations for Improved Aerodynamic/Structural Performance:

Subtask 6: Hardware Design for the AEDC 16T Space Shuttle External Tank(ET) Cable Tray Test:

*****End [R13] block deletions for completed/discontinued requirements*****

*****Begin [R13] block modification*****

Begin [R10] block addition

Subtask 7: Computational Aeroelasticity for Conventional and High Speed Slotted

<u>**Wing Configurations:**</u> The objective of this subtask is to utilize the CFL3D v6.0 Navier-Stokes Computational Aerodynamics program to perform computational aeroelasticity studies of a High Speed Slotted Wing (HSSW) and ***other vehicle concepts***.

A HSSW and conventional supercritical transport wing have been ***tested*** in the Transonic Dynamics Tunnel (TDT). This test ***recorded*** unsteady pressures, structural accelerations and deformations, and measured the flutter boundary for the HSSW concept and a conventional supercritical wing concept. The contractor shall perform independent computations using the CFL3D v6.0 computational methodology and compare the results with data resulting from the above TDT test. The contractor shall define grids for HSSW and conventional wing concepts and perform computational aeroelasticity analyses. Data from the computational analyses shall be compared with TDT ***aeroelastic*** data. ***In addition, other advanced configurations of interest to the NASA Vehicle Systems Program shall be analyzed using the CFL3D V6.0 computational aeroelasticity methodology***.

Deliverables:

1) Computed ***aeroelastic data*** for the HSSW and conventional wings and comparison with TDT data.
2) Unsteady pressure distribution comparisons with TDT wind tunnel data.
3) Interim and final reports detailing the analysis, comparisons with wind tunnel data, and a computational perspective of the performance of the wings.

Performance Measurement:

Minimum performance: Interim report documenting aeroelastic analysis and comparisons with wind tunnel data. Final report documenting aeroelastic analysis and comparisons with wind tunnel data. The reports will be complete, understandable, and professionally written in a contractor-specified format.

Exceeding Minimum Performance: Minimum performance will be exceeded with: suggestions of improvements to models, modeling techniques or analyses; identification of code deficiencies with suggestions for improvements; development of improved models or analysis techniques using existing tools, or developing new tools that allow for faster turn-around, or better integration of analysis methods; or perform studies in a more rapid manner than original time estimates (two or more weeks prior to specified date of delivery).

Government Furnished Items:
Wing geometry for both the HSSW and conventional wing. Necessary structural properties for aeroelastic analysis. Access to TDT wind tunnel data. Access to computers with software and hardware necessary to run the analysis. Access to CFL3D v6.0, Gridgen grid generation

	software, TECPLOT, and other pre- and post-processing tools. **Schedule:** Interim Report - ***30 June 2005*** Final Report - ***One week prior to task end date*** **End R10 block addition** *****End R13 block modification*****
3.	**<u>Government Furnished Items</u>:** Access to Unix-based workstations with MSC NASTRAN and PATRAN Software.
4.	**<u>Other information needed for performance of task</u>:** N/A
5.	**<u>Security clearance required for performance of work</u>:** None
6.	**<u>Period of Performance</u>:** Planned start date: ~~1/1/2001~~ R3 2/4/2002 Completion date: ~~9/30/2002~~ R6 ~~R3~~ ~~10/31/2002~~ R7 ~~11/30/02~~ R8 ~~10/31/03~~ R9 ~~12/30/03~~ R10 ~~3/30/04~~ R12 ~~1/28/05~~ R13 ~~2/28/05~~ ***11/30/05***
7.	**NASA Task Technical Monitor** R9 Stan Cole M/S 340 Phone: 757-864-1267 **NASA Competency/Other Technical Coordinator:** S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 03RFF Revision: 6 Date of Revision: 8/24/04

Title: Inflatable Column Test Hardware.

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

Provide Engineering design and development of test hardware in support of Langley's inflatable column technology program currently funded under the Deployable and Inflatable Structures Research Program. The specific objective of the work to be performed under the present task is to design fixtures and instrument-mounting hardware to be used in axial compression and tension, bending, and vibration tests of thin-walled, inflatable columns and trusses, and support the test activities.

Note: The design, development, and test support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). R1 This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. R1 The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: For NASA's convenience, updates NOR note and specimen estimate, and extends schedule and completion date one month (see R1 above and below).
Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see R2 below).
Revision 3: Adds new subtasks 2.2.9 & 2.2.10.
Revision 4: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the extension as new subtasks 2.2.11-14 (see R4below).
Revision 5: Extends the period of performance to September 30, 2004, in continuation of NASA's support requirements for Subtasks 2.2.13 and 2.2.14 (see R5below).
Revision 6: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the extension as new subtasks 2.2.17-19, and notes an Alternate POC (see R4below).

2. **Description of the Work to be Performed**:(GK21, NAS1-96013)

2.2.1 **(NOR item)** ***Design and develop fixtures for inflatable strut testing*** 4/30/01

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, bending, and vibration tests of thin-walled inflatable column specimens.

- PERFORMANCE METRIC: The hardware shall accommodate inflatable structural specimens ranging in length from 3’ to 50’.

2.2.2. ***Support strut test activities*** 4/30/01

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.1 for testing activities and participate (set up test articles, verify calibrations, and perform test data quick-look analyses) in the testing of the specimens.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least 21 specimens and support, at a minimum, compression and tension tests for the 21 specimens.

2.2.3 **(NOR item)** ***Design and develop fixtures for inflatable truss testing*** R1 ~~7/31/01~~ 11/30/01

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, and bending, tests of thin-walled inflatable truss specimens.

- PERFORMANCE METRIC: The hardware shall accommodate inflatable structural specimens ranging in length from 3’ to 25’.

2.2.4. ***Support truss test activities*** R1 ~~10/31/01~~ 11/30/01

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.3 for testing activities and participate in the testing of the specimens, R1 including coordination of the setup of the test data acquisition system and test specimen instrumentation test set-up, operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of test specimen test fixtures developed under task 2.2.3 for at least R1 ~~2~~ 30 specimens and support, at a minimum, compression and tension tests for the R1 ~~2~~ 30 specimens.

Begin R2 block

2.2.5. ***Design and develop fixtures for deployable/rigidizable strut testing*** 04/30/02

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, and bending, of thin-walled deployable/rigidizable column specimens.

PERFORMANCE METRIC: The hardware shall accommodate thin-walled structural specimens ranging in length from 3’ to 30’.

2.2.6. ***Support strut test activities*** 04/30/02

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.5 for testing activities and participate in the testing of the specimens, including coordination of the setup of the test data acquisition system and test specimen instrumentation test set-up, operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least 25 specimens and support, at a minimum, compression, tension and bending tests for the 25 specimens.

2.2.7. **(NOR item)** ***Design and develop fixtures for deployable/rigidizable truss testing*** 11/30/02

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression, tension, and assembly tests of thin-walled truss specimens.

PERFORMANCE METRIC: The hardware shall accommodate structural specimens ranging in length from 3’ to 25’.

2.2.8. ***Support truss test activities*** 11/30/02

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.7 for testing activities and coordinate the setup of the test data acquisition system and test specimen instrumentation. The Contractor will also provide assessment of test condition setup to assure data set uniformity and a preliminary visual evaluation of test results, and participate in the testing of the specimens, including operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of test specimen test fixtures developed under task 2.2.7 for at least 2 specimens and support, at a minimum, compression, tension, and assembly tests for the 2 specimens.

End R2 block

**Begin R3 block addition*

2.2.9 ***Design and develop fixtures and test hardware for inflatable strut testing*** 3/30/02

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, and bending tests of thin-walled inflatable column specimens under a range of temperature environments. The test conditions will be controlled to temperatures ranging from room temperature to -40 °C, ±5 °C. The Contractor is to develop designs for, and oversee fabrication of environmental boxes for hot and cold temperatures. The cold boxes will be used for deployment and testing of hardware to temperatures of -40 °C ±5 °C and the hot boxes will be used for deployment and cure of hardware up to 200 °C +/-5 °C.

PERFORMANCE METRIC: The hardware shall accommodate inflatable structural specimens ranging in length from 3-m to 5-m. Temperature can be controlled within the specified tolerance (± 5°C)

2.2.10 ***Support strut test activities*** 9/30/02

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.9 for testing activities and participate in the testing of the specimens, including coordination of the setup of the test data acquisition system and test specimen instrumentation test set-up, operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least 26 specimens and support, at a minimum, compression and tension tests for the 26 specimens.

End R3 block addition
Begin R4 block addition

2.2.11. ***Design and develop fixtures for deployable/rigidizable strut testing*** 6/30/03

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for axial compression and tension, and bending, of thin-walled deployable/rigidizable column specimens.

PERFORMANCE METRIC: The hardware shall accommodate thin-walled structural specimens ranging in length from 3' to 30'.

2.2.12. ***Support strut test activities*** 6/30/03

The Contractor is to aid in the integration of test fixtures and test specimens delivered under task 2.2.7 for testing activities and participate in the testing of the specimens, including coordination of the setup of the test data acquisition system and test specimen instrumentation test set-up, operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least 25 specimens and support, at a minimum, compression, tension and bending tests for the 25 specimens.

2.2.13. **(NOR item)** ***Design and develop deployable/rigidizable truss components*** R5 ~~11/30/03~~ ***09/30/04***

The Contractor is to develop designs for, and oversee fabrication of deployable rigidizable truss components and deployment fixtures.

PERFORMANCE METRIC: The hardware shall accommodate structural specimens ranging in length from 3' to 25'.

2.2.14. ***Support truss test activities*** R5 ~~11/30/03~~ 09/30/04

The Contractor is to aid in the integration of truss components and deployment fixtures delivered under task 2.2.9 for testing activities and coordinate the setup of the test data acquisition system and test specimen instrumentation. The Contractor will also provide assessment of test condition setup to assure data set uniformity and a preliminary visual evaluation of test results, and participate in the deployment testing of the truss, including operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of truss components and fixtures developed under task 2.2.14 for at least 2-bays of truss.

End R4 block addition

*****Begin R6 block addition*****

2.2.17. ***Design and develop deployable/rigidizable truss components*** 09/30/05

(Continuation of task 2.2.13)

The Contractor is to develop designs for, and oversee fabrication of deployable rigidizable truss components and deployment fixtures.

PERFORMANCE METRIC: The hardware shall accommodate structural specimens ranging in length from 3' to 25'

2.2.18. ***Support truss test activities*** 09/30/05

(Continuation of task 2.2.14)

The Contractor is to aid in the integration of truss components and deployment fixtures delivered under task 2.2.9 for testing activities and coordinate the setup of the test data acquisition system and test specimen instrumentation. The Contractor will also provide assessment of test condition setup to assure data set uniformity and a preliminary visual evaluation of test results, and participate in the deployment testing of the truss, including operation of test equipment, and operation of data acquisition equipment.

PERFORMANCE METRIC: Integration of truss components and fixtures developed under tasks 2.2.9, 2.2.14, and 2.2.17 for at least 2-bays of truss.

2.2.19 ***Modular assembly design and development activities*** 09/30/05

(Design and develop joining components for assembly of modular sections of inflatable rigidizable truss sections, including revisions and or updates to early erectable structure joint designs, as needed

PERFORMANCE METRIC: Design ready for fabrication by 6/30/05. Assembly and check-out of fabricated parts by 9/30/05.

*****End R6 block addition*****

3.	**Government Furnished Items:** Government Furnished Property and software will be furnished for the design, fabrication and testing of the deliverable items.
4.	**Other information needed for performance of task:** 4.1 One to two trips to Fredrica, Delaware. Each trip is a single day to confer with the manufactures of the inflatable columns.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: Jan. 1, 2001 Completion date: R1 ~~Oct. 31, 2001~~ R2 ~~Nov. 30, 2001~~ R4 ~~Nov 30, 2002~~ R5 ~~Nov 30, 2003~~ R6 ~~Sep 30, 2004~~ ***Sep 30, 2005***
7.	**NASA Technical Monitor:** William Berrios M/S: 432 Phone: 757-864-7183 **NASA Alternate POC:** R6 ***Judith Watson*** M/S: TBD Competency: SEC Phone: 757-864-***3116***

	Task Order Number: 02RDI Revision: 6 Date of Revision: 01/26/2005 Title: Electromagnetics Research

1.	**Purpose, Objective or Background of Work to be Performed**: (DI18, NAS1-96014) The Contractor is to perform hardware modifications, R3 ~~software development and enhancements~~ and data reduction for the High Intensity Radiated Fields (HIRF) Lab. The Contractor is to configure and integrate existing resources to accommodate the diverse requirements of various experiments conducted in the HIRF Lab. Reports and presentations are to be generated periodically. **Note**: For required hardware modifications, R3 ~~software development and enhancements~~, and data reduction not specified below, the Technical Monitor will provide notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will include test schedules as applicable, will require the same concurrence and/or approvals as the rest of the task order flow process, and becomes part of the official task requirements and records. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by removing the requirement for software support and enhancing the Electrical Engineering support. (For this revision see R3 above and below. For details of issued original, revision 1, and revision 2 SOWs see ETOS *doc* files *02RDI, 02RDI01,* and *02RDI02*, respectively). Revision 4: Extends the period of performance 12 months to 12/31/04 in continuation of NASA's support requirements with no changes in the detailed description except that some work will be classified (see R4 below). Revision 5: Extends period of performance two months to March 1, 2005 to accommodate delays in acquiring the necessary test equipment and deletes RAV program from consideration in subtask 2.1 (see R4 below). Revision 6: Extends the period of performance 10 months to December 31, 2005 in continuation of NASA's support with no change in detailed requirements (see R6 below, Section 6).
2.	**Description of the Work to be Performed**: **Begin R3 block requirements redefinition** 2.1 The Contractor shall provide Electrical Engineering support for various experiments to be conducted in the HIRF Lab. This support shall include the development of experiment interfaces and test plans. This support shall also include the conduct of said experiments for the Aviation safety and Aviation security R5 ~~and RAV~~ programs at NASA/ LaRC. Experiments shall also be conducted under agreements with the Major Airlines, Air-framers and the FAA. Deliverables: Experiment interfaces and test plans as required. (Scheduled to be provided by NASA Task Monitor) Data reduction, report generation and presentation.

Minimum Performance Standards: Experiment interface and test plans at inception of any scheduled HIRF tests. Test schedule to be provided by Technical Monitor 30 days before test inception. Reduction and reporting of data generated by said experiments.

Exceed Performance Standards: Recommend and implement time saving modifications to test procedures. Optimize or upgrade performance capability of existing RF systems. Conduct EMI/EMC tests independent of NASA personnel.

2.2 The Contractor shall design and develop mechanical, electrical, and electronic interfaces and components for experimental Devices Under Test (DUTs). This shall facilitate instrument control, data acquisition, and DUT monitoring while in the EMI/EMC test environment. The Contractor shall develop test systems for the analysis of PED'S (Personal Electronics Devices) emissions in support of NASA/LaRC FAA Cooperative agreement.

Deliverables: Mechanical, Electrical, and Electronic interface to HIRF/EMI/EMC tests and experiments. Test system for analysis of PED'S. December [R4]~~2003~~ 2004

Minimum Performance Standards: Experiment interface and hardware functional at inception of any scheduled HIRF tests. Test schedule to be provided by Technical Monitor 30 days before test inception.

Exceed Performance Standards: Optimize or upgrade performance capability of existing RF systems. Conduct EMI/EMC tests independent of NASA personnel.
End [R3] block requirements redefinition

3. Government Furnished Items:

For the convenience of the Government access will be provided to computer equipment, software, materials, facilities and office space, and government data. These computers are instrument controllers integrated into the HIRF Lab (special test equipment and workstations). The software is Agilent Visual engineering environment and is licensed to the instrument controllers (specialized software).

4. Other information needed for performance of task:

The performance of this task requires High Intensity Radiated Fields Radiation workers certification card.
No more than [R3]three trips per year will be required.

5. Security clearance required for performance of work:

Some work will be classified under the Aviation Safety and Security Programs requiring personel to maintain a secret clearance., personnel may also be required to complete

	nondisclosure agreements with laboratory customers.
6.	**Period of Performance**: Planned start date: R3 ~~01/02/2001~~ R4 ~~01/02/2003~~ 03/01/2005 Completion date: R3,R4 ~~12/31/2003~~ R5 ~~12/31/2004~~ R4 ~~03/01/2005~~ ***12/31/2005***
7.	**NASA Technical Monitor**: Reuben A. Williams M/S: 130 Phone: 757-864-6212 **NASA Competency Technical Coordinator**: RTD M/S: 162 Phone: 757-864-

Task Order Number: 02RFF Revision: 2 Date of Revision: March 26, 2003

Title: Future X Pathfinder Engineering Services

1. **Purpose, Objective or Background of Work to be Performed:** (Formerly, GK22, NAS1-96013)

An Advanced Technology Vehicle (ATV) proposed by Boeing Co. has been selected for development as a part of the Future-X Pathfinder program. NASA LaRC has committed to developing flight-control surfaces for the ATV. The control surfaces consist of Flaperons and Ruddervators, new technical terms generated for the combined functions of the control surfaces during the vehicle re-entry from Low Earth Orbit, and body flaps per new program requirements [rev 1]. The severe aero-thermal environment expected for the vehicle requires that the control surfaces be fabricated using state-of-the-art high temperature composite materials for which there is limited design property data. This lack of design data is critical for the development of the vehicle control surfaces. Also, there is limited experience in designing, fabricating, and analyzing load-carrying structures using the state-of-the-art high temperature composite materials.

The purpose of this task order is to generate a design properties database for applicable high temperature composite materials, to train LaRC personnel in using the proposed materials to design, analyze and fabricate high-performance structures, and to provide an independent assessment of the designs proposed for the ATV.

Revision 1: Changes schedule for some deliverables and extends period of performance one year to accommodate delays in delivery by GFE suppliers (see R1 below).

Revision 2: Extends the period of performance through September 30, 2003, in continuation of NASA's support requirements and updates the schedule (see R2 below)

2. **Description of the Work to be Performed:**

Task 1.1: The Contractor shall evaluate existing test data and data supplied by LaRC for C/SiC (carbon/silicon carbide) materials and generate a database featuring high temperature materials characteristics for the systematic selection of materials to enable the successful development of flight hardware for delivery to the program. The database shall identify materials and material coatings temperature regimes, structural characteristics, thermo-physical properties, sensitivities to fabrication processes, sensitivities to hypersonic and subsonic flight regimes, sensitivity to Low Earth Orbit environment, manufacturing issues, coefficient of thermal expansion, and service life.

Deliverables 1.1:

1.1.1 Final Report containing database for C/SiC material identified by the program, that will support the design, analysis, and fabrication efforts. **Due date:** R1 ~~**September 30, 2001**~~ R2 ~~**December 31, 2002**~~ ***September 30, 2003*.**

1.1.2 Monthly progress report of work accomplished, updated database including materials and/or coatings selected during the period and properties identified during the period.

Due two weeks after close of the monthly period. (Note: A standard civil service workweek of five working days is utilized for scheduling of deliverables. If a deliverable date falls in a federal holiday, the deliverable due date is moved to the next regular workday.)

Performance Standards 1.1:

a. Deliverable 1.1.1 is provided nine months after start of task.
b. Report 1.1.2 delivered two weeks after close of monthly performance period.

Significantly exceeds minimum acceptable performance 1.1:

1. Deliverable 1.1.1 is completed and delivered before the nine months delivery schedule by one or more months (delivery in eight months or less).
2. Deliverable 1.1.1 contains sufficient materials engineering data that no further LaRC engineers independent research in excess of 80 hours will be required to supplement database information for completion of engineering activities.
3. Deliverable 1.1.2 is completed before schedule by five working days or more.

Task 1.2: The Contractor shall develop guidelines for the selection and analysis of composite materials. Guidelines shall include rationale for selection of 2-D and 3-D weaving and other specialized features that will tailor the selected material to successfully withstand expected static/dynamic structural loads, space environment and heating environment dictated by flight envelopes. The Contractor shall also develop guidelines for the design, analysis, and testing of components designed with the high performance composite materials.

Deliverables 1.2:

1.2.1 Section of monthly report (deliverable 1.1.2) describing guidelines developed and transmitted to LaRC engineering personnel during the monthly performance period. **Due with deliverable 1.1.2.**

1.2.2 Compilation of 1.2.1 guidelines and executive summary included as appendix to the September report (deliverable 1.1.2 for September 2001). **Due October 14, 2001.**

Performance Standards 1.2:

a. Deliverable 1.2.1 included in monthly report.
b. Deliverable 1.2.2 included in September report.

Significantly exceeds minimum acceptable performance 1.2:

1. Deliverables for task 1.2 result in the development in a more efficient product development process in at least one of the following areas.

1.1 Design.
1.2 Analysis.
1.3 Testing.
1.4 Fabrication.
1.5 Integration.

Task 1.3: The Contractor shall provide third party independent review of engineering design and analyses to assure proper application of materials technology and design for fabrication of components. The independent review activity shall be performed at the peer review and project review levels. A preliminary report shall be generated to document findings. Recommendations for changes shall be included that will identify projected impacts to technical performance and schedules should the recommendations by implemented.

The Contractor shall also attach a copy of the periodic independent review activity report to the monthly activity report. Frequency of independent reviews shall be a minimum of one (1) review per month for the duration of the design activity until the completion of the Critical Design Review. After completion of CDR, the Contractor shall participate in project reviews during reviews of manufacturing organization(s) activities. Post CDR reviews shall be supported per project schedules only and will not be subject to a minimum.

Deliverables 1.3:

1.3.1 Review reports summarizing review activity and list of recommendations resulting from such review. Report shall include technical and programmatic impacts from adoptions of such recommendations. Recommendations will not be binding and engineering personnel will have final decision on adoption of recommendations. **Due date: five working days after peer/project reviews. Minimum of one review per month until completion of CDR and continued review activity until** [R1] **~~December 31, 2001~~** [R2]**~~December 31, 2002~~** ***September 30, 2003.***

1.3.2 Copy of 1.3.1 attached to deliverable 1.1.2. **Due with deliverable 1.1.2**.

	Performance Standards 1.3: a. Deliverable 1.3.1 recommendations result in delivered hardware in compliance with project technical requirements (provided by LaRC). b. Deliverable 1.3.1 is received within one working day of delivery due date. **Significantly exceeds minimum acceptable performance 1.3:** 1. Deliverable 1.3.1 recommendations result in reduction of development cost by 5% or more. 2. Deliverable 1.3.1 recommendations result in reduction of delivery schedules by 5% or more. 3. Deliverable 1.3.1 recommendations contribute to a service life rating of 50 flights or higher.
3.	**Government Furnished Items:** Government Furnished Property and software will be furnished for developing the deliverable items.
4.	**Other information needed for performance of task:** Contractor will have access to Government facilities to support this task, but not limited to fabrication, design and testing facilities. Contractor will interface with research, testing, design and fabrication organizations.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: January 2, 2001 Completion date: R1 ~~December 31, 2001~~ R2 ~~December 31, 2002~~ ***September 30, 2003***
7.	**NASA Technical Monitor:** William Berrios M/S: 432 Phone: 757-864-7183 NASA Competency/Other Technical Coordinator: Craig Cleckner M/S: 443 Phone: 757-864-7048

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 7 Statement of Work

Task Order Number: 03RCF Revision: 10 Date of Revision: 3/22/05

Title: Advanced Nondestructive Evaluation and Health Monitoring of Aerospace Systems

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

Research and technology development for advanced nondestructive evaluation and health monitoring sensors and intelligent systems to ensure structural integrity, configuration control, reliability, and safety for aerospace applications.

Revision 1: (Minor wording changes marked by bold italics, significant requirement additions marked by [R1]), "fabrication" portion of Subtask 4.3 removed to form new Subtask 4.4 and previous Subtask 4.4 renumbered as 4.5, added new Subtask 6. Update 1 (4/20/01): Explicitly states the understood maintenance requirement in Section 2 (2nd bullet, see [U1] below).
Revision 2: Discontinues Subtask part 4.3 for NASA's convenience.
Revision 3: Discontinues Part 2.2 of Subtask 2 and revises subtask title accordingly.
Revision 4: Discontinues Part 4.5 of Subtask 4 and all of Subtask 5 and increases Subtask 6 estimated requirements.
For details of Revisions 1-4, see ETOS SOW file *03RCF04.doc.*
Revision 5: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see [R5] below).
Revision 6: Extends the period of performance one year in continuation of NASA's support while keeping the same definition for all other requirements (see [R6] below).
Revision 7: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support, adds requirements as new Subtask 0 for the new period of performance, and updates Subtask 1 title for clarification (see [R7] below).
Change 1: Adds possible travel requirements (see [R2.1] in Section 4 below).
Revision 8: Extends Period of performance one year to December 31, 2005. Deletes Subtask 1 "Advanced System Software Development." Deletes parts of Subtask 6, "Advanced NDE System Data Acquisition," pertaining to electron microscopy scans of nanostructured sensor and device materials, vibrating sample magnetometer magnetic property measurements, Nano-manipulations, thin film deposition, and electron beam lithography (see [R8] below).
Revision 9: Due to NASA funding constraints, deletes parts of subtask 4 to eliminate requirements pertaining to electro-optic sensor systems and reduces number of work requests per year on subtask 4 from 6 to 3 (see [R9] below).
Revision 10: Deletes Subtask 0 (see [R10] and below).

2. Description of the Work to be Performed: ***The Contractor shall perform the task as detailed in subtasks below.***

Note:

The support required in this task is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Task Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports, R5 and informal oral updates in bi-weekly task technical reviews. (See NOR designated item(s) below.)

The Government will submit written work requests detailing specifications of tests, software modules, and fabrications to be delivered by the Contractor. The types and numbers of these work requests are described in subtasks below. Daily interactions concerning work requests will be conducted with the work request initiators. In the performance of the work requests, the Contractor shall conduct appropriate routine equipment maintenance R5 and calibration on the various systems used, and in some cases non-routine maintenance may be requested by NOR. R5 The Contractor shall provide bi-weekly oral progress reviews of all ongoing NORs, to be presented to the task technical monitor, NOR initiators, and other NASA observers selected by the Task Monitor, at regularly scheduled bi-weekly task technical reviews. In addition, the Contractor shall provide monthly technical reports and monthly financial reports, both broken down to the subtask level, and other reports specified as deliverables in the individual subtasks, to the Task Technical Monitor.

Begin R5 block requirements redefinition
Begin R7 block addition

Subtask 0: R10 *Deleted* ~~Advanced Scientific Software Development~~

End R7 block addition

Subtask 1: R8 Deleted ~~Advanced R7 *System* Software Development~~

Subtask 2: Routine Laboratory Control Software Development

The Contractor shall, on a work request basis, (NOR), develop software modules for laboratory instrument control, instrument reading, and database building, using commercial software applications and commercial software development tool applications (e.g. LabView, VBA, Excel, Access). Approximately 3 work requests will be submitted per calendar year

Deliverables for Subtask 2:

- Software modules integrated with NDE system components and mechanical subsystems
- Software module source code or databases as specified in work requests,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports

to Task Technical Monitor and in bi-weekly oral NOR reviews.

Performance Standards for Subtask 2:
MEETS
- Written reports in response to requests
- Adherence to cost and schedules
- Quality and ease of use of software
- Meeting the software performance requirements specified in the written requests
- Ease of obtaining data information from Contractor's file structures

EXCEEDS
- Completes software tasks ahead of schedule
- Exceeding the software performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

Subtask 3: Mechanical Subsystem, Sample, and Fixture Design and Fabrication

The Contractor shall, on a work request basis, (NOR), design and fabricate NDE mechanical subsystems, test samples, specialized sample and detector holders, stands, lamp enclosures, and fixtures. The Contractor shall validate and integrate these subsystems and fixtures into advanced NDE measurement systems. When requested, the Contractor shall provide CAD drawings,and electronic files containing CAD designs, compatible with NASA automated shop fabrication tools. Approximately 40 work requests will be submitted per calendar year

Deliverables for Subtask3:
- Validated Mechanical subsystems, integrated into NDE measurement systems, as specified in work requests,
- Test samples, holders, fixtures as specified in work requests,
- CAD files when specified in work requests,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOR reviews.

Performance Standards for Subtask 3:
MEETS:
- Written reports in response to requests,
- Adherence to cost and schedules,
- Quality and ease of use mechanical subsystems, fixtures, holders, and samples,
- Meeting subsystems integration and performance requirements specified in the written requests.

EXCEEDS:

- Completes work requests ahead of schedule
- Exceeding the integration and performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

Subtask 4: Electrical Fabrication and Integration of Advanced NDE System Components

The Contractor shall, on a work request basis, (NOR), fabricate electrical circuits and connections for interfacing and controlling mechanical subsystems, R9~~electro-optic sensor systems~~, and instrument components of advanced NDE measurement systems. The Contractor shall configure NDE systems. The Contractor shall calibrate and validate these systems, and assess their performance capabilities. Approximately R9~~6~~ 3 work requests will be submitted per calendar year

Deliverables for Subtask 4:

- Validated electrical circuits for interfacing, driving, and controlling NDE subsystems and system components as specified in work requests,
- Assessment of integrated system performance,
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOR reviews.

Performance Standards for Subtask 4:

MEETS:

- Written reports in response to requests,
- Adherence to cost and schedules,
- Integrated circuit performance performance meets specifications in the written requests.

EXCEEDS:

- Completes work requests ahead of schedule
- Exceeding the integration and performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

Subtask 5: Advanced Electronic Circuitry Fabrication

The Contractor shall, on a work request basis, (NOR), fabricate advanced electronic circuits for conditioning signals of advanced NDE instrumentation and systems. The circuits will be used to condition signals to enable improved processing capabilities and operating characteristics of advanced NDE systems. The Contractor shall perform the appropriate measurements required to determine the desirable operating characteristics of the circuits. The Contractor shall fabricate circuits that have the desired operating characteristics. The Contractor shall measure the operating characteristic of the circuit and determine deviations between actual and designed operating characteristics and report on effects of the deviations. The Contractor shall then test the circuit on the advanced NDE instrumentation and systems and validate its performance under operating conditions. Approximately 5 work requests will be submitted per calendar year

Deliverables for Subtask 5:
- Electronic circuits developed for conditioning signals of advanced NDE instrumentation and systems.
- Validated electronic circuits for conditioning of signals.
- Summary of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOR reviews.

Performance Standards for Subtask 5:

MEETS:
- Adherence to plan
- Adherence to cost proposal
- Meeting the circuit performance requirements specified in the written requests
- Quality of reports meet NASA publication standards for informal reports.

EXCEEDS:
- Completes tasks ahead of schedule
- Exceeding the circuit performance requirements specified in the written requests
- 10% improvement in scheduled deliveries

Subtask 6: ~~Advanced NDE System Data Acquisition~~

The Contractor shall, on a work request basis (NOR) and as specified by the work requester, perform routine and advanced multi-disciplinary NDE measurements and analyses using NASA specified methodologies and with NASA developed data acquisition equipment and analysis software, in both the NDE laboratory and in in-situ settings. The Contractor shall insure currency of calibration status of measurment systems prior to data collection. As specified in the work requests, the Contractor shall employ NASA provided methodologies and NDE technologies and measurement systems including but not limited to:

- Advanced thermography systems for actively stimulated temperature histories for large field image scans and for fixed point and line scans (Approx. 2/month)

- Advanced Ultrasonic systems for Ultrasonic image scans and multi-point measurements (Approx. 6/month)
- Ultrasonic velocity, amplitude, and attenuation reduction (Approx. 6/month)
- Advanced lamb wave ultrasonic measurements (Approx. 2/month)

Begin R8 block deletion

- ~~Scanning probe microscopy scans of nanostructured sensor and device materials (Approx. 5/month)~~
- ~~Scanning electron microscopy scans of nanostructured sensor and device materials (Approx. 5/month)~~
- ~~Vibrating sample magnetometer magnetic property measurements (Approx. 5/month)~~
- ~~Thin film depositions (Approx. 5/month)~~

End R8 block deletion

- X-ray CT scan runs (Approx. 15/calendar year)
- Reverse geometry x-ray scan runs (Approx. 5/month)
- Rotating electromagnetic probe measurements (Approx. 3/month)
- GMR-based self nulling probe measurements (Approx. 3/month)

Begin R8 block deletion

- ~~Nano-manipulation (Approx. 6/month)~~
- ~~Electron beam lithography (Approx. 6/month)~~

End R8 block deletion

Deliverables for Subtask 6:

- Archived raw and processed data (electronic and hardcopy),
- Informal written and oral reports of work request technical results submitted to work requester,
- Summary of subtask technical results, activity and updated plans in monthly reports to Task Technical Monitor and in bi-weekly oral NOR reviews.

Performance Standards for Subtask 6:

MEETS:

- Written reports in response to requests:
- Completeness of reports (including archived raw and processed data, verification of system configurations and methodologies, difficulties encountered, and quality of data).
- Adherence to cost and schedules,
- Quality of data

EXCEEDS:

- Completes tasks ahead of schedule

Task Order Number: 03RCF Revision: 10 Date of Revision: 3/22/05

Title: Advanced Nondestructive Evaluation and Health Monitoring of Aerospace Systems

	• 10% improvement in scheduled deliveries **End R5 block requirements redefinition**
3.	**Government Furnished Items:** The Government will provide specialized NDE systems, comprising portable R5data acquisition computers, data acquisition cards, manual scanners, motorized scanners, and sensors. The Government will provide parts, materials and components for approved mechanical or electrical modifications. The Government will provide parts, materials, and components for specimen mounting and preparation, and will provide access to the NESB R5NDE laboratories and machine shop R5as needed to complete task requirements. The government will provide software development tools and manuals required for completion of task requirements. The Government will establish appropriate memoranda of agreement with third party participants to enable full collaborative efforts.
4.	**Other information needed for performance of task:** The Contractor shall conform to all Government, NASA LaRC, and other standard safety practices in all work areas at all time. Data generated in this task shall not be released to the public without prior written approval from the LaRC Task Technical Monitor. R2.1Some travel may be required depending on the requested (NOR) work
5.	**Security clearance required for performance of work:** The task is unclassified, however, parts may be subject to Limited Exclusive Rights Data (LERD) restrictions.
6.	**Period of Performance:** Planned start date: R5~~1/1/2001~~ R6~~1/19/02~~ R7~~1/1/03~~ R8~~1/1/04~~ 1/1/05 Completion date: R5~~12/31/2001~~ R6~~12/31/02~~ R7~~12/31/03~~ R8 ~~12/31/04~~ 12/31/05
7.	**NASA Technical Monitor:** D. Michele Heath M/S: 231 Phone: 757-864-4964 **NASA Directorate Technical Coordinator: R&T**/S&MC/Laurie Johansen M/S: 121 Phone: 757-864-1757

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Statement of Work</td></tr>
<tr><td colspan="2">Task Order Number: 03RDH Revision: 8 Date of Revision: 11/17/04
Title: Photonics Fabrication, Test and Characterization for Advanced Sensor Data Systems</td></tr>
</table>

1. **Purpose, Objective or Background of Work to be Performed:** (DI22, NAS1-96014)

The objective of this work to be performed is to implement sensor and data systems for the advancement of technology for aeronautics and space programs (HYDROSTAR, MICROWAVE RADIOMETRY, FIBER OPTICS, LASER, and LIDAR TECHNOLOGIES).

Note: For each required hardware and/or software modification, development, and enhancement, not specified explicitly below (see Subtask 3.5), the Technical Monitor will provide a Notice Of Requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will include detailed specifications as applicable, will require the same concurrence and/or approvals as the rest of the task order flow process, and becomes part of the official task requirements and records. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports.

Revision 1: Clarifies NOR requirement, adds requirement b) to subtask 3.1, adds new subtasks 3.3, 3.4, and 3.5.
Revision 2: Extends subtask 3.1 and 3.5 deliverable due dates and task completion date to accommodate unplanned technical complexity.
Revision 3: Extends the period of performance one year in continuation of NASA's support requirements, extends subtask 3.4 schedule, and adds subtask 3.6.
Revision 4: Adds configuration constraint to and extends the schedule of subtask 3.1.
Revision 5: Changes the title of subtask 3.4 and specifies to greater detail the work to be accomplished under subtask 3.4. Revision 5 also adds subtask 3.7 which is for the design of a second generation Child Proximity Detector (this is a continuation of work done in '01 under the first generation Child Proximity Detector under subtask 3.3). Subtask 3.7 will be done on an overtime basis. Revision 5 also adds subtask 3.8.

For details of original and Revisions 1 through 5 SOWs, see ETOS doc files 03RDH, 03RDH01,…02, …03u, …04, and …05, respectively.

Revision 6: Extends the period of performance one year and updates the requirements for calendar year 2003 with (sub)tasks 3.1 to 3.7 annotated as complete and (sub)task 3.8 updated to continue (see [R6] below).
Revision 7: Extends the period of performance one year in continuation of NASA's support requirements with no changes in detailed requirements (see [R7] below).
Revision 8: Adds requirements as new subtask 3.9 and extends the period of performance 12 months to December 31, 2005 (see [R8] below).

2. **Description of the Work to be Performed:**

SCOPE

The Photonics Group (PG) of the Sensors Research Branch (SRB), Airborne Systems Competency, designs, develops and applies a variety of photonics technology to solving problems in sensors and data systems for both aeronautics and space system applications (HYDROSTAR, MICROWAVE RADIOMETRY, FIBER OPTICS, LASER, and LIDAR TECHNOLOGIES). Engineering disciplines range from electronic sensor and data component technology to photonic sensor and data components. Sensor systems that utilize semiconductor lasers, fiber optics, fiber lasers, microwave radiometry, along with data systems that utilize fiber optics, fiber optic transceivers as well as a variety of networking and interconnects are but a few examples of technology applications performed by the PG. In addition, packaging, thermal, radiation effects, power, weight, and size are but a few of a wide range of engineering tasks that are addressed.

The general purposes of the tasks are:

a) Provide required technology in the area of microwave, millimeter-wave and sub-millimeter wave imaging, and radiometry. This includes the design, development, demonstration, analysis and characterization of a variety of electronic and photonic components and systems.
b) Provide required technology in the area of laser diode automated testing development in support of solid state laser development for LIDAR systems. (DI22, NAS1-96014).

Special Requirements
Security clearances (Secret rating) may be needed for some of the work. Laser worker cards are required for all laser work as well as having passed NASA's radiation safety course. Electronic and optical component handling, space qualified soldering, and hazards associated with gigahertz electronics, ultraviolet curing of glues and including visible through far infrared laser and optical technology are required.

Exceeding Minimum Performance

The metrics included below for each task describes minimum acceptable performance.

To exceed minimum performance, the Contractor can:
a) Suggest alternative approaches that result in time and/or cost savings,
b) Improve specified procedures and/or tools to increase productivity, accuracy, or reduce costs or
c) Propose alternative technologies that will benefit the government in achieving the goals of the tasks included herein.

Technical Requirements
Note: Tasks 3.1 and 3.2 are a continuation of Task Order DI22R6 (NAS1-96014).

3.1 STAR Coupling Calibration Testing
COMPLETED.

3.2 Dual Correlated Noise Source (DCNS)
COMPLETED.

3.3 Child Proximity Detector
R6COMPLETED.

3.4 Optoelectronic Photonic Components and Systems
R6COMPLETED.

3.5 (NOR) 1.4 GHz Radiometric Characterization of Mesh
R6COMPLETED.

3.6 Electromagnetic Chamber Probing System
R6COMPLETED.

3.7 Child Proximity Detector (second generation design)
R6COMPLETED.

3.8 **Data Acquisition for the High Spectral Resolution Lidar (HSRL) Instrument**
Begin R6 block requirements update

a. The Contractor shall continue the design, construction, and demonstration for the data acquisition portion of the HSRL instrument begun previously under Revision 5. This system shall be designed and fabricated under the design restraints and guidelines set forth by NASA and shall include features such as hardware averaging, a multiplexing/interface scheme, and an overall instrumentation systems operation scenario implemented in National Instruments LabView software.
b. The Contractor shall provide support for the development of a Photomultiplier (PMT) Detector Test Bed design and fabrication.
c. The Contractor shall provide software and electronic design and fabrication services for developing a circuit for locking the HSRL seed laser to a Doppler-free absorption line of an iodine cell.
d. The Contractor shall provide support for the development of various LIDAR related electronics circuits, and LabView hardware/software development to support LIDAR related laboratory experiments.

Assumptions: The Government will direct the required operational scenarios, provide operational testing, supply the required components, tools, and development software required to complete the data acquisition hardware design in a timely matter.

Task Order Number: 03RDH Revision: 8 Date of Revision: 11/17/04
Title: Photonics Fabrication, Test and Characterization for Advanced Sensor Data Systems

Performance Evaluation Criteria: Completion of the deliverables by December 31, 2005 will meet the requirements. An earlier delivery date of the system or any additional ideas that improve the functionality of the system described above will exceed the criteria.

Deliverables: The deliverables shall be a working data acquisition system as described above, a PMT test bed, a circuit for locking the HSRL laser to an iodine line, and various LIDAR electronics circuits as required and customized LabView programs that support various LIDAR related laboratory testing plus design and test documentation with a delivery date of December 31, 2005.
End R6 block requirements update

Begin R8 block added requirements
3.9 **Evaluating Electromagnetic Properties of Materials for Microstrip Antennas**

a. The Contractor shall perform C & X - Band measurements of approximately 30 dielectric conformal antenna material specimens. These samples will be provided by the government. The Contractor shall measure the complex permittivity and permeability of the samples to assess the expected performance for functional breadboard antenna models.

b. Once the materials are evaluated approximately 4 conformal microstrip patch antenna elements mounted on a leading edge of a wing structure will be provided by the government mounted and ready for testing. The Contractor shall measure the input S-parameters (input impedance) of the array elements.

Assumptions: The Government will provide the facilities, tools, training, and equipment required to complete the measurements described above in a timely, manner.

Performance Evaluation Criteria: Completion of the deliverables by December 31, 2005 will meet the requirements. An earlier delivery date or any additional ideas that expedite or improve the measurement results mentioned above will exceed the criteria.

Deliverables: The deliverables shall be the results of all electromagnetic test provided on CD along with hardcopy. Photographs of the measurement setups shall be supplied for documentation purposes. All design and test documentation for the above systems shall be supplied by December 12, 2005.
***End R8 block added requirements ***

3. Government Furnished Items:

1. Furnished parts will be an IBM-PC, components, materials, software, shop and hand tools, and any additional design requirements to complete the automated STAR Coupling Calibration System.

	2. Furnished parts will be the completed DCNS system, an IBM-PC, components, materials, software, shop and hand tools, and any additional design requirements to complete the DCNS system.
4.	**Other information needed for performance of task:** Laser workers card required. Space qualified soldering required.
5.	**Security clearance required for performance of work:** None for current Subtasks.
6.	**Period of Performance:** Planned start date: ~~1-2-2001~~ R6 1-2-2003 Completion date: ~~9-30-2001~~ ~~12-31-2001~~ ~~12-31-2002~~ R7R6 ~~12-31-2003~~ R8 ~~12/31/2004~~ ***12/31/2005***
7.	**NASA Technical Monitor:** Anthony Cook M/S: 473 Phone: 757-864-6502 NASA Competency/Other Technical Coordinator : AirSC/ M/S: Phone: 757-864-

Task Order Number: 04OCB   Revision: 2   Date of Revision: 6/27/02

Title: Cluster Computing Platform Development for Hypersonic CFD Applications

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

Develop a successful alternative to current dependency on supercomputer platforms for Computational Fluid Dynamics (CFD) simulations of hypersonic flows. [R1]Upgrade security protocol for the cluster as required. Bring the current cluster into production for classified computing. Perform/recommend code modifications and migrations for CFD tools in use as required for effective and efficient performance on the system. [R2] [R1] ~~Recommend upgrades/enhancements for the current cluster. Design/develop a new cluster at several levels of projected funding to provide a new resource for unclassified parallel computing~~. ***Design/develop and build the next generation cluster with the intent of merging the two systems when the new cluster is sufficiently tested.***

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, updates the requirements for the new period of performance, and adds an Alternate Technical Monitor (see [R1] above and below).

Revision 2: Extends the period of performance to 02/28/03, updates the requirements for the new period of performance including the implementation of the next generation cluster, and changes the NASA Technical Monitor (see [R2] above and below).

2. **Description of the Work to be Performed:**

2.1 Description of Sub-Tasks

The Contractor shall

Begin [R1] block requirements update

2.1.1 Upgrade the security protocol for the cluster as required.

~~2.1.2~~ [R2] ~~Facilitate the transfer of the VA Linux Beowulf cluster and the DLT tape backup system into the secure computing facility.~~

2.1.3 Reestablish the same system performance / operability in a classified mode as was demonstrated in an unclassified mode.

~~2.1.4~~ [R2] ~~Recommend upgrade options for the current cluster.~~

~~2.1.5~~ [R2] ~~Design/develop a new cluster at low/medium/high funding levels to replace the unclassified parallel computing platform.~~

2.1.6 Continue to develop cluster management software which can be tailored to the changing needs of the user community.

2.1.7 Continue to perform/recommend code modifications for CFD tools used on the cluster as required.

****Begin R2 block requirements update*****

2.1.8 Design, develop, and build a next generation cluster.
2.1.9 Establish the new system performance/operability using metrics developed with lycan.
2.1.10 Merge the lycan cluster and new cluster into a super cluster.

****End R2 block requirements update*****

2.1.11 Provide a continuous system administration function for the cluster throughout this work period and document any major issues.

2.2 Deliverables and Schedule

The Contractor shall deliver

2.2.2 The Beowulf cluster and tape backup system operational in a secure environment.
~~03/30/02~~
R2 07/31/02

~~2.2.3~~ R2 ~~A written report describing the design/features/benefits/cost of a new cluster to be used for unclassified computing. 03/30/02~~

~~2.2.4~~ R2 ~~A written report describing the upgrade options for the current platform (lycan). 06/30/02~~

2.2.5 Additional informal status reports describing code conversions, hardware/software upgrades, usage and system performance. As required
End R1 block requirements update

****Begin R2 block requirements update*****

2.2.6 A written report describing the lycan configuration when the machine was put in classified mode including documentation of the build process and maintenance requirements. 08/31/02
2.2.7 Provide performance metrics for the new cluster as compared to platforms used previously. 10/31/02
2.2.8 A written report fully describing the merged cluster. 02/28/03

	End R2 block requirements update 2.3 Performance Metrics 2.3.1 Meets schedule 2.3.2 Meets cost 2.3.3 Exceeds Minimum Requirements 2.3.3.1 Beats schedule and/or cost
3.	**Government Furnished Items:** Access to Beowulf Cluster
4.	**Other information needed for performance of task:**
5.	**Security clearance required for performance of work:** A SECRET clearance is required before the transition of the cluster to a classified environment.
6.	**Period of Performance:** Planned start date: R1 ~~01/01/2001~~ R2 ~~01/01/2002~~ ***07/01/2002*** Completion date: R1 ~~12/321/2001~~ R2 ~~6/30/2002~~ ***02/28/2003***
7.	**NASA Technical Monitor:** R2 ***David Reubush*** M/S: 353X Phone: 757-864-***3749***

	Task Order Number: 03OCB Revision: 1 Date of Revision: 12/1/01
	Title: SRGULL: Propulsion Design Code Update, Documentation and Distribution

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

NASA Langley Research Center (LaRC) has been a major player in the development of scramjet and hypersonic vehicle systems technology since 1960. Over this time, LaRC has developed wind tunnels, engine test facilities, and experimental testing, data analysis, analytical, computational, and design specific methodologies. 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. The on going, Langley- led Hyper-X Program will demonstrate in flight, the technology required for hypersonic cruise aircraft and efficient air breathing engine-powered orbital launch vehicles.

Current SOA – Effective utilization of airbreathing engines requires careful integration of the engine, airframe and rocket motors. This can only be achieved using design codes such as the LaRC SRGULL code, or the proprietary Boeing-Rocketdyne HyCad codes. The ramjet/scramjet cycle code used for characterizing performance as well as refining flowpath design for highly integrated engine/airframe configurations at NASA Langley Research Center is SRGULL. SRGULL was developed at Langley over the last twenty five years by S. Z. Pinckney. It accurately resolves the net propulsive thrust of an airbreathing vehicle as a small difference between the combustor/nozzle thrust and the forebody/inlet drag. The forebody flowfield properties and the mass capture which SRGULL predicts are critical in resolving the net thrust.

SRGULL uses a 2-D/axisymmetric Euler (finite-difference, shock fitting) algorithm on the forebody and inlet, coupled with a boundary-layer solution, to predict the forebody/inlet drag and the flow properties entering the engine. The ramjet/scramjet solution is then completed using a 1-D cycle analysis with equilibrium chemistry and multiple steps through the combustor. A fuel mixing distribution with length is required input. Finally, the nozzle forces are resolved using the 2-D Euler and boundary layer codes. A 3-D Euler capability is now being implemented in a separate version of the code.

Capabilities in the SRGULL code include the analysis of laminar, transitional, and turbulent boundary layers; engine flowpath forces such as lift, thrust, and moments; and LOX augmentation of the scramjet which consists of small rocket motors firing parallel to the flow just downstream of the throat either at stoichiometric, fuel-rich or fuel-lean conditions. To first order, a thermal balance can also be accomplished. Given the wall temperature, heat flux to the walls (calculated by the code) and the fuel injection temperature, the amount of fuel required to actively cool the vehicle is determined. This fuel flow rate is then used to predict the net thrust for a thermally balanced system. Particularly at high hypersonic flight Mach numbers, the increased fuel flow rate, which is generally above an equivalence ratio of one can significantly

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increase thrust but decreases specific impulse. The prediction of coolant fuel flow rate is further refined in the thermal management analysis as described in the corresponding section below.

SRGULL includes subroutines for various low-speed and high-speed engine cycles such as ejector ramjet, RBCC, AAR, ducted rocket and scramjet “Oxygen addition”. Chemistry models are available for both Hydrogen and generalized chemistry. These routines are limited to equilibrium chemistry, with specified combustion efficiency distribution.

SRGULL also has the capability to predict engine unstart, which is another unique feature of this cycle code. This is accomplished using a proven inlet isolator modeling procedure, which accurately predicts the pressure distribution and rise magnitude, and the resulting flow distortion. This is particularly useful in “low speed” operation (Mach less than about 6-7) of dual-mode scramjets and RBCC engines. SRGULL has been shown on numerous occasions to accurately predict the pressure disturbance in isolator models, both back pressured and conventional engine operation (combustor interaction driven).

Likewise, the SRGULL code has extensive calibration with wind tunnel data. SRGULL accurately predicted the flowpath pressure distribution, including the pressure-rise magnitude and location, heat flux as well as inlet and nozzle flow structure, wall pressure and heat flux for numerous NASP and NASA engine and component tests performed in the Mach 4 – 7 speed range.

Other organizations are investigating hypersonic air breathing vehicles for both space launch, missile and revolutionary aircraft. These organizations now understand the requirement for integrated analysis methods, such as the LaRC design tools. One of these programs is the Bantam Program at the Marshall Space Flight Center (MSFC). The Bantam Vehicle has the requirement to delivery small University class payloads (100-300 lbs.) to orbit at a fraction of the current cost.

For other organizations to effectively utilize the SRGULL capability, the code must be transitioned from a research tool to a more user friendly, robust code, and usable for a larger classes of flowpath shapes and fuel options.

For original issued SOW see ETOS file *03OCB.doc*.
Revision 1: Extends the period of performance one year in continuation of NASA’s support requirements, redefines the requirements for the new period of performance, and adds an alternate technical monitor (see R1 below).

2. **Description of the work to be performed**:

2.1 SRGULL Propulsion Design Code update, documentation, and distribution.

Task Order Number: 03OCB Revision: 1 Date of Revision: 12/1/01

Title: SRGULL: Propulsion Design Code Update, Documentation and Distribution

2.1.1 The Contractor shall make the following changes and enhancements to the SRGULL code, both the 2-D and 3-D versions 2D.1.0 and 3D.1.0:

*****Begin R1 block requirements redefinition*****

2.1.1.1 The Contractor shall upgrade the code (V2D1.1) to effectively converge isolator reattachment model prediction in the flight Mach 3 – 5 speed range.

2.1.1.2 Review and update SRGULL code and documentation based on user inputs .

2.1.1.3 Validate code to existing engine data, including GRC axisymmetric, MSFC ART sidewall compression and P&W "2-D" concepts. This shall include both dual-mode scramjet and RBCC data

2.1.1.4 Support MSFC/ISAT and other users as required.

2.1.2 DELIVERABLES

2.1.2.1	Complete code upgrades/documentation for Mach 3-5 isolator model	8/1/02
2.1.2.2	Release v2D1.3	9/30/02
2.1.2.3	Document application of 3-D SRGULL code to ART database	12/1/02

*****End R1 block requirements redefinition*****

2.1.3 SCHEDULE

See section 2.1.2 above.

2.1.4 METRICS FOR DELIVERABLES

2.1.4.1 Meet schedule and cost.

2.1.4.2 Solution methodology consistent with standard NAO-CSO/CFD procedures and methodologies "calibrated".

2.1.4.3 Results documented in Contractor Report and/or meeting papers.

2.1.5 EXCEEDS MINIMUM REQUIREMENTS

2.1.4.1 Exceed schedule and cost.

2.1.4.2 Results documented in NASA Contractor Reports or other refereed documents.

3. **Government Furnished Items**:

3.1 Specialized 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
- BEOWULF Cluster – 32 Processor

3.2 Available Specialized 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

3.3 Special furniture
- Safes for storage of classified material
- Private/secure office for task leader

4. <u>Other information needed for performance of task</u>:

4.1 Estimated Travel requirements

-Performance of these tasks may require travel to: Marshall Space Flight Center, Norfolk Va., and Kennedy Space Center to participation in the JANNAF Propulsion meeting.

5. <u>Security clearance required for performance of work</u>:

5.1 Much of the work performed on this work order requires a SECRET clearance.

5.2 United States Citizenship is also required, although, in some isolated circumstances, Resident Alien status is adequate.

5.3 Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.

6. <u>Period of Performance</u>:

Planned start date: Jan. 1, R1 ~~2001~~ ***2002*** Completion date: Dec. 31, R1 ~~2001~~ ***2002***

7. NASA TECHNICAL MONITOR:

NASA TECHNICAL MONITOR: Charles R. McClinton M/S: 353X Phone: 864-6253

R1 ***NASA TM ALTERNATE: Shelly Ferlemann M/S: 353X Phone: 864-8786***

NASA TM ALTERNATE: Ken Rock M/S: 168 Phone: 864-6265

Task Order Number: 03RAA Revision: 9 Date of Revision: 01/27/05

Title: Advanced Space Transportation Systems Modeling and Structural Analysis

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

The NASA Langley Research Center *R8*Exploration Concepts Branch (ECB) develops and applies computational analysis tools in the systems analysis and optimization of advanced space transportation concepts. Engineering disciplines include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, and operations. The hardware platforms that host the analysis codes critical to this systems analysis work include Silicon Graphics workstations, Apple Macintosh and PC's.

Contract support is needed to: provide improvements in the computer-aided tools and methods used for modeling, analysis and optimization of advanced transportation vehicle conceptual designs and to perform analyses in selected disciplinary areas. Products from these efforts include study results, analysis method and code enhancements, user interfaces, visualization techniques and code maintenance and distribution functions.

Revision 1: Extends the period of performance ten months in continuation of NASA's support requirements and adds requirements for the new period of performance along with some adjustments to previous requirements.
Revision 2: Modifies task 4 to be in compliance with updated NASA requirements.
Revision 3: Extends the period of performance 12 months in continuation of NASA's support requirements and adds requirements for the new period of performance along with some adjustments to previous requirements
Revision 4: Adds anticipated travel requirement in Section 4
Revision 5: Provides directive refocus of tasks for approximately one year and eliminates some work in the mass properties area. Completed work removed for clarity.
Revision 6: Task 3.0 revision to deliverables dates. Task 4.0 modifications to adjust to NASA's more recent goals in space exploration.
Revision 7: Used to add additional work to tasks 1 and 5, also to extend deliverable dates for tasks 3 and 4.
Revision 8: Discontinues tasks 2 and 6, and is also used to add additional tasks, including Extensions to the JAVA development programs and the addition of Cost/Risk considerations to planetary vehicle design tools. New task 1 deliverables will be project phase based.
Revision 9: Adds task 4.4 and thereby extends period of performance 4 months to 6/30/05 (see R9 below).

2. **Description of the Work to be Performed:**

Revision 5: (major rewrite to remove completed past task work, see Revision 4 for past task definitions)

1.0 Launch Vehicle Conceptual Analysis
Provide quick response consultation and expert opinion on the potential success of proposed launch vehicle design concepts using rapid turn-around, low fidelity analysis techniques, and expert opinion with historical basis. Analyses in the areas of vehicle definition and performance

expert opinion with historical basis. Analyses in the areas of vehicle definition and performance assessment, vehicle structural arrangement, structural design, and mass properties will be required.

Deliverables: informal written report (Due date: 3 weeks from assigned start date)

1.1 (a rev 7 mod) Assessments will be performed on TSTO Booster Launch vehicle thermal/structural technologies. Primarily reusable tanks based upon hot-structure concepts will be analyzed, use of internally insulated cryogenic tanks may also be considered. The definition of and technical merits of deployable wings for terminal area energy management will also be examined. (end a rev 7 mod)

Deliverables:
1. (rev 7 mod) Analysis models, quantitative and qualitative assessment of the state of technology assessment for reusable vehicle thermal/structural concepts. 11/30/04
2. *R8* Booster Launch Vehicle Thermal-Structural assessment summaries due 3 mos from specific assignment dates.

2.0 Langley Glide Back Booster (LGBB) Concept:

2.1 Structural Design Studies:
Complete evaluation of the candidate structural design approaches for the reusable first stage LGBB concepts.

Deliverables:
1. informal monthly written reports, due end of each month thru 05/31/04
2. FEA models, datafiles, supporting documentation 06/30/04

3.0 Tool and Methodology Development

3.3 Mass Properties/Structures/Design Tools
Develop a mass properties estimation and structural sizing design tool for planetary exploration vehicles.

3.3.1 Develop a mass properties and vehicle systems characteristics database (MPD) from existing planetary exploration vehicles and design studies.
3.3.2 Define a mass properties breakdown (MPB) for planetary exploration vehicles.
3.3.3 Derive mass estimating methods (MEM's) for each element of the MPB. These methods shall be a combination of analytical techniques and empirical relationships based on the MPD, and take into account relevant design parameters such as geometry, loads (both structural and

thermal), and materials.

3.3.4 Implement the MEM's in a planetary mass properties software tool (PMPST).

3.3.5 Develop an entry system geometric definition environment (ESGDE) within I-DEAS for various entry system geometries.

3.3.6 Develop an automated geometric data transfer link from the ESGDE to the PMPST.

3.3.7 ~~Define an approach for incorporating the PMPST into IDS.~~ (Cancelled)

3.3.8 Extend the ESGDE to include an automated finite element model generation capability for the entry system.

3.3.9 Develop an automated lumped mass data transfer link (LMDTL) from the PMPST to the ESGDE-generated finite element model.

3.3.10 Develop an automated data transfer link from IDEAS to HyperSizer within PMPST

R8 3.3.11 Investigate incorporating other system design methods into the PMPST, such as risk and cost analysis.

Deliverables:

1. Mass Properties and Vehicle Systems Characteristics Database (MPD) – database, list of sources for database. (Due R8 2/28/05)
2. Planetary Mass Properties Software Tool (PMPST) monthly report– provide a brief report on software development. (Due first Friday of every month)
3. Entry System Geometric Definition Environment (ESGDE) – software delivered which defines and implements an entry system geometric definition environment (ESGDE) within IDEAS for sphere-cone entry system geometries. (Due R8 2/28/05)
4. Entry System Geometric Definition Environment (ESGDE): Finite Element Generation – software extending ESGDE to automatically generate finite element model, report describing software, users manual, example cases. Program shall provide an automatic data transfer link between the ESGDE to the PMPST. (Due R8 2/28/05)
5. Lumped Mass Data Transfer Link (LMDTL) – software, report describing software, users manual, example cases. (rev 7 Due 11/30/04) Due R8 2/28/05)
6. Demonstrate an automated data link to HyperSizer within PMPST for sphere-cone geometry. ~~(~~Due R8 2/28/05)
7. Demonstrate the PMPST capability in any future aeroshell systems study. (Due R8 2/28/05)
8. Brief reports, emails, verbal meetings to discuss results of incorporating new methods within the PMPST. (Due R8 2/28/05)

(rev6 start)

4.0 Aeroshell mass properties, sizing and sensitivities for Titan, Neptune and Mars aerocapture, and candidate future technologies that may include TPS or structural concepts.

4.1 Support the development of the Titan Explorer: Orbiter and Aerial Platform for NRA-03-

oss-01. Work includes all structural sizing and aeroshell mass estimating techniques necessary from launch to aerocapture at Titan. Level of fidelity of analysis is expected to match previous aerocapture system studies.

4.2 Support a high fidelity systems study for a large robotic class Mars aerocapture orbiter. This shall include development of structural concepts to meet mission requirements and all necessary structural analysis. Aeroshell mass properties will be evaluated and tracked as needed during the study.

4.3 Titan aerocapture systems study will be updated to suit new aeroheating and TPS estimates. Structural concepts for supporting a large lander on top of the orbiter will be further investigated as well as methods to reduce aeroshell mass.

Deliverables:

1. Updated PMPST; report documenting correlation to provided TPS and structures results, example results, example equations (~~rev 7 due 11/30/04)~~ Due ***R8***02/28/2005
2. Briefing and presentation of sensitivities at aerocapture systems analysis telecons and meetings. (6/30/04, and 10/31/04)and ***R8*** 02/28/2005
3. Informal report summarizing deliverable item 2 above. (6/30/04, and 10/31/04)
4. Informal report summarizing Aerocapture vs. propulsively captured launch mass activities (6/30/04)

(end rev6 mod)

*****Begin R9 block addition*****

4.4 Human Precursor Landing System Study

Utilizing ProbeMass1 (updated PMPST) develop mass properties for Mars human and human precursor landing system vehicle concepts.

Deliverables:

1. Mass properties for Mars human and human precursor landing system vehicle concepts 6/30/05.
2. Updated ProbeMass1. 6/30/05

*****End R9 block addition*****

5.0 3D FEA based Structural Design

5.1 The previously developed Model Center based process which implements ***ECB's*** Problem Solving Environment (PSE) for 3D FEA based structural weight estimation shall be maintained and improved. The Loft program will be updated as required to support new configurations as defined in this task (ie: Task 5.0). Utility computer programs for analysis setup such as loads, boundary conditions, etc. will be created/modified as necessary to enhance the automated procedures. Use of the AML language may be implemented if deemed useful. JAVA, Visual Basic, and C language codes will be developed, implemented and maintained.

5.2 Procedures for analysis of an ELV Delta IV Heavy type vehicle configuration will be developed in a manner similar to the existing SSTO configuration. The process configuration will be developed to the same level of capability that exists for the current SSTO configuration, from geometry creation through structural design and weight estimation. This process will be exercised on data representing a Delta IV Heavy and results compared to actual flight hardware structural weights.

5.3 An NGLT lifting body configuration will be developed to the same level of capability that exists for the current SSTO configuration, from geometry creation through structural design and weight estimation. Multi-Lobe cryogenic tanks will be an option for this configuration.

(a rev 7 mod)
5.4 A graphical user interface will be developed for the JAVA based 3D FEA analyis and sizing procedures. The GUI will be written in JAVA. Intent of the GUI is to make it possible for users to define their 3D analysis working environment and set which options of the program will be executed for a particular run. Additional enhancements such as saving the analysis state in an ASCII file and using this file to load restart solutions must be considered in planning for future requirements. (end of a rev 7 mod)

Deliverables:

1. Installation and checkout of the SSTO PSE on contractor utilized computing equipment 10/31/03
2. ELV implementation added to the PSE, includes computer programs (source and executable), associated files, documentation, and checkout case analysis with results – 2/28/04, [R8]status report on JAVA version to replace PSE version 2/28/05
3. Lifting body implementation added to the PSE, includes computer programs (source and executable), associated files, documentation, and checkout case analysis with results – 6/30/04
4. Minimum 2 documented updates to the LOFT program, to include source, executable, and documentation, 6/30/04, and 10/31/04.
5. Utilization of the PSE [R8]and/or JAVA based utilities to assess structural weight and thermal structural designs of government chosen launch vehicles – 1 month from assigned start date which will be post 6/30/04
6. (a rev 7 mod) [R8]Interim Documentation for the JAVA GUI and associated source and example code. 11/30/04. [R8]02/28/2005

6.0 Calibration of WINGSIZER calculated structural weights to existing wing data

6.1 WINGSIZER, or an equivalent level of analysis FEA based procedure, shall be exercised against data provided by the customer for typical aircraft wings such as a 747, F-15, and the space shuttle. Analysis and calibration techniques shall be determined for these various types of wing structures with regard to calculating feasible structural weights for system studies.

Deliverables:

1. Data files and calibration documentation, 01/31/04

Metrics:

1. The thoroughness of reports with respect to inclusion of:
   a. an outline of the study guidelines
   b. a concise statement of the particular design problem being addressed
   c. any rational for proposed vehicle design characteristics
   d. a description of the actual analysis process employed
   e. listings of all assumptions made and limitations they impose
   f. satisfactory validation of solutions
   g. analysis of results with useful conclusions
   h. identification of issues with recommendations for corrective actions
   i. follow-on design study options and ideas
2. The creativity and effectiveness of selected designs.
3. The depth, breadth and correctness of analysis.
4. The clarity and completeness of explanations.
5. Depth of databases
6. Robustness and Functionality of tools.
7. Number and functionality of design process enhancement tools developed
8. Number of vehicle components analyzed to enhance weight calculation techniques

3. Government Furnished Items:

1. Access to SGI workstations, PC's, and Macintosh computers loaded with specialized software.
2. Access to the commercial I-DEAS executable.
3. Access to the commercial HyperSizer executables.
4. Access to GUI development tools.
5. Access to the LaRC technical library.
6. Access to any required, permissible vehicle and test article design data requested.

4. Other information needed for performance of task:

R5 Anticipated travel: 4 5-day business trips 2 of which may include registration fees of $1000.00 each.

R8 Anticipated travel: 2 5-day business trips each of which may include registration fees of

	$1000.00 each Travel may be International R8 Anticipated courses to advance 3.0 and 4.0: Nasa systems analysis course (5 days), HyperSizer software course (5 days) **Exceeding Minimum Performance** The metrics included in the task descriptions above describes minimum acceptable performance. To exceed minimum performance, the Contractor may: 1. Improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or 2. Suggest innovative approaches to achieving the task goals that result in time and/or cost savings or an improved product. 3. Provide greater quantity and/or depth of analysis, documentation, or process understanding than as required by specified tasks.
5.	**Security clearance required for performance of work**: None
6.	**Period of Performance:** Planned start date: January 1st, 2001 Completion date: *R9* ~~February 28th ,2005~~ ***June 30, 2005***
7.	**NASA Technical Monitor**: Jeff Cerro M/S: 365 Phone: 757-864-9151 NASA Competency/Other Technical Coordinator M/S: Phone:

Task Order Number: 03RBJ Revision: 4 Date of Revision: 3/9/04

Title: Dynamic Data Acquisition and Laser Support

1. **Purpose, Objective or Background of Work to be Performed: (DA10, NAS1-96014)**

The demand by research customers for high quality dynamic data and laser test systems requires rigorous test and instrumentation preparation and data analysis to be conducted. These data acquisition and test techniques place high demand on the RFB test engineers and data reduction staff. The Contractor is expected to provide wind tunnel test support for dynamic data acquisition and reduction and laser test support to the Research Facilities Branch (RFB) facilities at LaRC. In addition to the unique data system associated with the test techniques, the data collection system in the wind tunnels consists of a data acquisition computer and a variety of instrumentation (balance, tunnel Q, model attitude, etc) for producing and gathering electronic data. The raw electronic data are converted into engineering units in the data acquisition/reduction process. These data are processed to obtain the aerodynamic coefficient information required by the research customer. The specialized requirements associated with the dynamic data acquisition and laser test techniques must be integrated with the standard data systems to ensure a quality test program.

Note: When specific test details are defined, the Technical Monitor will provide the Contractor with a notice of requirement(s) (NOR) through the automated task order system implemented for the contract. Each NOR will allow for adequate Contractor preparation (see deliverables below), will require the same concurrence and/or approvals as the rest of task order flow process, and will be part of the official task requirements and records.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements with some clarification (see R1 below).
Revision 2: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements for the new period of performance (see R2 below).
Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with no change in detailed requirements for the new period of performance (see R3 below).
Revision 4: For NASA's convenience the period of performance is moved up 8 months to April 30, 2004 with no other changes in detailed requirements (see R4 below, Section 6)

2. **Subtask Description:**

1. The Contractor shall maintain, upgrade, and operate the dynamic data acquisition systems, located in building 1212 at NASA LaRC, to be capable of supporting all RFB wind tunnel test programs. Each year, the branch will conduct approximately 4 tests , 3 weeks in duration per test, that will require dynamic data acquisition support. For all required tests identified by a NOR, the Contractor shall setup the dynamic data acquisition system and . obtain, reduce, and disseminate data.

Deliverables/Schedule:

a) Memo documenting proposed data acquisition setup – one week prior to tunnel entry

b) Modified acquisition and reduction system to meet the specific test needs described in a NOR – one week prior to tunnel entry

c) Memo and inline comments documenting proposed acquisition and reduction system modifications – one week prior to tunnel entry.

d) Data reduced to engineering units and dissemination to customer – within 2 weeks from end of test

e) Log of system upgrades, code modifications, and backups – ongoing

f) Software upgrades installed and validated – ongoing

g) Post-test data report for each test supported – within 6 weeks from end of test

Metrics: Operational readiness of system, Accuracy and timeliness of implementing system modifications, Responsiveness to system problems

Minimum acceptable performance standard:

a) System is operational two days prior to scheduled test start

b) Accuracy and timeliness of implementing system modifications such that no more than 5% of modifications fail to validate within 1/2 shift c) Response to system problems within 1 shift of tunnel test time.

Exceeds acceptable performance standard:

a) Proposes, initiates or suggests innovative methodologies;

b) Submits any deliverables prior to delivery dates.

2. The Contractor shall maintain, upgrade, and operate laser test systems capable of supporting all RFB wind tunnel test programs. These test systems include test hardware, instrumentation, software, and data systems for laser vapor screen, laser velocimetry, and doppler global velocimetry test capability. Each year, the branch will conduct approximately 4 tests, 2 weeks in duration per test, that will require laser test system support. For all required tests identified by a NOR, the Contractor shall support laser system testing needs through hardware and instrumentation setup and calibration, system operation, and data acquisition and reduction.

Deliverables/Schedule:

Task Order Number: 03RBJ Revision: 4 Date of Revision: 3/9/04

Title: Dynamic Data Acquisition and Laser Support

a) Memo documenting proposed data acquisition setup – one week prior to tunnel entry.

b) Modified acquisition and reduction system to meet the specific test needs described in a NOR – one week prior to tunnel entry.

c) Memo and inline comments documenting proposed acquisition and reduction system modifications – one week prior to tunnel entry

d) Data reduced to engineering units and dissemination to customer – within 2 weeks from end of test

e) Log of system upgrades, code modifications, and backups – ongoing

f) Software upgrades installed and validated – ongoing

g) Post-test data report for each test supported delivered – within 6 weeks from end of test

Metrics: Operational readiness of system, Accuracy and timeliness of implementing system modifications, Responsiveness to system problems

Minimum acceptable performance standard:

a) System is operational two days prior to scheduled test start

b) Accuracy and timeliness of implementing system modifications such that no more than 5% of modifications fail to validate within 1/2 shift c) Response to system problems within 1 shift of tunnel test time.

Exceeds acceptable performance standard:

a) System is operational one week prior to scheduled test start

b) Accuracy and timeliness of implementing system modifications such that no modifications fail to validate within 1/2 shift c) Response to system problems within 1/2 shift of tunnel test time.

d) Test report containing test setup description, test run log, data analysis process, and analysis results is delivered 3 weeks following completion of each test.

e) Proposes, initiates or suggests any innovative or novel methodologies.

3. **Government Furnished Items:**

Checkout area, access to laser system hardware and documentation, access to data acquisition computer systems hardware, software and documentation, wind tunnel model hardware and documentation, access to wind tunnel support hardware and documentation, wind tunnel test instrumentation and documentation provided at the 14x22 Wind Tunnel and the 16 Foot Wind tunnel for the time period of 1 month prior to test start to 1 month following test completion. Office space and access to data acquisition computer systems

Task Order Number: 03RBJ Revision: 4 Date of Revision: 3/9/04

Title: Dynamic Data Acquisition and Laser Support

	hardware, software and documentation provided in building 1212 at NASA LaRC.
4.	**Other information needed for performance of task:** Although this task is anticipated to last more than one year, the period of performance will be approximately one year in duration with modifications as needed. The Contractor should plan according to the current period of performance.
5.	**Security clearance required for performance of work:** Security clearance, secret level, may be required for some tests. (possibly 1 to 2 tests)
6.	**Period of Performance:** Planned start date: January 2, 2001 Completion date: R1~~December 31, 2001~~ R2~~December 31, 2002~~ R3~~December 31, 2003~~ R4~~December 31, 2004~~ ***April 30, 2004***
7.	**NASA Technical Monitor:** David A. Dress M/S: 289 Phone: 757-864-5126 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 04RAA	Revision: 1	Date of Revision: 12/20/01	

Title: Advanced Space Transportation Systems Tool Integration and Interface Development

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

*****Begin R1 block requirements redefinition*****

The NASA Langley Radiation Physics Group will be using IDS/FACE to enable outside customers to utilize all the radiation shielding tools for spacecraft design, mission analysis, and operational analysis. The IDS/FACE tool is a stable web based platform that allows minimal changes to the Radiation Tools for implementation. The Radiation Tools on the IDS/FACE tool is called the Space Ionizing Radiation Effects and Shielding Tool (SIREST). This is envisioned to be one tool among many to perform total spacecraft design and analysis.

The NASA Langley Research Center Vehicle Analysis Branch (VAB) will be closing out its development of IDS of Planetary Entry Vehicles.

*****End R1 block requirements redefinition*****

For original issued SOW see ETOS file *04RAA.doc.*

Revision 1: Extends the period of performance 11 months in continuation of NASA's support requirements and redefines the requirements for the new period of performance: This change addresses FY02 plans for the SIREST site, along with the closeout of the planetary effort (see R1 above and below).

2. **Description of the Work to be Performed:**

*****Begin R1 block requirements redefinition*****

1.0: Documentation of the IDS/FACE system.

The Contractor shall provide programming support for new radiation modules, support for new IDS features, general cleanup of the programs to enable simpler module creation, and documentation. This could include, but is not limited to,

a) Password protect the administration tools
b) Collaborative functionality between SIREST and other IDS based tool sets
c) Enable module configuration via configuration files instead of modifying CGI scripts.
d) Provide consulting on module creation for radiation tools and related tools
e) Support network configuration changes

The public accessible SIREST core machine is hosted by LaRC IT Branch. The Remote machine is currently in VAB (vab11), but will be moved to SIRESTREM in the near future, which is controlled by the Radiation Physics Group. The Radiation Physics Group also supports the development machine, SIRESTDEV. The Contractor will support module creation on the public and development machines and any new features for those modules. This could include, but is not limited to, creating an interface from IDS/FACE to the

CAVE, supporting off-site collaborations, and making data transfers between the machines as efficient as possible.

2.0: Repair of any known bugs in the IDS/FACE system.

The Contractor shall repair all known bugs and adequately comment all code so that the system would be usable in the future by other developers not currently knowledgeable of the system. The Contractor shall create a CD that will allow the system to be installed on computer systems not yet in the IDS/FACE system.

3.0: Documentation of the IDS/FACE system.

The Contractor shall develop a comprehensive integrated web-based user's manual, programmer's guide, and "how to"/FAQ document covering the capabilities and features of the FACE infrastructure, as well as integrated modules for both the planetary and SIREST sites.

Deliverables for the above items:

ELEMENT	DELIVERABLE	DATE
1.0	Fully functioning upgrades to SIREST	11/30/02
2.0	CD containing all software	11/30/02
3.0	Completed documentation	11/30/02

Metrics/Standards:

Meets: Thoroughness of the effort to include all requirements as defined and validated. Usability of the enhanced tools as measured by the ability of the Radiation Physics Group Analysts to operate the tools without assistance.

Exceeds: To exceed minimum performance, the Contractor may: (a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or (b) suggest innovative approaches to achieving the task goals that result in time and/or cost savings or an improved product.

*****End R1 block requirements redefinition*****

3. <u>**Government Furnished Items**</u>:

1) R1*Access to IT public Web Server (SIREST).*
2) R1*Access to development machine (SIRESTDEV), remote machine (SIRESTREM),*

	Task Order Number: 04RAA Revision: 1 Date of Revision: 12/20/01 Title: Advanced Space Transportation Systems Tool Integration and Interface Development

	and computational machines (HESB3 to date). *3)* [R1]***Access to any programs needed to implement SIREST.*** 4) Access to specialized workstations, computers, and printers. 5) Access to the internet via Netscape. 6) Access to the following software: I-DEAS, TECPLOT, LaTEX, and POST (3- and 6-DoF).
4.	**<u>Other information needed for performance of task</u>:** NONE
5.	**<u>Security clearance required for performance of work</u>:** NONE
6.	**<u>Period of Performance</u>:** Planned start date: [R1]~~1-1-01~~ ***1-1-02*** Completion date: [R1]~~12-31-01~~ ***11-30-02***
7.	**NASA Technical Monitor:** F. McNeil Cheatwood M/S: 365 Phone: 757-864-2984 **NASA Competency Coordinator:** ASCAC/M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 05RAC Revision: 1 Date of Revision: 12/1101

Title: Analysis of Advanced Aircraft Concepts

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

This task supports the NASA Quiet Supersonic Flight Activity. In this activity, NASA is developing technology that will overcome the barriers to sustained supersonic cruise flight. The activity requires the systems level trades be studied to determine the best suite of technologies to overcome these barriers. To perform these trades, NASA requires baseline vehicles with sufficient definition. This task will develop a series of small supersonic business jet aircraft concepts to support the QSF activity.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by changing the focus of the activity to that of a variable sweep configuration. The revision also changes the takeoff and landing noise goals for the vehicles. (See [R1] below.)

2. Description of the Work to be Performed:

Subtasks

1. Conduct an analysis and design study of a low sonic boom business jet aircraft. Begin with existing minimum boom design and identify design features required to improve performance. Identify technology development requirements for achieving economic viability for this class of vehicle
   - Determine the aerodynamic performance of the defined configurations, including the low speed, transonic and supersonic regimes.
   - Perform aerodynamic design studies to identify improvements to the aerodynamic performance with minimum impact to the sonic boom signatures. Utilize aerodynamic design data, methodology and technology projections from the High Speed Research (HSR) Program.
   - Perform interior layout, packaging, weight, and balance analysis of the proposed vehicles. Develop fuselage area distribution modification required to provide cabin comfort consistent with luxury class business aircraft.
   - Identify technology application opportunities, particularly from the HSR program, that provide improved performance and economic viability for the low boom business jet aircraft. The following characteristics are to be assumed:
   - Range 4000-4500 n.mi.
   - Takeoff field length: 7000 ft
   - Payload: 8 passengers and baggage, 2 crew
   - FAR 36 Stage [R1]~~3~~ ***4*** noise rules

2. Develop a baseline supersonic business jet configuration for the purposes of performing technology trade and sensitivity studies. Identify technology development requirements for achieving economic viability for this class of vehicle
   - Develop a baseline geometry layout, including wing planform, control surfaces, fuselage and engine nacelles. Perform aerodynamic design and optimization studies to identify a configuration with balanced potential to meet the stated performance requirements
   - Perform aerodynamic design studies to identify improvements to the aerodynamic performance with minimum impact to the sonic boom signatures. Utilize aerodynamic design data, methodology and technology projections from the High Speed Research (HSR) Program.
   - Perform interior layout, packaging, weight, and balance analysis of the proposed vehicles. Develop fuselage area distribution required to provide cabin comfort consistent with luxury class business aircraft.
   - Identify technology application opportunities, particularly from the HSR program, that provide improved performance and economic viability for the supersonic business jet aircraft. The following characteristics are to be assumed:
   - Mach 1.8-2.0 cruise
   - Range 4000-4500 n.mi.
   - Takeoff field length: 7000 ft
   - Payload: 8 passengers and baggage, 2 crew
   - FAR 36 Stage R1 ~~3~~ *4* noise rules

3. Conduct a study of a supersonic business jet aircraft incorporating a supersonic natural laminar flow wing and tail design. Identify technology development requirements for achieving economic viability for this class of vehicle. In particular, identify the required extent of laminar flow required to make this configuration competitive with the vehicle developed in task 2.
   - Develop realistic fuselage and propulsion pod geometry based on initial configuration supplied by NASA.
   - Perform aerodynamic design studies to identify improvements to the aerodynamic performance with minimum impact to the sonic boom signatures. Utilize aerodynamic design data, methodology and technology projections from the High Speed Research (HSR) Program.
   - Perform interior layout, packaging, weight, and balance analysis of the proposed vehicles. Develop fuselage area distribution modification required to provide cabin comfort consistent with luxury class business aircraft.
   - Identify technology application opportunities, particularly from the HSR program, that provide improved performance and economic viability for the supersonic natural laminar flow business jet aircraft. The following characteristics are to be assumed:

- Mach 1.4-1.8 cruise
- Range 4000-4500 n.mi.
- Takeoff field length: 7000 ft
- Payload: 8 passengers and baggage, 2 crew
- FAR 36 Stage R1 ~~3~~ *4* noise rules

*****Begin R1 block requirements redefinition*****

4. Conduct a study of a supersonic business jet aircraft incorporating variable wing geometry to minimize both sonic boom and takeoff and landing distance and noise. Identify technology development requirements for achieving economic viability for this class of vehicle. In particular, identify the required wing structural weight required to make this configuration competitive with the vehicle developed in task 2.
   - Develop realistic fuselage and propulsion pod geometry based on initial configuration supplied by NASA.
   - Perform aerodynamic design studies to identify improvements to the aerodynamic performance with minimum impact to the sonic boom signatures. Utilize aerodynamic design data, methodology and technology projections from the High Speed Research (HSR) Program.
   - Perform interior layout, packaging, weight, and balance analysis of the proposed vehicles. Develop fuselage area distribution modification required to provide cabin comfort consistent with luxury class business aircraft.
   - Identify technology application opportunities, particularly from the HSR program, that provide improved performance and economic viability for the supersonic natural laminar flow business jet aircraft. The following characteristics are to be assumed:
   - Mach 1.5-2.0 cruise
   - Range 4000-4500 n.mi.
   - Takeoff field length: 7000 ft
   - Payload: 8 passengers and baggage, 2 crew
   - FAR 36 Stage 4 noise rules

*****End R1 block requirements redefinition*****

Deliverables:

- For subtasks 1,2,3 above:
  - For each subtask, a 1-2 page summary of vehicle characteristics and findings
  - All analysis models' input & output files (electronically)
  - A concise technical report presenting the material defined in subtask elements above
  - Deliverable due dates, as follow:

    Subtask 1

- Summary and electronic data: 4/1/01
- Written Report: 12/31/01

Subtask 2

- Summary and electronic data: 8/1/01
- Written Report: 12/31/01

Subtask 3

- Summary and electronic data: R1~~12/1/01~~***12/1/02***
- Written Report: R1~~12/31/02~~***12/31/02***

R1***Subtask 4***

- ***Summary and electronic data: 9/1/02***
- ***Written Report: 9/30/02***

Metrics

Meets: Deliverables on time

Exceeds: Summary and electronic data delivered one month prior to specified date

3. Government Furnished Items:

NASA shall furnish the necessary access to HSR material for subtask 1,2,3

NASA shall furnish the necessary design & mission specifications for subtasks 1,2,3

NASA shall furnish the required engine-cycle data.

NASA shall furnish access to computer workstations, CPU time, FORTRAN compiler, word-processing software, FLOPS software, ELAPS software, and linear theory computer programs as required.

NASA shall furnish geometry data for the low boom business jet configurations and the supersonic laminar flow business jet configuration (subtasks 1,3)

4. Other information needed for performance of task:

None.

5. Security clearance required for performance of work:

Unclassified.

Proprietary Data.

6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R1 ~~12/31/01~~ ***12/31/02***
7.	**NASA Technical Monitor:** Peter G. Coen M/S: 348 Phone: 757-864-5991 NASA Competency Coordinator: M.F. Verlander M/S: 327 Phone: 757-864-1944

	Task Order Number: 04RFK Revision: 1 Date of Revision: 7/3/01 Title: **LASE Instrument Electronics Subsystem Changes and Maintenance with Documentation**

1.	Purpose, Objective or Background of Work to be Performed: (GL29, NAS1-96013) The Lidar Atmospheric Sensing Experiment (LASE) project is an aircraft-based active-sensor system which recently completed participation in the SAGE III Ozone Loss and Validation Experiment (SOLVE) mission and is scheduled for participation in the ARM-FIRE Water Vapor Experiment (AFWEX) flight in late 2000. Upgrades and modifications to LASE are required based on experience with the system during previous missions. The instrument normally consists of four subsystems: laser, receiver, thermal control, and CDS/DRS aboard the ER-2 aircraft, but on the DC-8 aircraft the thermal control will be a lab chiller. 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) which is an optical drive with removable data plotter. 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), a VAX-based computer system which receives, processes, displays, and archives data from the instrument. The hardware involved in this task includes the LASE Instrument Electronics, it's associated support equipment, and the DPS. Revision 1: Makes some date extensions including completion date, annotates Subtask 2 as complete, adds new requirements as Subtasks 4, 5, and 6, and travel (see R1 below).
2.	Description of the Work to be Performed: **Subtask 1.** Subsequent to AFWEX flights, identify any hardware anomalies, determine cause, and recommend corrective action for Government approval. Once approved, the 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 LASE Electronics & GSE hardware with anomalies corrected, and fully functional to support future missions. Exceeds: 1. Identify additional anomalies during the course of correcting the anomalies resulting from changes. 2. Performance of all task activities are consistently and reliably completed before R1 ~~March 1, 2001~~ ***July 30, 2001***, without increasing the negotiated cost of the repairs nor decreasing the government's confidence in the operational readiness of the hardware. **Subtask 2.** R1 ***Complete***

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Title: **LASE Instrument Electronics Subsystem Changes and Maintenance with Documentation**

Subtask 3.

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:

All hardware logbooks are maintained complete and up-to-date, within 48 hours, detailing all operations of and modifications to the hardware.

Exceeds:

Documentation of all activities is consistently and reliably completed by [R1] ***October 15, 2001***, without increasing the negotiated cost or decreasing the government's confidence in the accuracy of entries.

Begin [R1] block

Subtask 4.

Support CAMEX-4 re-integration at DFRC to allow all necessary electrical interfaces to the Dryden DC-8 aircraft. Check LASE for proper operation after re-integration.

Performance Standards and Evaluation Criteria:

Meets:

1. Complete the electrical interface, which will provide all necessary electrical power and data to meet mission needs.

Exceeds:

1. Improvements made to the hardware, with government approval, which will decrease the set-up time by 25%. 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 7-25-2001, 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. During the science mission, provide troubleshooting, unscheduled maintenance and repair as needed to keep the instrument operational. This support shall be provided by phone, network, or on-site. The method used shall be determined by LASE Project Office to provide the best and most economical support as determined at the time.

Performance Standards and Evaluation Criteria:

Meets:

1. On site help resolved any problem.

Exceeds:

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Title: **LASE Instrument Electronics Subsystem Changes and Maintenance with Documentation**

1. All changes, checklists, and drawing precluded any need for on site help during the deployment.

Subtask 6.
Following the deployment, perform the task of re-connecting the LASE instrument for checkout in building 1250 following return to Langley. Review the list of all outstanding anomalies generated during the science mission, add potential solutions and provide the list to the LASE Project Office. Provide training and troubleshooting aids to the LASE technicians.

Performance Standards and Evaluation Criteria:
Meets:
1. The LASE instrument is setup in building 1250 and operational within ten working days after return to Langley.
2. Any needed cross training will be provided during and after this time period. This assumes the area will be prepared upon arrival of the instrument.
Exceeds:
1. Completion of the task in ten days after access to the setup area with cross trained persons comfortable with the setup and basic operations.
End R1 block

3\. 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
8. Access will be available to standard tools and lab test equipment (e.g. meters and o'scopes).
9. Laboratory facilities are available in buildings 1202 and 1250.
10. Revisions to Government furnished software in a timely manner.
11. Consultation in specialty areas as necessary.

4\. Other information needed for performance of task:
Requirements:
All flight hardware repair and modification to be done by NASA flight wiring and soldering

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	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. R1 ***Some travel to DFRC and Florida may be required to support LASE mission.***
5	. Security clearance required for performance of work: *unclassified.*
6.	Period of Performance: Planned start date: January 2, 2001 Completion date: R1 ~~June 30, 2001~~ ***October 15, 2001***
7.	NASA Technical Monitor: Ben C. Barker M/S: 474 Phone: 757-864-7064

Task Order Number: 05OCB Revision: 4 Date of Revision: 4/15/02

Title: **Hyper-X Separation Analysis**

1. **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.

Revision 1: Adds post-flight analysis .

Revision 2: Refines post-flight analysis, adds support for future flights and follow-on programs, and extends the completion date for NASA's convenience .

For Revision 1 and 2 details see ETOS file *05OCB02u.doc.*

Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and updates/clarifies/redefines the requirements for the new period of performance (see [R3] below).

Revision 4: Updates schedule and documents Alternate TM change (see [R4] below).

HYPER-X PROGRAM SCHEDULE - MAJOR MILESTONES TO FIRST FLIGHT

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
3/16/99	FDR for Mach 10 flight vehicle
1/15/00	Mach 7 vehicle test flight
10/00	CDR for Mach 10 flight vehicle
2/6/01	Complete risk reduction for flight 1
6/2/01	1st flight, Mach 7 [R3](Mishap due to booster failure)
[R3]12/2/02 (est.)	2nd Mach 7 flight
[R3]8/1/03 (est.)	3rd flight (Mach 10)

2. DESCRIPTION OF THE WORK TO BE PERFORMED

2.1.1 Task Description: The Hyper-X Program requires simulation analysis support for the stage separation analysis activity. On-going support is necessary to accomplish the analysis tasks that are critical to reducing risk and assuring success for this high-risk flight event. [R3]Given the mishap that occurred during the boost phase of the first flight attempt, and the intense investigation that followed, it is expected that a more rigorous independent review process will be imposed on all risk elements of the Hyper-X program. The separation analysis effort will undergo extensive review given that it is considered the highest risk element of the flight program. Moreover, NASA management will be much less tolerant of risk for the second and final attempt at the Mach 7 flight test. The plan to prepare for this will consist of two phases. Phase one entails validation of all models contained in the separation simulation analysis tool SepSim. The second phase will entail a thorough view of all analysis performed previously including assumptions and data sources, and re-perform analysis where necessary. In addition to these efforts, the Hyper-X Program will have made many modeling changes that will have to be incorporated. Post-flight analysis will be performed [R3]to support validation of the simulation tool and pre-flight analysis. In addition, flight number 3 is a different mission than the first two flights and will require a repeat of many of the analyses supporting the [R3]Mach 7 flight. This statement of work covers the tasks supporting the [R3]return-to-flight effort and includes post-flight analysis tool development. In addition to providing separation analysis model validation, post-flight analysis will include trajectory reconstruction, which is essential to satisfying the various research objectives of the Hyper-X (X-43A) program. Given that the tools and methodology that will be developed to perform separation trajectory reconstruction can be readily applied to the other phases of the mission, the experiment and descent phase reconstruction will be included in this task. [R3]This statement of work also covers support to the separation analyses associated with follow-on, or derivative, programs to Hyper-X, including but not limited to X43C. An objective of this effort is to continually increase the fidelity of separation analysis tools.

Scope of work:

Begin [R3] block requirements redefinition

2.1.1.1 The Contractor shall implement a configuration control process for SepSim and will integrate the Hyper-X Program Configuration Control Board review and approval process.

2.1.1.2 The Contractor shall develop an independent separation simulation using the POST II code that will provide independent validation of SepSim results and provide the ability to study the effects of interpolation done on the non-rectangular wind tunnel matrix that was necessary to provide the rectangularized aero tables for SepSim. The POST II based simulation will also provide a more rapid conceptual-level separation analysis capability necessary to support preliminary analysis for follow-on flight projects such as X-43C.

2.1.1.3 The Contractor shall perform validation efforts for all application specific models used in SepSim such as aerodynamics, actuators, sensors, uncertainties, etc.

2.1.1.4 The Contractor shall review all analysis performed to support flight 1 and re-perform as necessary. These analysis shall include Monte Carlo analysis, stress test study, etc. The contractor shall review the separation control logic and re-perform the initial angle-of-attack optimization study, if necessary.

2.1.1.5 The Contractor shall incorporate all final SepSim model updates to perform final pre-flight analysis.

2.1.1.6 The Contractor shall prepare a flight readiness presentation to support the Dryden Independent Review (DIR.)

2.1.1.7 The Contractor shall perform the necessary analyses and investigations to respond to the RFI's and RFA's generated during the DIR.

2.1.1.8 The Contractor shall update/enhance the day-of-flight analysis tools.

2.1.1.9 The Contractor shall develop Matlab based analysis tools for post-flight stage-separation data analysis and trajectory reconstruction activities.

2.1.1.10 The Contractor shall provide day-of-flight support at the Langley control room facility.

2.1.1.11 The Contractor shall perform trajectory reconstruction using Matlab based tools and flight telemetry. The Contractor shall compare SepSim results with the reconstructed trajectory.

2.1.2 DELIVERABLES

The following deliverables and dates apply:

2.1.2.1 The Contractor shall provide a baseline configuration controlled version of SepSim in the form of electronic files and a User's Guide that includes an outline of the configuration control approach to the government by [R4] ***5/15/02***.

2.1.2.2 The Contractor shall provide a status summary of the development of POST II separation analysis capability and any validation performed to the SepSim tool by R4***6/03/02***.

2.1.2.3 The Contractor shall provide an update to model validation including plots, electronic files, and an updated SepSim User's Guide, by R4***6/17/02***

2.1.2.4 The Contractor shall provide all updated analysis results to the government by 7/01/02. Specifically, the Contractor shall provide a summary or memo, plots, and the electronic files of the runs and plots. The Contractor shall also provide a recommendation on changes to the separation control logic and separation angle-of-attack that will be used to support flight software changes.

2.1.2.5 The Contractor shall provide a description of the proposed software changes in accordance with the SepSim Configuration Control Board process by 7/12/02. The Contractor shall provide the modified SepSim code within one week upon approval of the software changes.

2.1.2.6 The Contractor shall provide the flight readiness presentation package to the government R4***within two weeks of DIR***.

2.1.2.7 The Contractor shall provide a response to the DIR RFI/RFA's to the government R4***within two weeks after DIR***. Specifically, the Contractor shall provide the a summary memo and all supporting plots and electronic files.

2.1.2.8 The Contractor shall provide electronic files and user documentation for the day-of-flight analysis tools to the government R4***one month before flight***.

2.1.2.9 The Contractor shall provide electronic files and user documentation for the post-flight trajectory reconstruction and data analysis tools to the government R4***one month before flight.***

2.1.2.10 The Contractor shall provide day-of-flight tools and implement to an operational readiness state in the Langley control room facility R4***one week before flight.***

2.1.2.11 The Contractor shall provide an informal report for the first assessment within two weeks of flight. The Contractor shall provide a report detailing the separation event and correlating the flight test results with simulation results.

2.1.2.12 The Contractor shall provide the separation force and moment delta output from the Monte Carlo analysis component of task 2.1.1.4 to the government by R4 ***7/15/02.***

End R3 block requirements redefinition

2.1.3 SCHEDULE
(See section 2.1.2)

2.1.4 METRICS

2.1.4.1 Meet schedule and cost.

2.1.4.2 Analysis performed with state-of-the-art methods and documented in presentations to IPT and copy in Hyper-X official files.

2.1.4.3 Quality of analysis documented by reference to previous work or new validation performed.

2.1.5 EXCEEDS MINIMUM REQUIREMENTS

2.1.5.1. Methods utilized exceed standard and/or that requested by Contractor team members.

2.1.5.2. Results presented in NASA Contractor Reports (CR)

2.1.5.3. Documentation includes assumptions, models and/or inputs to programs required to produce results

3. **Government Furnished Items:**

3.1 The government will provide access to UNIX computers loaded with specialized software (ADAMS®, Matlab®, SepSim tool with Monte Carlo utilities, and FORTRAN 77 and C Compilers), R3 configuration control software tools, and documentation R3 describing the configuration control process.

	3.2 Special furniture Furniture required for safe storage of sensitive material
4.	Other information needed for performance of task: 4.1 Estimated Travel requirements -Performance of these tasks may require travel to Dryden Flight Research Center, Edwards, CA.
5.	**Security clearance required for performance of work:** 5.1 [R3]***Secret clearance*** is required.
6.	**Period of Performance:** Planned start date: ~~Jan. 19, 2001~~ [R3]Jan 1, 2002 Completion date: ~~Dec 31, 2001~~ [R3]Dec 31, 2002
7.	**NASA TECHNICAL MONITOR:** John G. Martin M/S: 353X Phone: 757-864-3755 NASA TM ALTERNATE: [R4]***Jeffrey S. Robinson M/S: 365 Phone: 757-864- 3782***

Task Order Number: 06RCD Revision 12 Date of Revision: 2/9/2005

Title: Material/Structural Mechanics Analysis and Testing

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

The objective of this task is to conduct research and technology development that evaluates concepts, quantifies behavior, durability, and damage tolerance, validates analysis tools, and validates performance of advanced materials and structures for aerospace applications.

Revisions 1-5: (For details see electronic task order system [ETOS] files *06RCD01.doc, 06RCD02.doc, 06RCD03.doc, 06RCD04.doc, and 06RCD05.doc, respectively*).
Revision 6: Task Order extended through November 30, 2003. Subtasks renumbered, added, and modified with updated requirements to reflect NASA's need for continued support (see R6 below).
Revision 7: Subtasks 9 and 10 are discontinued. Subtask 20 is added. Period of performance is extended to 12/30/03. (see R7 below)
Revision 8: Deleted subtasks 11 and 16. Extended the period of performance ten months to October 31, 2004. Adjusted schedules of all active subtasks except 15 and 20. Added short-term Subtask 21. Plan to do further definitions of subtasks after the beginning of the new fiscal year (see R8 below).
Revision 9: Extends Subtasks 20 and 21 schedules to March 31, 2004, and January 31, 2004, respectively (see R9 below).
Revision 10: Discontinues Subtasks 6 and 13, and replaces Subtask 17 with a new subtask. Annotates Subtask 16 as Completed. Extends schedules for Subtasks 15, 20, and 21. Extends the overall completion date two weeks to accommodate Subtask 17 schedule. Adds POC for Subtask 20 and changes Technical Monitor to Dr. T.S. Gates. See R10 below for changes to current requirements. For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files *06RCD through 06RCD09.*
Revision 11: Extends the period of performance one year to October 31, 2005 with updated requirements (see R11 below).
Revision 12: Extends the period of performance two months to December 31, 2005, reduces and updates requirements and other info (see R12 below).

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall provide technical progress reporting and full financial reports at the individual subtask level in the monthly reports to the Task Technical Monitor

Subtask 1. Composite aircraft structural response with and without stiffness discontinuities.
POC: Dr. Mark Hilburger, 4-3106/ Dr. Cheryl Rose, 4-5419

a. The Contractor shall design test fixtures and coordinate test-specimen and test-fixture preparation for R12~~an estimated~~ R6~~60 to 70 nominal structural element and panel tests~~ R6~~and 10 to 20~~ tailored panel tests that will be used to evaluate the influence of structural details and R6damage on the R11~~compression~~ response of composite structures. The Contractor shall also coordinate test-specimen and test-fixture preparation for R12~~an estimated 10 to 15 laboratory scale composite cylindrical shells~~ R6~~that will be loaded in compression, or subjected to internal pressure. Panel and cylindrical shell test specimen preparation shall include preparation for~~ full-field displacement measurement during R11~~compression~~ testing using the VIC3D measurement system. The imperfection measurement of selected specimens also shall be done by the Contractor. The Contractor shall reduce the test data R6obtained during the performance period for comparison with analytical results. The Contractor shall assist NASA personnel in coordinating and conducting tests.

Begin R6 block addition
b. The Contractor shall develop finite element models R12~~for an estimated 5-10 panels with notches~~ to determine critical loading conditions for notch-tip damage growth and panel residual strength. The Contractor shall conduct nonlinear analyses of the panels using the finite element models for an estimated 1 to 2 different loading configurations for each R12~~notched~~ panel configuration R12***when necessary***. The structural analyses R12***may*** include damage progression analyses.
End R6 block addition

Deliverables: Test specimens prepared for testing, test fixtures, support fixtures, and reduced test data. R6Finite element models and analytical results.

R6**Schedule:** Complete test preparation of nominal specimens by September 30, R8~~2003~~ R11~~2004~~ 2005. Complete test preparation of tailored specimens by September 30, R8~~2003~~ R11~~2004~~ ***2005***. Finite element models and analysis results shall be provided by March R12***30***, R8~~2003~~ R11~~2004~~ 2005.

Metrics: Test specimens and test fixtures shall be compatible and adequate for testing in government testing machines with loaded ends and fixtures prepared to assure adequate load introduction into the test specimens. Design work shall conform to appropriate standards. R6The finite element models shall have adequate fidelity to represent global and local critical response and failure modes.

Begin R6 block addition/redefinition

Subtask 2. (was Subtask 5) Evaluation of the effects of manufacturing defects, impact damage on structural residual strength
POC: Dr. Cheryl Rose, 4-5419

a. R11~~The Contractor shall develop finite element models of an estimated 1-2 standard fracture toughness tests to validate decohesion elements and delamination growth models for Mode I and mixed mode loadings. The Contractor shall conduct nonlinear analyses of the fracture toughness tests using the finite element models and compare the analysis predictions with existing test data provided by the Government.~~(Completed) R12~~The Contractor shall develop finite element models of an estimated 10 to 15 flat and curved laminated composite panels to evaluate the influence of implanted delaminations on the residual strength of panels loaded in compression.~~ R12~~R11The Contractor shall modify progressive failure analysis routines to reflect recent advances in failure criteria development and delamination growth modeling for composite structures. The Contractor shall conduct nonlinear, progressive failure analyses of the panels using the finite element models to determine residual strength, and the mode and extent of delamination growth. Refined analysis models shall include fixturing to determine test load and restraint conditions.~~

b. The Contractor shall coordinate test-specimen preparation for an estimated 10 to 15 flat and curved panels to evaluate the influence of implanted delaminations on the residual strength of panels loaded in compression. Panel test specimen preparation shall include imperfection measurement of the specimens, and preparation for full-field displacement measurement during testing using the VIC3D measurement system. The Contractor shall assist NASA personnel in coordinating and conducting tests. The Contractor shall reduce the test data obtained during the performance period for comparison with analytical results.

c. R12~~The Contractor shall develop finite element models of an estimated R11 5 ***20*** to 10 ***125*** flat and curved laminated composite panels to evaluate the impact damage resistance of these panels. The Contractor shall conduct nonlinear, transient, progressive failure analyses using the finite element models to determine contact forces, displacements, and damage resulting from the impact event.~~ R11~~The analytical results shall be compared with existing test data provided by the government.~~
Begin R11block addition
d. The Contractor shall design test fixtures and coordinate test-specimen and test-fixture preparation for an estimated R620 to 25 flat and cylindrical panels that will be used to evaluate the impact damage response of composite structures. The Contractor shall assist NASA personnel in coordinating and conducting tests. The Contractor shall reduce the test data obtained during the performance period for comparison with analytical results. The Contractor shall coordinate post-impact inspection of the impact-damaged panels.
End R11block addition

Deliverables: Test specimens prepared for testing, and reduced test data. Finite element models and analytical results.

Schedule: R11~~Finite element models and analytical results for fracture toughness tests shall be provided by March 31, 2003.~~ All flat and curved panel specimens for impact testing shall be prepared for testing by March 31, 2005.

R12~~Finite element models and analytical results for flat and curved panels with an initial delamination and for impact damage modeling shall be provided by September 30, R8 2003 R11 2004 2005. All flat and curved panel specimens with an initial delamination shall be prepared for testing by September 30, R8 2003 R11 2004 2005. All impact testing of flat and curved panel specimens shall be completed by September 30, 2005.~~

Metrics: Test specimens shall be compatible and adequate for testing in government testing machines and loaded ends and fixtures prepared to assure adequate load introduction into the test specimens. Design work shall conform to appropriate standards. The finite element models shall be detailed enough to represent the global and local response of the panels, delamination growth, and to determine instrumentation patterns. The analysis results shall accurately correlate with test results when test data are available during the period of performance of the task.

Subtask 3. Evaluation of failure criteria for laminated composite structures.
POC: Dr. Cheryl Rose, 4-5419

Begin R12 block update
The Contractor shall perform the following requirements:

a. Develop finite element models and conduct analyses in support a study of failure criteria for laminated composite material.
b. Coordinate test specimen preparation.
c. Correlate tests/analyses as test data becomes available.

This effort will concentrate on materials used for space such as the woven Reinforced Carbon-Carbon Composite used for the leading edge of the space shuttle and will include:

- An estimated 10 to 15 finite element models of damaged or cracked laminated composite panels shall be developed to evaluate damage and fracture models in tension and compression. Progressive failure subroutines shall be modified to reflect the developed failure models. Nonlinear progressive failure analyses shall be performed to predict the residual strength. Refined finite element models shall be developed incorporating the test fixturing to determine test load and restraint conditions.
- Preparation of an estimated 1 or 2 full leading edge space shuttle panel models. These models shall be used to evaluate the effect of different damage levels and locations.
- Preparation of an estimated 10 to 15 impacted or cracked test specimens will be coordinated. These specimens shall be used to evaluate the influence damage on the residual tension and compressive strength of laminated composite panels. This specimen preparation shall include coordinating the measurements of various imperfections and preparation for full-field displacement measurements using the VIC 3-D measurement system. Assistance shall be provided as requested by the Government in coordinating and conducting the tests. Test data shall be reduced, as it becomes available for comparison with analytical results.

Deliverables: Test specimen and fixture requirements, test plans, and drawings defining geometry and materials for all test specimens and test fixtures.

Schedule: The estimated schedule for all deliverables is dependent on receipt of Government-furnished items mentioned above. The estimated completion date for preparation of all damaged panels for residual strength testing is May 31, 2005. The estimated completion date for finite element modeling and analyses related to the tests of damaged panels panels is September 30, 2005. Status Reports of work accomplished are due by the following dates: January 1, 2005 and July 1, 2005.
End R12 block update

Metrics: Test specimens and test fixtures shall be adequate for testing in government testing machines with loaded ends prepared to assure adequate load introduction into the test specimens.

Subtask R6 5 (was Subtask 2): Metallic aircraft structural response with and without stiffness discontinuities. R11 Discontinued

Subtask R6 6 (was Subtask 4) : Evaluation of Ultra Lightweight Multifunctional Structures. R10 Discontinued

Subtask R6 7 (was Subtask 6): Morphing Technologies for Subsonic Aircraft Wing Structures
R11 Discontinued

Subtask R6 8 (was Subtask 7): Upgrades to VICONOPT analysis tool.
The Contractor shall further extend the capability of the VICONOPT composite panel sizing code, which is resident in the Mechanics and Durability Branch of Langley Research Center to include the following:

a. Demonstrate improved post buckling analysis capability for built-up structures where reduced stiffnesses for the structure are analytically obtained and taken into account well the into postbuckling regime.
b. Verify methods that include first failure prediction in the postbuckled structure.
c. Document results and train government personnel in the usage of the above capabilities.

Special requirements: To implement Langley's mission, performance of this subtask requires special skills and in-depth experience in the stability of shells and a thorough knowledge of the VICON and VICONOPT codes. The dependence of the mission on the subtask requirements will not allow time for normal on-the-job training and familiarization. For compatibility issues, the Contractor shall program the analysis methods using standard FORTRAN coding practices.

Deliverables: The Contractor shall provide engineering and technical modifications to the analysis methods and programs and document code capabilities before the end of September 30, 2002.

Schedule: Studies, documentation and training to be completed by R12 ***March 31, 2005***. Status Report of work accomplished by R12 ***March 31***, R6 ~~2001~~ R8 ~~2003~~ R11 ~~2004~~.2005.

Metric: The results from the Contractor developed code comparing within 2 percent of the existing results on existing benchmark problems.

Performance Standards:

MEETS:

- adherence to schedule and cost
- completion of all analysis
- final written Contractor Reports to meet NASA editorial standards

EXCEEDS:

- completion ahead of schedule
- completion under cost

Subtask R6 9 (was Subtask 11): Y-Joint Test Facility Modifications. -- R7 Discontinued

Subtask R6 10 (was Subtask 12): (Delay start until June 1, 2002) Y-Joint analysis for combined mechanical and thermal loading conditions. – R7 Discontinued**.**

Subtask R6 11 (was Subtask13): Bondline analysis. R8 DISCONTINUED after October 31, 2003

Subtask R6 12 (was Subtask 14): Structural integrity of friction stir-welded aerospace materials.
POC: Dr. Scott Forth, 4-3823

Purpose: Experimentally evaluate friction stir-welded panels for aerospace applications.
Objective: Conduct fatigue, fatigue-crack growth and fracture tests on friction-stir-welded specimens to assess the structural integrity for fuselage and wing applications in commercial

aviation.

Description of the Work to be Performed:

Begin R11 block requirements update
a. The Contractor shall conduct experiments to support the damage tolerance certification of friction-stir welded structure for primary aircraft structure. The development of relative damage tolerance data and interpretation of the failure modes of the specimens will be critical to the safe certification of an aircraft. The number of tests and complete description of the effort are included in the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications." (To be provided by NASA).

Deliverables: (due at completion of the task unless noted)

- Documentation of experimental data as required by the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications."

End R11 block requirements update

- brief written summary of each test (noting any testing anomalies)
- brief informal written monthly report
- formal written Contractor Report at the end of the task.

Performance Period: R11~~Nov . 1,~~ R8~~2001 2002 through~~ R8~~March 31,~~ R6 ~~2002 2003 September 30, 2004~~ Oct 1, 2004 through September 30, 2005

Performance Standards:

MEETS

- adherence to schedule and cost
- adherence to test and safety procedures
- R11data developed in accordance to the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications."
- final written Contractor Report to meet NASA editorial standards.

EXCEEDS:

- completion of tests ahead of schedule
- completion under cost
- R11completion of additional tests not included in test matrix

Subtask R613 (was Subtask 15): BOSOR4, PANDA2, VICONOPT, and FASOR development for PCs.
R10Discontinued

Subtask R614 (was Subtask 16): R11Fatigue and Fracture Testing of Aerospace Structures.
POC: R6Dr. Scott Forth , 4-3823

Purpose: Determine R11fatigue crack growth and residual strength behavior of aerospace materials and structural configurations.

Objective: Conduct tests on R11~~aluminum alloys,~~ laboratory coupons and integrally stiffened specimens R11~~riveted stiffener specimens, and biaxial cruciform specimens.~~

Description of the Work to be Performed:
Begin R11 block requirements update
a. The Contractor shall perform fatigue crack growth tests on an aerospace alloy to identify the effects of specimen

configuration, laboratory environment and loading profile. These experiments will be used to support aerospace dynamic component damage tolerance research and modification of the ASTM testing standards as needed.

b. R12~~The Contractor shall perform fracture tests on integrally-stiffened specimens to develop new methods for determining residual strength. The results will be compared to existing residual strength information for built-up structure and be used as a baseline for the development of a new residual strength method for integral structure.~~

Deliverables (for each item): (due at completion of each test, unless noted)

- fatigue crack growth rate data
- integrally-stiffened structure residual strength data and methodology

End R11 block requirements update

- brief written summary of each test (noting any testing anomalies)
- brief informal written monthly report
- formal written Contractor Report at the end of the task.

Schedule: All work to be completed by September 30, R6~~2002~~ R8~~2003~~ R11~~2004~~ 2005.

Performance Standards:

MEETS

- adherence to schedule and cost
- adherence to test and safety procedures
- test data reports
- all tests in subtasks R11a R12~~and b~~ above complete
- final written Contractor Reports to meet NASA editorial standards.
- presentation and paper meet conference standards

EXCEEDS:

- completion ahead of schedule
- completion under cost
- R11completion of additional tests not included in test matrix

Subtask R615 (was Subtask 17): Characterization of Advanced Materials.
POC: Dr. Tom Gates, 4-3400

Purpose, Objective or Background:
As part of the Computational Materials Program, R11***Return to Flight***, and the R11***Advanced Vehicles*** program, LaRC has been tasked to evaluate the behavior of polymers, foams, polymeric composites, and nanostructured materials over a range of thermal, mechanical, and environmental conditions. The specific objective is to perform tests, reduce data, and analyze the results to establish performance of existing and new materials under a variety of loading conditions.

Description of the Work to be Performed:
a. Contractor shall conduct mechanical/environmental tests to simulate the effects of load, temperature, and moisture, and other environmental factors on stiffness and strength of advanced polymers, R11***foams***, polymeric composites, and nanostructured materials. Test specimen mechanical loading conditions shall be tension and compression over a range of static and time-dependent conditions. NASA shall supply all test articles. Detailed measurements on mechanical and physical properties shall be performed on specimens. Records shall be maintained to document the material properties. The Contractor shall report monthly on the progress of this testing.

b. Contractor shall perform as needed detailed data reduction and associated analysis to determine the final engineering-level properties of the test specimen. The analysis shall be used to guide the selection of applied loads and test apparatus. Analysis methods may include the use of concepts from elasticity, viscoelasticity, strength of materials, and damage mechanics. A Contractor report shall be issued upon the completion of work.

c. The Contractor shall assist as needed in development of environmental/mechanical test apparatus for use in the materials characterization work. This apparatus shall be located in the R12 ***MSMB*** materials characterization laboratory. The Contractor shall report monthly on the progress of test apparatus development.

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

Deliverables:

- laboratory test log shall be kept by Contractor
- informal written and oral reports after completion of each round of testing/analysis
- formal written Contractor report at end of task

Schedule: Completed by October 31, R6 ~~2002~~ R10 ~~2003~~ R11 ~~2004~~ ***2005***.

Performance Standards:

MEETS

- perform from 10 to 50 material property tests
- adherence to schedule and cost
- adherence to test and data reduction procedures
- test data reports and laboratory maintenance log
- final written Contractor Report meets NASA editorial standards

EXCEEDS:

- completion ahead of schedule

Subtask R6 16 (was Subtask 19): Cryogenic tank structural analysis and concepts development
R8 DISCONTINUED after September 30, 2003 R10 Completed

Subtask R6 17 (was Subtask 22): Automated finite element analysis of elastically-tailored laminates.
R10 Discontinue and replace with new Subtask17 as described below

Begin R10 block replacement subtask

Subtask 17: Tow-steering design work

POC: D. C. Jegley, 4-3185

Task Description: This task will concentrate on extending several novel design techniques to alternative geometries and loading conditions using the *OLGA* software, the *STAGS* finite element code, and the *Cellular Automata (CA)* continuum partitioning concept.

The Contractor shall perform the following design and analysis requirements:

1) Employing the tow-steering design approach, design flat panels with central holes subjected to combined in-plane normal and shear load using the existing design environment that implements *STAGS* as the analysis tool. Panel stacking sequence shall be optimized for a given loading configuration using the parallel; tow-drop; and overlap methods of construction.

2) Employing *CA* techniques and the same loading and boundary conditions used in the tow-steered designs, design flat panels with sparsely distributed plies. Designs shall be verified to meet required loadings using finite elements. .

3) Design flat panels to be constructed using selective reinforcement of metals. This design approach shall be integrated with the tow-steering design methodology. Subroutines within the *STAGS* analysis code shall be modified to implement these new selective reinforcement components. Initial design studies shall be conducted for

a flat panel with a central hole and compared to the tow-steered design approach.

4) Modify the existing *OLGA* design software to allow for design of curved panels and cylinders using the tow-steering approach and design curved panels with and without a central hole based on required loading and specimen geometry provided by the government.

Begin R11 block addition

5) Enhance the topology design optimization tool to produce manufacturable designs composed of multiple layers with different orientations through the use of lamination parameters. A topology design tool based on the Cellular Automata paradigm shall be used. Fiber angle shall be used in a spatially continuous design optimization design problem with the lamination parameters as design variables instead of the fiber angles. With this new formulation, the stacking sequence of the optimal laminate with multiple layers is expected to be determined efficiently and reliably. Stacking sequences corresponding to the optimal lamination parameters shall be determined. These laminates shall be analyzed using the *STAGS* finite element program to determine the best laminates with respect to buckling performance.

End R11block addition

Deliverables and Schedule:

1) *Monthly progress reports detailing the progress of the work delivered electronically for all months of the task except the first and last month.* R11~~May 31, June 30~~, July 31, Aug 31, Sept 30, Oct 31, R11Nov. 30, Dec. 31, 2004 R11and Jan 31 2005

2) *A midterm report and presentation giving details of the designs for the tow-steered, the sparse coverage, and the selectively reinforced flat panels with holes*. This report shall summarize the expected buckling loads and responses for each panel, and indicate the avenues that possess the most potential for flat panels that utilize these approaches. Recommendations for parts to be manufactured and tested to best support the potential of the design concept shall also be included. R11~~June 30~~ Dec. 15, 2004

3) *All new software functional on NASA Langley computers and demonstrated to NASA personnel. and a user's manual*. R11~~Nov~~ Dec. 15, 2004

4) *A final report detailing the OLGA extension to curved panel geometries, presented in suitable form to be published as a NASA-CR.* R11~~Oct~~ Jan. 31, 2004

5) *A final presentation to NASA-Langley personnel introducing the extensions to the analysis and design tools for three-dimensional shell geometries* R11~~Nov. 15~~ Feb. 28, 2004

Government Furnished Items:

1) A software usage agreement for the use of *STAGS* by Contractor personnel will be provided by NASA-Langley.

2) NASA will provide boundary and loading conditions and models suitable for insertion into the STAGS finite element code for all panels to be designed

3) Contractor personnel will have access to Langley computers for checkout and installation of all new software.

End R10 block replacement subtask

Period of Performance:

Planned start date: June 15, 2004 Completion date: R12~~Oct. 3, 2005~~ March 30,2005

Begin R6 block addition/redefinition

Subtask 18. Column Test and Analysis Support

Point of contact: Judith Watson 43116

1 *R12* ***Deployable/rigidizable column test activities*** 6/30/R8 ~~03~~ R11 ~~04~~ 05

The Contractor shall support the integration of test fixtures and test specimens in the test facilities (building 1293 room temperature and cold temperature test cells). Participation in the testing of the specimens shall include coordination of the preparation and setup of the data acquisition system and test specimen instrumentation, operation of test equipment, operation of data acquisition equipment (Labview/VXI based), and reduction and analysis of data.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least R12 ***75*** specimens and support, at a minimum, compression, tension, and bending tests for the R12 ***75*** specimens and reduction of data.

R11 Additional support shall be provided for incorporation of columns into a truss structure. Test support will be provided for deployment and load testing of the truss.

Begin R11 block deletion

~~2. ***Support column analysis*** 10/31/R8 03 04~~

~~The Contractor shall use finite element code to model and compare analytical results to experimental test results for the deployable rigidizable columns under axial compression and tension, and bending loads. The analysis shall include parametric studies of variables in the column geometry that influence the columns structural behavior.~~

- ~~PERFORMANCE METRIC: A finite element model of a typical column specimen and comparison results for the experimental load regimes, and the structural behavior results of varying up to 3 geometry parameters of the column.~~

End R11 block deletion

One trip to Fredrica, Delaware. The trip is a single day to confer with the manufactures of the inflatable columns.

. Period of Performance:

Planned start date: Oct. 1, 2002 Completion date: ***December 31***, R8 ~~2003~~ R11 ~~2004~~ 2005

Subtask 19: Structural behavior of high-temperature adhesives and composite materials.
POC: Timothy J. Collins, 4-3113 R11 ~~/ Stanley S. Smeltzer, 4-3120~~
*****Begin R11 block requirements update*****
The Contractor shall perform analyses of advanced heat-shield (aeroshell) structural concepts, including sandwich construction test panels and subscale prototype aeroshell structures. The subtask will include the following components:

1) The Contractor shall perform analyses of the thermal expansion characteristics of advanced thermal protection system (TPS) materials. The TPS material systems to be considered consist of an ablative material embedded in E-Glass reinforcing honeycomb. Using supplied properties for the constituent components (E-Glass honeycomb and ablative material), and the known geometry of the honeycomb cells, the contractor shall perform analyses to determine the equivalent coefficient of thermal expansion (CTE) of several TPS material systems.

2) The Contractor shall validate the analyses performed in (1) above by performing limited laboratory tests using an 18"x24" (approximate) sample of TPS material. This will include gross CTE measurements of the sample TPS panel. The contractor shall recommend a suitable test procedure for determining the panel CTE and shall coordinate and execute the test.

3) The Contractor shall perform analyses of the thermal expansion behavior of advanced heatshield structural concepts subjected to heating loads representing the loads that will be applied to the structures during ground testing (designed to simulate typical planetary entry loads). The temperature profiles for these analyses will be

supplied by NASA. These analyses will consist of flat sandwich panels, curved sandwich panels, and subscale prototype aeroshell structures, all of which consist of a primary load-bearing structure with bonded TPS material. The analyses will be similar for each set of analyses, but the geometry and boundary conditions may vary (depending on anticipated test conditions). The test conditions and test article geometries to be modeled will be supplied by NASA. The primary result of interest is the shear stress at the adhesive bond line (between TPS and composite facesheet) created by differential expansion of the sandwich structure and the TPS material. Note that the CTE for the TPS materials in these analyses will come from the analytical results derived from work item (1) above.

Deliverables:

1) Analytical models and equivalent CTE analysis results for the following for at least five TPS materials to be selected and specified by NASA.

2) CTE experimental test results for one sample TPS material panel (approximately 18”x24”), including data reduction and correlation with the CTE predicted analytically under item (1) above.

3) Analyses models and results for at least five flat and two curved panel structural concepts subjected to radiant heating profiles representative of those expected during tests at the Air Force's Sandia Solar Tower facility. (panel geometries and heating profiles to be provided by NASA).

4) Analyses models and results for at least three subscale prototype aeroshell structural concepts subjected to heating profiles representative of those expected during arc-jet testing. (geometries and heating profiles to be provided by NASA).

Schedule: Monthly informal progress reports and a final report of work accomplished by October 1st, 2005 (final written report, Microsoft Word Format).

Metrics: Analyses shall be performed using suitable finite-element codes (such as MSC/NASTRAN, ABAQUS, and/or STAGS).

*****End R11 block requirements update*****

Performance Standards:

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- completion of all design, test, and analysis activities
- test data and analysis reports
- R11***monthly progress reports***
- final written R11~~Contractor Report (informal)~~ ***report***

EXCEEDS:

- completion ahead of schedule
- completion under cost
-

End R6 block addition/redefinition

Begin R7 block addition

Subtask 20: Subtask: Development of a small-crack monitoring system in metallic materials subjected to cyclic loading conditions

R10POC: Andy Newman, 4-8945

DESCRIPTION:

These specifications are being defined to develop an automated small-crack measurement system. Small cracks are herein defined as cracks that occur under cyclic fatigue loadings in metallic materials where the length of these small cracks is 20 microns or less. This system needs to be electronically linked to an electronic controller that is a part of a closed-loop fatigue testing system to allow stopping of a crack growth test in order to take small-crack measurements during cyclic fatigue loading. The electronic controller sends a control signal that causes a load, strain, or displacement to be applied to the test specimen. The small-crack measurement system being developed shall be capable to being linked to both a MTS-458 or Instron 8500 closed-loop electronic controller. The following specifications are required in this system.

System Specifications:

1. Resolution:
The measurement of small cracks with total crack lengths of 20 microns or less is required. The x-y coordinates of the crack tip for each crack measured must be determined and recorded.

2. Typical Area of Measurements:
A typical area where these small-cracks will be measured is for a standard single-edge-notch tension specimen configuration. A typical radius for the edge notch in this specimen configuration is between 3 and 5 millimeters, mm. The area to be considered for possible small-crack measurements is plus and minus 1 mm about the notch centerline. Crack measurements would be recorded up to when the small-cracks have coalesced into a primary crack and the primary crack breaks through the specimen thickness. Test specimen thickness could be up to 10 mm.

3. Frequency of Measurements:
Frequency of measurements should be automated at specified time or cycle intervals with up to 40 intervals per test.

4. Number of Measurements Required:
Up to 20 separate small cracks in the measurement area, see specification number 2, could be measured per test at any given measurement interval.

5. Data to be Recorded:
   a) Crack lengths.
   b) Incremental length of crack growth between succeeding crack lengths.

6. Data Storage Requirements:
Crack lengths, crack-growth increments, and crack-tip x-y coordinates must be stored on a PC hard disk.

7. Load Control During Crack Length Measurements.
This system needs to be capable of being electronically linked to both a MTS-458 closed-loop electronic controller and an Instron 8500 closed-loop electronic controller to allow the crack-growth test to be stopped in order to take small-crack measurements during cyclic fatigue loading. Only one of these electronic controllers will be used doing a given test. After the crack-growth test has been stopped for crack length measurements, a signal needs to be sent to the electronic controller, commanding the controller to increase the load to a certain percentage of the test systems maximum load to allow for the crack to open adequately in order to obtain an accurate crack length measurement. Before restarting the cyclic loading another command must be sent to the controller to return to the mean load that has been set for the cyclic fatigue loading being commanded. After the load has been returned to mean load, a signal needs to be sent to the electronic controller restarting the cyclic fatigue loading.

DELIVERABLES and SCHEDULE:

Aug. 15, 2003: Development of a prototype crack detection system and verification against alternative method on samples provided by LaRC.

R10 ~~Sept. 30, 2003~~ June 15, 2004: Phase 1: Manual system to identify and track growing cracks. Delivery shall include on-site installation, system validation and training.

R9 ~~Dec. 30, 2003~~, R10 ~~March 31, 2004~~ R11 ~~August 30, 2004~~ R12 ~~December 30, 2004~~ ***April 30, 2005***: Phase 2:

Automated system to identify and track growing cracks integrated with MTS-458 or Instron 8500 closed-loop controller. Delivery shall include on-site installation, system validation and training.

Performance Standards:

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- completion of all design and test activities
- test data reports
- Contractor User Report (informal)

EXCEEDS:

- completion ahead of schedule
- completion under cost

**End R7 block addition **
Begin R8 block addition

Subtask 21: Real-Time Structural Response Measurement and Visualization System

R11Discontinued

**End R8 block addition **

3. **Government Furnished Items:**

Test specimens

Test specimen instrumentation

Specialized measurement R6and testing equipment

STAGS nonlinear structural analysis code

Desk-top computers with specialized software

Computer CPU time for structural modeling and analyses

Access to appropriate test equipment

Office space (as required)

4. **Other information needed for performance of task:**

- All Langley safety procedures shall be followed.
- 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.
- Subtasks 10, 11, 16, and 17: Applicable documents may include:

  LMS CP-5518 Granting Foreign Nationals and Foreign Representatives Computer Accounts.
  LMS-CP-5549 Responding to Reports of Information Technology Security Incidents and Inappropriate Activity.
  LMS-CP-5519 Requesting Access to Information Technology Resources.
- Subtasks 12 and 13: **SPMP REQUIREMENT:** The Contractor shall comply with the responsibilities described by LMS-CP-5528 and LMS-CP-5532, as well as the requirements specified in the Data Acquisition and Information Management Branch (DAIMB) software plans for any new software developed or purchased. These software project management plans (SPMP), if required, shall be reviewed and accepted by DAIMB.
- R6Subtask 18: One trip to Fredrica, Delaware. The trip is a single day to confer with the manufactures of the inflatable columns.

5. **Security clearance required for performance of work:**

	Subtasks 10 and 11: ITAR and ADP clearances
6.	**Period of Performance:** Planned start date: 1/2/01 Completion date: R6 ~~10/31/2002~~ R7 ~~11/30/03~~ R8 ~~12/30/03~~ R10 ~~10/31/2004~~ R11 ~~11/15/04~~ R12 ~~10/31/2005~~ ***12/31/05***
7.	**NASA Technical Monitor**: R10 Dr. Thomas S. Gates M/S: 188E Phone: 757-864-3400 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2 Statement of Work
Task Order Number: 06RDM Revision: 7 Date of Revision: 7-28-04 Title: Flight Operations - Coordination and Implementation	

1.	**Background:** This task provides contract pilot services for flight operations support for NASA's flight activities to enable NASA LaRC to conduct flight research projects for both internal and external customers. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see R1 below). Revision 2: Extends the period of performance one year in continuation of NASA's support with no changes to detailed requirements and newly designated organizational technical coordinator for the new period of performance (see R2 below). Change 2: Specifies previously omitted aircraft, tail numbers, and pilot-in-command duties (see R2.2 below). R3Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 06RDM, 06RDM01, 06RDM02, and 06RDM022. Revision 3: Revises the task to include contract pilot services only and extends the period of performance for 3 months in continuation of NASA's support requirements (see R3 above and below). Revision 4: Extends the period of performance one month to April 30, 2004 in continuation of NASA's support with no other changes to detailed requirements (see R4 below, Section 6) Revision 5: Extends the period of performance five months to September 30, 2004 in continuation of NASA's support with no other changes to detailed requirements (see R5 below, Section 6) Revision 6: Extends the period of performance three months to December 31, 2004 in continuation of NASA's support with no other changes to detailed requirements (see R6 below, Section 6) Revision 7: Extends the period of performance six months to June 30, 2005, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see R7 below, Section 6).
2.	**Description of the Work to be Performed:** Operations Engineering R3(Deleted) Provide the services of a contract pilot to support research and/or support fights and simulation studies as required to support NASA research goals R2.2to include the following aircraft: Raytheon/Beechcraft Be-200 King Air – N529NA, Cirrus SR22X – N501NA, Cessna 206X – N504NA, and the Lancair LC40X – N507NA. Duties will be requested on short notice and will include serving as in-flight R2.2pilot-in-command and/or copilot-in-command for in-type aircraft ratings, or as approved by NASA's flight operation organization. Pilot and mission information on each flight shall be documented, maintained, and reported on a monthly basis. Deliverables:

	Contract pilot services as required and defined by flight operation organization [R3]not to exceed 200 flight hours per year. Metrics: Timely and accurate preparation and delivery of [R3]pilot services so as to preclude research schedule cancellations and/or delays. Acceptable level of performance: 95% of assigned missions conducted on schedule. Exceeds: 98% of assigned missions conducted on schedule.
3.	**Government Furnished Items:** Contractor will be provided access to Government supplied equipment required for task completion, including flight personal equipment and office furnishings.
4.	**Other information needed for performance of task:** Contractor may be required to work outside of normal duty hours, weekends or holidays as required to support flight missions. Contractor may be required to travel to deployment locations in the conduct of flight activities.
5.	**Security clearance required for performance of work**: Although a Secret Clearance is not required on a continuing basis, Contractor must be able to reinstate such clearance when required by the nature of the flight activity or as an access requirement at off-site locations.
6.	**Period of Performance:** Planned start date: [R3]~~January 2, 2001~~ January 2, 2004 Completion date: [R1] ~~December 31, 2001~~ [R2]~~December 31, 2002~~ [R3]~~December 31, 2003~~ [R4]~~March 31, 2004~~ [R5]~~April 30, 2004~~ [R6]~~September 30, 2004~~ [R7]~~December 31, 2004~~ ***June 30, 2005***
7.	**NASA Technical Monitor:** Luci Crittenden M/S 256 Phone (757) 864-1776 NASA Competency/Other Technical Coordinator: ***FRSC/D102***/Barbara S. Trippe M/S: 255A Phone: 757-864-3874

Task Order Number: 06RFM Revision: 1 Date of Revision: 12/7/01

Title: Conduction of Tests and Instrument Operations for the CERES Project/EOS-PM Spacecraft

1.	**Purpose, Objective or Background of Work to be Performed:** The Clouds and Earth's 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 3 (FM3) and Flight Model 4 (FM4) instruments will be delivered to TRW, Redondo Beach, California, integrated on to the Earth Observation System PM (EOS-PM) spacecraft and complete the system verification and pre-launch environmental testing (See the attached EOS-PM I&T schedule). The EOS-PM spacecraft is scheduled for launch on December 31, 2000. The Contractor will be responsible for all of the CERES instruments' performance verifications, flight readiness testing and health operations. This is done by developing and executing procedures to operate and monitor the CERES Instruments via the Instrument Ground Support Equipment (IGSE) while connected in the Direct Configuration, or through the Spacecraft Configuration (Figures 1 & 2 show both of these configurations). In either configuration, The CERES instruments will be commanded to perform various test operations to collect information which defines and verifies the instruments' performance. Revision 1: Extends the period of performance seven months in continuation of NASA's support requirements (see [R1] below).
2.	**Description of the Work to be Performed:** 1. The Contractor shall modify existing CERES test procedures required for EOS-PM test operations. Additionally, the Contractor will develop special test procedures to troubleshoot and verify instrument performance operations as required to resolve anomalous Spacecraft and CERES Instrument operations. The procedural content of the day to day EOS-PM test operations will vary according to specific test objectives and may include the following activities: a. Verification of the CERES instruments' functional status and readiness for I&T operations. This will be accomplished through the execution of the "CERES Aliveness Test Procedure. b. Verification that the CERES instruments' 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 instruments' components and subsystems are fully

functional with respect to their operational designed specifications. This will be accomplished through the execution of the "CERES Comprehensive Performance Test (CPT) Procedure".

d. Verification that specific CERES instruments' components and subsystems are operational within their designed specifications post any anomalous performance detected during I&T operations. This will be accomplished through the execution of approved special test procedures developed specifically to troubleshoot a performance problem revealed during normal I&T operations.

e. All instrument powered operations in support of S/C Integration and Testing.

f. Instrument unpowered operations in coordination with S/C operations, such as: Cleaning and Inspection, Alignment, Mechanical preparations for moving, Acoustic and Shock Tests, etc.

NOTE: It is anticipated that the normal CERES test operations, and therefore the procedures, will not change significantly following an initial test period. As part of this task, the Contractor shall provide current information regarding execution of the above mentioned test procedures and instrument operations to the LaRC CERES project personnel and to TRW S/C test personnel. Test information will be provided to GSFC project personnel on request or as needed.

2. The Contractor shall provide operations monitoring via IGSE when the above mentioned test procedures are executed by the TRW Operations Team via the SGSE. All of these operations will occur according to the attached TRW/EOS-PM I&T schedule, or the schedule updates.

3. The Contractor shall operate the IGSE or a computer with CERES Bench Checkout Unit (BCU) software and appropriate Archiving Media Drives to play back data files for analysis of recorded normal and anomalous operations.

4. The Contractor shall maintain Log Records at LaRC or the operations sites (i.e. TRW and VAFB) tracking all of the operating time of the CERES instruments, executed test procedures, operations data files and operations
anomalies.

5. The contractor shall maintain a CERES I&T test data archive on the LaRC DMSS computer in Building 1268 of all BCU Archived test data files.

6. The Contractor shall maintain a hard copy or electronic copy, as appropriate, of all CERES I&T Test procedures.

7. The Contractor shall develop and maintain standard operations procedures (SOP) required for

IGSE and instrument operations for both bench and spacecraft testing.

8. The Contractor shall have at least one representative participate in scheduled LaRC CERES Project meetings dealing with the EOS-PM schedule, CERES schedule and instrument operations, as test schedules permit.

9. The Contractor shall participate in TRW's EOS-PM meetings that pertain to CERES Instrument operations and schedule of I&T at TRW and the launch site.

10. The Contractor shall review EOS-PM I&T test procedures and schedules, SOP's, 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 instruments. 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 instruments operations.

11. The Contractor shall setup the CERES IGSE as necessary to support the I&T effort at TRW.

12. The Contractor shall pack in government furnished shipping containers all of CERES IGSE and documentation necessary to support launch activities at Vandenberg AFB in California. Also, the Contractor shall unpack and set up the IGSE at Vandenberg Air Force Base, California to support EOS-PM/CERES pre-launch, launch and post-launch operation activities.

NOTE: The timetable is defined according to the attached table of EOS-PM/CERES Integration and Test events as well as the events necessary to prepare the CERES instrument and IGSE for shipment to Vandenberg 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 CERES procedures four weeks (20 working days) prior to the scheduled test. If the procedural changes are not identified in a timely manner to allow complete procedure modification four weeks prior to a scheduled test, then the completed modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test.

2. Final copy of the above mentioned CERES procedures two weeks (10 working

days) prior to the actual test. If the procedural changes are not identified in a timely manner to allow complete final procedure modification two weeks prior to a scheduled test, then the completed final modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test. The Final copy, once approved, will be the CERES Test Procedure used to conduct the scheduled 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 instruments 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 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 instruments, CERES IGSE.

NOTE: The financial status of this task order will be part of the NYMA monthly status report summary.

Metrics:
1. Satisfactory effort:

a. All of the CERES instrument and IGSE operations are executed in a manner such that the CERES instruments' operational readiness is maintained and the spacecraft I&T and Launch schedules are met.

Note: 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 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 instruments' 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 CERESProject or Contractor's control.

b. All of the above mentioned procedures and reports are delivered 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 and reports 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.

3. **Government Furnished Items:**

1. Access to specialized software as determined necessary 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.

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4.	**Other information needed for performance of task:** 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 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 TRW/EOS-PM personnel. Travel: Travel to GSFC, Redondo Beach, California, and Vandenberg Air Force Base, California will be required to conduct instrument operations in support of this task.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:** **Planned start date:** 1/1/01 **Completion date:** R2 ~~12/31/01~~ ***7/31/01***
7.	**NASA Technical Monitor:** Charles E. Jenkins Jr.; M/S: 424 ; Phone: 757-864-7080 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

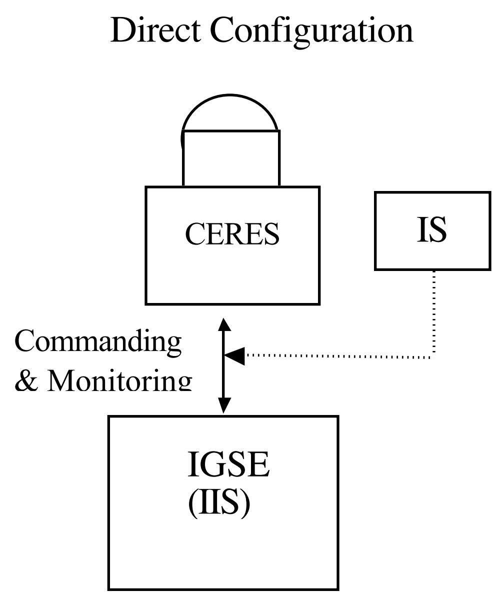

Figure 1: CERES instrument Direct GSE configuration

Spacecraft Configuration

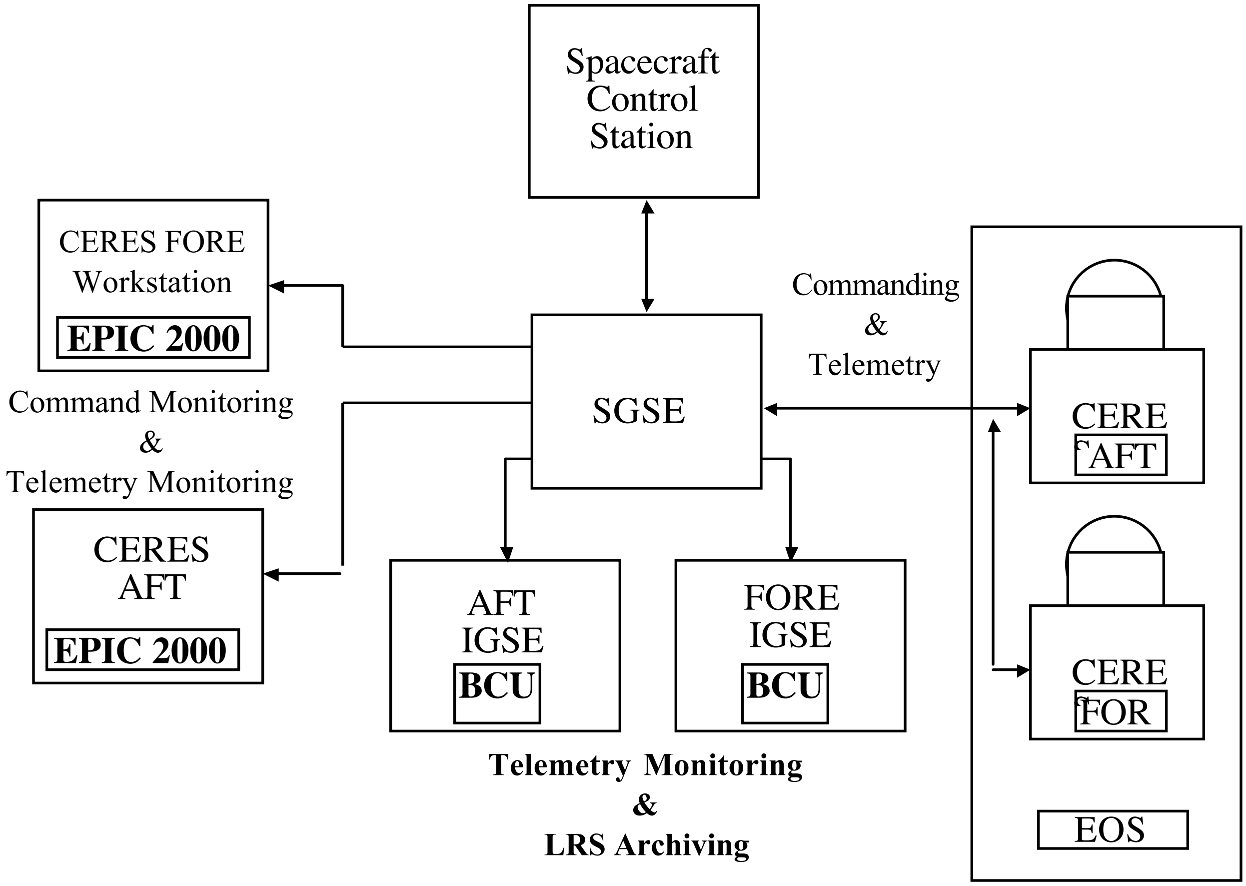

Figure 2: CERES instrument Spacecraft GSE configuration

	Task Order Number: 07RAC Revision: 1 Date of Revision: 12/11/01 Title: Flight Optimization System (FLOPS) Support

1. **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.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by revising deliverable dates for the FLOPS update and maintenance task and by revising the development subtasks. (See [R1] below.)

2. **Description of the Work to be Performed:**

Subtasks

1. 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.
2. 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.
3. Prepare methodology documentation for the FLOPS Operational Modules. Documentation shall be accessible on-line
4. Develop an improved takeoff and landing noise capability for FLOPS. Implement available HSR developed noise prediction modules. [R1]***Contact Mr. Bob Golub of NASA Langley's Acoustics Branch to obtain the necessary software and documentation.*** Implement new jet noise modules to be provided by NASA. Study available methodology for supersonic nozzle sizing for feasibility of implementation in FLOPS.
5. Study the potential for using the closed form wave drag analysis method developed in NASA grant NAG-1-1160 as an improved wave drag scaling module. [R1]***Contact Professor Bill Mason of Virginia Polytechnic Institute for source code and available documentation related to this grant.*** If applicable, incorporate this method as an improved module. Examine the utility of other simplified analysis techniques developed in NAG-1-1160 to improve the FLOPS aerodynamic data scaling
6. Review FLOPS algorithms for efficiency and accuracy. Provide improved algorithms for program subroutine elements if efficiency and accuracy can be enhanced.
7. Review available literature on simplified high lift aerodynamic analysis. Develop strategy for implementation of an improved high lift aerodynamics analysis capability in FLOPS

Deliverables:

1. 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.

2. 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.

Deliverable due dates

Subtask 1 R1~~12/31/01~~ ***12/31/02***
Subtask 2 R1~~12/31/01~~ ***12/31/02***
Subtask 3 R1~~12/31/01~~ ***12/31/02***
Subtask 4
- R1***HSR noise module implementation 3/31/02***
- Nozzle sizing recommendations R1~~4/30/01~~ ***4/30/02***
- R1***New noise module implementation 12/31/02***

Subtask 5
- Feasibility recommendation R1~~4/30/01~~ ***4/30/02***

Subtask 6 R1~~12/31/01~~ ***12/31/02***
Subtask 7
- Implementation recommendation 8/31/01

Metrics:
Meets: Deliverables on time
Exceeds: Deliverables one month prior to due date

3. Government Furnished Items:

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

NASA will furnish required source code for subtasks 4 and 5

4. Other information needed for performance of task:
None.

5. Security clearance required for performance of work:

	Unclassified. Proprietary Data.
6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R1 ~~12/31/01~~ ***12/31/02***
7.	**NASA Technical Monitor:** Peter G. Coen M/S: 348 Phone: 757-864-5991 NASA Competency Coordinator: M.F. Verlander M/S: 327 Phone: 757-864-1944

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 07RBL Revision: 1 Date of Revision: 7/9/01

Title: Blended Wing Body – Low Speed Vehicle Specialized Technical Service

1.	**Purpose, Objective or Background of Work to be Performed:** [R2] ***Originally***, NASA LaRC [R1] ~~along with Dryden Flight Research Center (DFRC)~~ and industry partner Boeing, [R2]***had*** committed to develop a subsonic, remotely piloted, horizontal take-off and landing, [R1] jet-engine-powered vehicle called the Low Speed Vehicle (LSV). The vehicle is [R1] a composite material, 14.2 percent scale version of a transport-type Blended Wing Body (BWB) configuration [R1] concept aircraft. The [R1] BWB LSV [R2]***was to*** be designed, fabricated, and integrated at LaRC. DFRC [R1] [R2]***would ultimately have been*** responsible for the [R1] test flight operations. The purpose of this task is to acquire a third party review of the engineering design concepts, [R1] ***as well as associated engineering analysis and design support,*** for the airframe and mechanical integration of various systems [R1] ***and subsystems*** of the LSV. This task is a follow-on to Task GK23 begun under contract NAS1-96013, approximately April 7, 1999. The subject task duration is from January 2, 2001 [R1] ***through September 30, 2002.*** Revision 1: Updates and clarifies the background description and existing requirements, adds requirements for the Contractor to provide specific analysis/design items, extends the completion date, and identifies a new Technical Coordinator (see [R1] above and below). Revision 2: Alters the scope of the work required by the Contractor due to the changes NASA has made to the overall BWB research effort. The Contractor shall provide specific analysis/design of the Wing Proof Testing System (see [R2] above and below).
2.	**Description of the Work to be Performed:** The Contractor shall provide a third party independent review of the LaRC BWB-LSV engineering team's concepts for mechanical integration designs and analysis of the Low Speed Vehicle to [R1] ensure appropriate use of material technology, manufacturing processes, and engineering principles in reference to flight hardware, [R1] systems, and subsystems. **Begin [R1] block** The Contractor shall perform analyses and/or designs of airframe hardware. The analysis and design activity shall include the winglet[R2]***/wing*** attachment**,** , proof testing system, and generation of drawings of ***the Proof Wing Testing*** System components for fabrication purposes. Detailed requirements : 1. It is essential that airframe fabrication activities proceed without delays. 2. The generation of drawings shall adhere to the following standards and specifications: MIL-STD-100, DoD standard practice for engineering drawings, ASME Y14.100M, engineering drawing practices and MIL-T-31000, technical data packages. 3. Some analysis will be for composite structures and metal applications. 4. The engineering services provided shall be internally coordinated within the

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Title: Blended Wing Body – Low Speed Vehicle Specialized Technical Service

Contractor's own third party independent review function such that the Contractor is responsible for coordinating the priority, content, information exchange/assimilation, level of detail, and schedule of the assigned analysis, design, and drawing work associated with subsystems/components.

5. All activities shall be integrated within the overall Project requirements, including technical, schedule, and programmatic.

End R1 block

To ensure currency with all aspects of the review areas, it is anticipated that the Contractor will need to R1 have representation at the Technical Interchange Meetings (TIM) two days per week, as well as at system level peer and design reviews, the schedule of which are to be determined. In addition, the Contractor may be required to participate in periodic team status meetings, which will take place no more frequently than the normal TIM schedule.

Begin R1,R2 block

Deliverables and Schedule:

2.1 Design and analyze the following components for the composite airframe:

(1) The winglet/wing attachment, , completion date ***March 31, 2002.***

(2) A proof load testing system for the LSV ***Proof Test Wing,*** including ***a) Bending test components, b) Torsion(+) and (-) test components, c) Ground support system, and d) Backstop support system test components.*** required drawings for fabricating proof load testing hardware, completion date ***March 29,200 .***

~~(3) Upper and lower radomes, completion date February 28, 2002.~~

~~(4) Upper and lower antenna farms with ground planes, completion date February 28, 2002.~~

~~(5) Antenna electronics mounting within the antenna farm complex, completion date February 28, 2002.~~

~~(6) Line replaceable unit (LRU) mountings, completion date March 30, 2002.~~

~~(7) Landing gear mounting design and installation support, completion date March 30, 2002~~

~~(8) The environmental control system (ECS) ducting and flow control registers. Completion date April 30, 2002~~

(9) Fabrication liaison in support of Proof Wing and Proof Wing Test System, completion date June 28, 2002.

End R1, R2block

Note: For compatibility with standing LaRC processes, it is anticipated that all of the above work will involve ProE and Mechanica software use. Use of NASTRAN/PATRAN software will be beneficial as well.

2.2 Generate drawings of the LSV R2***Proof Wing Test*** components for use in the fabrication process utilizing existing Pro-E solid model designs, completion date February 28, 2002.

2.3 R1 Recurring Deliverables**:**

(1) Summary monthly report of all reviewed activities to include, as a minimum, the following:

Summary of the reviewed activities
Summary of R1 progress on assigned analysis and/or design work
Summary of all applicable results
Recommendations
Impacts to design and fabrication schedule and cost
A Preliminary Configuration Description Document

(2) R2 Bi-weekly review report. This report shall be provided by the end of R1 the week following the R1 bi-weekly reviews. This report shall include all recommendations, findings, and/or suggested changes to the design or analysis. The recommendations may be in the form of written specifications or conceptual drawings. The acceptance of recommendations is at the discretion of the LaRC Technical Project Engineer.

Begin R1 block

(3) Documented engineering analyses and design results of assigned subsystems/components, including R2***the proof testing system and winglet/wing attachment. .*** Delivery requirements and schedule shall be as coordinated with the LaRC Technical Project Engineer by the Contractor via their third party independent review activities.

(4) Engineering drawings and drawing revisions of assigned subsystems/components, including the winglet R2***attachment,*** proof testing system, , and fabrication components. Delivery requirements and schedule shall be as coordinated with the LaRC Technical Project Engineer by the Contractor via their third party independent review activities.

2.4 Performance Measurements (Standards):

Deliverable (1) shall meet project technical and system requirements R1 as set forth herein and in NASA-provided (section 4 below) project documentation and shall be

delivered within 5 working days after the end of the calendar month
Deliverable (2) shall be delivered within [R1] ~~two~~ five working days of the [R1] bi-weekly review meeting.
[R1] Deliverables (3) and (4) shall be delivered within the timeframe set forth by the individual work packages.

"Meets" would be if the required document dates and contents are met, [R1] and if no major revisions are required to final reports, documents, or drawings.

"Exceeds" would be if the required document dates and contents are met [R1] or bettered, and: if recommendations are made and at least 75% of them are implemented [R1] with no modifications required; or if recommendations are made and at least 90% of the recommendations are accepted with only minor modifications [R1] and no major revisions are required for any final report, document, or drawing, and at least 90 percent of them require no revisions.

3. **Government Furnished Items:** The Contractor will have access to existing databases, and, [R1] as available, to applicable software programs which may be required during the performance of this task, as well as [R1] existing data, analyses and drawings related to the task work, and office space in [R1] ~~room 137C of~~ Building 1209 [R1] and/or other on-site office space .

4. **Other information needed for performance of task:**

Documents that apply:

Blended Wing Body-LSV Project Requirements Documents-0104 Series
Vehicle Configuration Requirements Document-0101-3 Draft
Project Plan-0100-1 Rev C Draft
Research Goals & Objectives-0101-2 Rev B Approved

5. **Security clearance required for performance of work:** None; however, the Contractor employees [R1] will be required to sign a Boeing Standard Non-Disclosure Agreement, along with any Contract-applicable Conflict of Interest Avoidance Plan certification.

6. **Period of Performance:**

Planned start date: January 2, 2001 Expected Completion date: [R1] ~~June 30, 2002~~ September 30, 2002

7.	**NASA Technical Monitor:** William M. Langford M/S: 432 Phone: 757-864-7144 **NASA Competency/Other Technical Coordinator:** R1 Kurt Detweiler M/S: 246 Phone: 757-864-2566

	Task Order Number: 07RCG Revision: 11 Date of Revision: 03/09/2005 Title: Structural Dynamics Analysis and Testing

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

The Structural Dynamics Branch (SDB) conducts research and technology development to quantify and control impact dynamics, ground operations, and structural dynamics of aerospace systems. SDB: *confirms* validity of approaches by conducting tests on full-scale structures, structural elements and scaled structural models; *conducts* research to advance the technology for improving the safety and handling performance of aircraft during all-weather ground operations, including takeoff, landing impact, and ground handling phenomena; *develops* fundamental understanding of crash behavior and crash-mitigating design; *develops and validates* predictive tools for crash dynamics; *conceives and confirms* new dynamic test techniques; *operates* the Structural Dynamics Research Facility, the Impact Dynamics Research Facility (IDRF), and the Aircraft Landing Dynamics Facility. In particular, the IDRF is used to conduct dynamic testing of full-scale aircraft and space structures. IDRF studies the response of the aircraft/space structures under crash loads so that better energy absorbing systems and better energy management systems can be incorporated into future structures. The IDRF uses Finite Element Modeling (FEM) and sub-scale and sub-component testing to support the design efforts. Programs that the IDRF support are The Aviation Safety Program (AvSP) and Mars Exploration Rover (MER).. The Contractor [U1] will be required to develop FEM and perform analyses to support crashworthiness tests and/or analytical studies for structures such as the Fokker 28 aircraft or other AvSP specific projects.

Update 1: Adds NOR feature and other wording changes for requirement clarification, adds an omitted travel/conference requirement to agree with January 2, 2001 approved Task Plan, and revises GFI for contract compliance (see [U1] above and below).
Revision 1: Closes Subtask 1 and extends Subtasks 2 and 3 to continue work on the commuter aircraft analysis and modeling and the foam testing.
Revision 2: Extends the period of performance six months and updates requirements for Subtasks 2 and 3 to continue work on the commuter aircraft analysis and modeling and to complete the development of the foam testing apparatus (see [R2] below).
Revision 3: Adds new requirements as Subtask 4(see [R3] below).
Revision 4: Modifies Subtask 2 to extend the completion date to September 30, 2003 to allow time to incorporate additional model modifications developed by Fokker. Subtask 4 is modified as follows: 1) Extends delivery date for meshed model due to delays in receiving data from FAA and computer network problems. 2) Adds requirements to include masses in FE model and to conduct pretest impact analyses and convert the finite element model to LS-DYNA format. The overall task order period of performance is extended to September 30, 2003. (see [R4] below).
Change 1: Extends Subtask 2 schedule and overall period of performance to 11/15/03 to complete NASA documentation edit/review process (see [R4.1] below).

Revision 5: Adds new requirements as Subtask 5, extends the period of performance to October 31, 2004, annotates Subtasks 3 and 4 as completed, and changes the Technical Monitor (see [R5] below).
Revision 6: Modifies requirements in Subtask 5 to reflect new analysis schedule, shortens the period of performance to June 30, 2004, and annotates Subtask 2 as completed. (see [R6] below).

Revision 7: Updates requirements in Subtask 5 to reflect new analysis schedule and extends the period of performance three months to September 30, 2004 (see R7 below).
Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as doc files 07RCG, 07RCGu1, 07RCG01, 07RCG02, 07RCG03,07RCG04, 07RCG05 and 07RCG06.
Revision 8: Extends the schedule and period of performance three months to December 31, 2004 (see R8 below).
Revision 9: Adds requirements as new Subtask 6 and extends the period of performance three months to March 30, 2005 (see R9 below).
Revision 10: Adds requirements to Subtask 5, extends the period of performance for Subtask 5 to March 31, 2005, and resets the task order completion date accordingly (see R10 below).
Revision 11: Adds requirements to Subtask 5, extends the period of performance for Subtasks 5 and 6 to September 30, 2005, and resets the task order completion date accordingly (see R11 below).

2. **Description of the Work to be Performed**:
Begin U1 block
Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)
End U1 block

Overall Requirement: The Contractor shall provide technical progress reporting and U1 financial reports at the individual subtask level in the monthly reports to the Task Technical Monitor. U1 The financial reporting at the subtask level will be used only for cost sharing and/or accrual determination within the user organization.

The Contractor shall perform the following subtasks:

Subtask 1. (Completed)

Begin R2 block requirements update
Subtask 2. R6 (Completed)

Subtask 3. R5 (Completed)
End R2 block requirements update

Begin R3 block addition
Subtask 4. R5(Completed)
End R3 block addition

**Begin R5 block requirements addition **
Subtask 5. Analysis of Space Shuttle Wing Leading Edge Impact Scenarios. The CAIB ruled that foam debris from the external tank impacting the Reinforced Carbon-Carbon RCC wing leading edge caused the Columbia disaster. One of the major space shuttle return-to-flight (RTF) activities is to determine the damage threshold to the wing leading edge RCC panels. The RCC material is a complex layered composite material and fails similarly to Ceramic Composite Materials. The impact velocities of the debris range from 700 ft/s to over 1000 ft/s. The teams working impact scenarios are located at LaRC, GRC, and at Boeing. This work is sponsored by NASA JSC and is highly schedule driven.

1) The Contractor shall create, run, analyze, post-process and validate multiple LS-Dyna dynamic finite element models to predict the threshold of impact damage to the Shuttle wing leading-edge from various debris including foam, ice, and ablator material. Models may require updating or refinement such as re-meshing using MSC-Patran with the LS-Dyna preference. Most post-processing will be done with LS-Post. Use of EnSight to make enhanced animations will be needed for some cases.

2) The models shall be validated for different debris material, material geometries, impact velocities, impact trajectories, locations on the RCC panels, and for a number of different RCC panels. In addition, subcomponent models shall be created to compare with impact test data of RCC panels, test coupons, etc.

3) The Contractor shall coordinate with test engineers and use test data from impacts onto foam and onto RCC to determine and/or modify the inputs for material models in LS-Dyna. Models include complex failure mechanisms and strain-rate effects.

4) Models shall be created using the MSC.Patran pre-processor using both explicit and implicit formulations of LS-Dyna. For example, the implicit version of LS-Dyna will need to be run to apply flight loads before impact (pre-stressing).

**Begin R10 block requirements addition **
5) The Contractor shall investigate boundary conditions for flat plate RCC panels including modeling of rod supports.

6) The Contractor shall complete the SwRI Panel 8 LS-DYNA model.
**End R10 block requirements addition **

*****Begin R11 block requirements addition *****
7) The Contractor shall model using LS-DYNA ice and other debris impacts onto RCC full

scale panels and impacts onto smaller test RCC panels. Models shall be correlated with test data.
****End R11 block requirements addition *****

Deliverables: (1) Monthly progress reports
(2) Reports summarizing each LS-Dyna analysis with digital charts, graphs, animations, and jpeg pictures from LS-Post or other post-processing software such as Patran, EnSight, Excel, MatLab, and Kaleidagraph.

Schedule:

**Begin R6 block requirements update **
Review LS-Dyna, Post,& RTF models
12/31/2003

Help set up Documentation and Quality Control for Production Runs
1/26/2004
**Begin R7 block requirements update **
Support LS-Dyna Damage Threshold Studies
1/27/2004
**Begin R10 block requirements update **
LS-Dyna Damage Threshold Studies Complete
R10 R8 ~~9/30/2004~~ ~~12/31/04~~ 3/31/2005

Document RTF work
R10 R8 ~~9/30/2004~~ ~~12/31/04~~ 3/31/2005

Complete SwRI Panel 8 LS-DYNA Model
R10 12/31/2004
**End R10 block requirements update **
**End R7 block requirements update **
**End R6 block requirements update **

****Begin R11 block requirements update *****
Test/Analysis correlation for ice and other debris impacts 09/30/2005
****End R11 block requirements update *****

Performance Measurements:

Minimum Performance
Work completed accurately and on time

Exceeding Minimum Performance
Work completed ahead of schedule, or suggestions by Contractor to make model development and/or analysis easier, more accurate, or more efficient.
**End R5 block requirements addition **

Begin R9 block addition
Subtask 6. Revision of ATR42 Patran Model for Impact Simulation.
Technical Monitor: Karen E. Jackson M/S 495 Phone: 757-864-4147
The ATR42 is a high-wing, twin turbo-prop, commuter-category aircraft. The FAA performed a vertical drop test of this aircraft in July 2003. A finite element model of the airframe was developed and transient dynamic simulations were executed to generate predictions of structural response. This task involves revising and upgrading the existing model of the aircraft to improve its accuracy, fidelity, and efficiency. The following subcomponents are included:

1.) The existing model contains a large number of nodal discontinuities, which cause problems with the contact algorithms in the model. As a result, the model cannot be executed on the multiple-parallel processing version of LS-Dyna and instead must be executed on the single-processor version of the code, thus requiring as much as 3 to 4 times the CPU to execute a single run. These nodal discontinuities also cause errors in the model results. The Contractor shall remove the nodal discontinuities, thereby providing a more robust and accurate model.
2.) The existing mesh is fairly crude, especially in regions of high stress, e.g. the heavy fuselage frames at FS 25 and FS27 that support the high wing. The original coarse mesh in the model was dictated by the geometry that was supplied by the FAA. The Contractor shall refine the mesh, especially for the two fuselage frames mentioned.
3.) In addition to remeshing the model in general, the Contractor shall remesh and copy the two fuselage frames at FS25 and FS27 separately into a Patran database, and execute a NASTRAN model to evaluate failure behavior under quasi-static loading applied through the brackets. This work shall include development of detailed models of the support brackets.

Deliverables: The Patran database of the remeshed and corrected ATR42 finite element model. A Patran database containing only the remeshed fuselage frames at FS25 and FS27 with supporting brackets and results from Nastran simulations to determine the load at failure of the frame/bracket assembly when loaded quasi-statically through the brackets.

Schedule:
Planned start date - September 1, 2004 Completion date - R11 ~~March 30, 2005~~ ***September 30, 2005***

- Removal of nodal discontinuities by R11 ~~December 30, 2004~~ ***April 30, 2005***
- Model remeshing by R11 ~~March 30, 2005~~ ***September 30, 2005***
- Nastran analysis of fuselage frames by December 30, 2004

Performance Measurements:

	Minimum Performance Work completed accurately and on time. **Extended Minimum Performance** Work completed ahead of schedule, or suggestions by contractor to make model development easier, more accurate, or more efficient. **End R9 block addition**
3.	**<u>Government Furnished Items</u>**: Test specimens Test specimen instrumentation U1 Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/DYTRAN, R6 LS-Dyna, LS-Post, etc. Computer CPU time for structural modeling and analyses Office space *****Begin R9 block addition***** Subtask 6 Existing Patran database of ATR42 model Example output file (d3hsp) from LS-Dyna simulation that lists nodal discontinuities Advise on model remeshing efforts and Nastran analysis study Access of a piece of the fuselage frame at FS25 and FS27 for modeling details Access to NASA specialized structural analysis software including MSC.Patran, MSC.Nastran, and LS-Dyna. *****End R9 block addition*****
4.	**<u>Other information needed for performance of task</u>**: 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, <u>comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance. U1 Dissemination of significant results through an international forum along with associated travel may be required as appropriate.
5.	**<u>Security clearance required for performance of work</u>**: *None*
6.	**<u>Period of Performance</u>**: Planned start date:01/01/2001 Completion date: R2 ~~12/31/2002~~ R4 ~~6/30/2003~~ R2.1 ~~9/30/2003~~ R5 ~~November 15, 2003~~ R6 ~~October 31, 2004~~ R7 ~~June 30, 2004~~ R8 ~~September 30, 2004~~ R9 ~~December 31, 2004~~ R10 ~~March 30, 2005~~

	R11 ~~March 31, 2005~~ ***September 30, 2005***
7.	**NASA Technical Monitor** R5 Ed Fasanella M/S 495 Phone: 757-864-4345 **NASA Competency/Other Technical Coordinator** S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 07RDE Revision: 6 Date of Revision: 11/17/04

Title: **ATC/NAS Operations Research Support**

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

The [R6]***Crew Systems and Operations Branch (CSOB)*** of Langley Research Center (LaRC) is engaged in research activities that involve aircraft operations in the National Airspace System (NAS) as well as flight deck and flight display design. These activities require expert operations input into simulation development and simulation support in the form of realistic representations of the air traffic system and other air traffic in the experimental airspace [R4]and occasionally include day to day flight planning and coordination with the air traffic control [R4](ATC) system. For validity, that research requires the realism of high fidelity simulation hardware and the support of personnel who have extensive experience in aircraft operations from an ATC perspective combined with an understanding of air traffic flow management. The research requirement also involves providing expert advice in the design of experimental facilities and procedures, as well as assistance in planning and coordinating flight deployments.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, changes the title, and redefines the requirements for the new period of performance.

Revision 2: Adds requirements (Subtask 5 and metrics/standards), clarifications, and a technical coordinator for OLEO.

Change 1: Re-designates Task 5 as Subtask 5 and adds its previously omitted planned completion date.

Revision 3: Extends Subtask 5 completion date 3 months and adds deliverables 4 and 5.

Revision 4: Deletes OELO technical coordinator and some associated requirements and extends the period of performance one year in continuation of NASA's support with updated requirements. (For Revision 4 see [R4] above and below. For complete details of original, Revision 1, Revision 2, Change 1, and Revision 3 SOWs see ETOS *doc* files *07RDE, 07RDE01, 07RDE02, 07RDE021, and 07RDE03*, respectively.)

Revision 5: Extends the period of performance one year in continuation of NASA's support with updated travel requirements and other info for the new period of performance (see [R5] above and below).

Revision 6: Extends the period of performance one year to December31, 2005, in continuation of NASA's support with updated requirements and other info (see [R6] above and below).

2. Description of the Work to be Performed:

The Contractor shall provide support for these areas: simulation and laboratory development and operation, scenario development and flight deployment planning and coordination**,** [R2]current and future ATC/NAS operations.

Begin [R1] block – requirements redefinition

The Contractor shall perform the following subtasks:

Subtask 1: ATC simulation facility development and maintenance - The Contractor shall provide inputs to the development of simulation facilities and creation of a realistic ATC communications and procedural environment for the conduct of real-time piloted-cockpit simulation studies and flight test/demonstrations. The development of simulation facilities shall include designing and implementing communications systems, display and video map development; participation in simulation check-out and real-time simulations.

Subtask 2: Provision of realistic [R2]ATC/NAS environment – The Contractor shall provide realistic [R2]ATC/NAS environment for piloted simulation activities that include [R2]air traffic flow management, [R6]***and representation of*** ATC towers, terminal radar facilities, en route centers, state-of-the-art consolidated facilities and oceanic operations. Accepted ATC procedures shall be applied using standard controller/pilot phraseology and jargon. A cursory understanding of flight characteristics of the various aircraft involved in the operations will be needed.

Subtask 3: Flight operations review - Reports for specific research simulation and flight test projects shall be provided to ensure ATC considerations are adequately reflected in the plan of test. The overall goal of this task is to ensure that research conducted is appropriately designed and executed to ensure that the value of the resulting data is maximized with respect to realistic current, and foreseeable future, ATC operations. ATC operations review reports shall included appropriate scenarios. Scenarios shall either be modified from existing scenarios provided by the researchers, or completely new scenarios based on research requirements.

Subtask 4: Investigation of NAS/ATC state and procedures - Reports shall be submitted in response to requests for investigation of current or future NAS/ATC state or procedures. The Contractor shall gather facts/figures as needed in order to frame the research as well as provide a realistic environment for simulations.

End [R1] block – requirements redefinition

Begin [R2] block requirements addition

[C1]**Subtask 5: Flight Operations ATC Support** – Provide planning and coordination for research flights from an air traffic controller perspective to include all research programs using LaRC's research aircraft and other aircraft to support LaRC research activities. Provide training, operational, and technical support to programs and to OELO to facilitate integration of projects with Federal Regulations procedures, National Airspace System (NAS), ATC and pilot/cockpit crew procedures, other R&D projects, and technologies/systems as required.

End [R2] block requirements addition

Metrics: [R2]*Simulation.* Minimum acceptable performance shall be based on availability and realism of controller performance and the degree to which the task is successfully completed as documented in informal reports. [R1]In addition, minimum acceptable performance will include timeliness and completeness of ATC operation reports. [R2] *Flight activities***.** Minimum acceptable performance shall be based on documentation which indicates that the necessary planning and coordination has been affected to facilitate research flight activities.

Meets Standards: [R2]*Simulation.* Maximum acceptable number of either check-out or data production simulation runs canceled, because of Contractor supplied controller/pseudo-pilot non-availability, shall be no more than 3 % of a study's real-time sessions. In addition 90 % of simulation flight crews shall rate the ATC support realism as at least adequate (3) on a post experiment questionnaire with a five point rating scale. The possible ratings of ATC realism shall be: 1 - seriously deficient, 2 - somewhat deficient, 3 - adequate, 4 - more than adequate, 5 - highly realistic. [R1]In addition, [R2]~~ATC documents shall be delivered on time, and~~ ATC operations reports shall be received within 2 weeks of established delivery dates. [R2]*Flight activities.* No delays or cancellations of research flights are attributable to inadequate planning or coordination on the part of individuals providing those services under this task.

Exceeds Standards: [R2]*Simulation.* Greater percentage of availability and higher realism ratings will be used to assess the level of performance exceeding the acceptable level. [R1]ATC operations document delivered 2 weeks ahead of schedule. [R2]*Flight activities.* Value added to the research flights through the negotiation of maximum latitude for flight activities in operational airspace. Evaluation from principal investigator for applicable research project results in an "exceeds requirements" that is accompanied by adequate justification based on exceptional contributions to planning and flight coordination.

Deliverables: The availability and participation of Contractor supplied controllers in specified real-time-piloted simulation studies check-out, all data-gathering production runs, experimental design requirements, and flight activities when required. Informal documentation of experiment planning, conduction, and evaluation. [R1]Formal operations documents providing ATC operations information to optimize anticipated research results. ATC operations documents shall include proposed maneuvers and scenarios to optimize the relevance of research results to current aircraft operations and conceptualized future aircraft operations. [R4]Documentation is due within one month following completion of specified activity.

3. **Government Furnished Items:**

The controller display interfaces and communication interfaces available in the LaRC Mission Oriented Terminal Area Simulator (MOTAS) facility, the Free Flight Simulation, [R1]General Aviation Work-Station (GAWS), NASA [R4]aircraft, or similar facilities. Access to computers

Task Order Number: 07RDE Revision: 6 Date of Revision: 11/17/04

Title: **ATC/NAS Operations Research Support**

	loaded with specialized software, and lab or office space required to complete the tasks.
4.	**Other information needed for performance of task:** It is anticipated that the task will run to the completion date indicated below. Personnel will, on occasion, be required to work R2irregular hours (i.e., 17:00 to 24:00), although the normal expected hours will be between 8:00 to 17:00. Travel: The Contractor will be required to perform several trips during the period of performance as listed below. All trips are single person trips with durations indicated. ~~1. Juneau Alaska - support Capstone-2 (1 week)~~ ~~2. Roanoke Va. region – support SVS-GA (R4 1 2-day trip)~~ ~~3. R4Domestic US – Additional trip envisioned – location TBD~~ 4. R6R5~~EAA (Experimental Aircraft Association) Air Venture (Oshkosh, WI), 1 week, July 2004.~~ *****Begin R6 block update***** 5. SV Roanoke Flight Demonstration: Roanoke, VA, three weeks (21 days), April, 2005. Transportation shall be provided by NASA. 6. Oshkosh Air Show: Oshkosh, WI, One week (seven days), June 2005. *****Begin R6 block update *****
5.	**Security clearance required for performance of work:** All work will be unclassified however personnel will be required to obtain an ADP clearance for access to the MOTAS lab.
6.	**Period of Performance:** Planned start date: R1~~January 2, 2001~~ Completion date: R1~~December 31, 2001~~ R4~~January 1, 2002~~ R4~~December 31,2002~~ R5~~January 1, 2003~~ R5~~December 31, 2003~~ R6~~January 1, 2004~~ R6~~December 31, 2004~~ ***January 1, 2005*** ***December 31, 2005***
7.	**NASA Technical Monitor:** Gary Lohr M/S: 152 Phone: 757-864-2020

Task Order Number: 07RFM Revision: 3 Date of Revision: 8/30/2004

Title: CERES Flight Operations

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

The NASA LaRC CERES project team, with extensive SAMS contractor support, successfully developed and commissioned five CERES instruments on three NASA spacecraft. The first CERES instrument, the proto-flight model, was operated on the NASA TRMM spacecraft until September 1998. The CERES Flight Model 1 (FM1) and Flight Model 2 (FM2) instruments were successfully launched December 18, 1999 on the NASA Terra spacecraft. The CERES Flight Model 3 (FM3) and Flight Model 4 (FM4) instruments were successfully launched May 4, 2002 on the NASA Aqua spacecraft. These instruments have successfully completed the on-orbit-commissioning phase and are performing routine scientific measurements.

CERES instrument operations are performed by a SAMS contractor team located at the NASA Langley Research Center (LaRC) in conjunction with spacecraft control centers for Terra and Aqua at the NASA Goddard Space Flight Center. SAMS support of CERES operations is anticipated for the life of the mission currently scheduled through 2008.

Change 1: Notes increase in travel and support required as indicated in Contractor's June 4, 2001 plan and clarifies GFI for overall contract compliance.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements.

> For details of original, Change 1, and Revision 1 SOWs see ETOS *doc* files *07RFM,* ***Error! Reference source not found.***~~*07RFM*~~*001,* and ***Error! Reference source not found.***~~*07RFM*~~*01*, respectively.

Revision 2: Extends the period of performance through December 31, 2005 (SAMS contract completion date) in continuation of NASA's support with extensively redefined requirements and a newly appointed NASA Technical Monitor (see R2 below).

Revision 3: Requires re-planning for off-site performance beginning October 1, 2004 (see R3 below).

2. Description of the Work to be Performed:

*****Begin R3 Constraint*****

Beginning October 1, 2004 all Contractor work shall be off-site performance.

*****End R3 Constraint*****

The Contractor shall perform CERES instrument flight operations for duration of the EOS-Terra mission and the EOS-Aqua mission. CERES Flight operations shall be coordinated with the CERES Flight Operations Manager. CERES flight operations tasks include, but are not limited, to the following:

- Monitor CERES health and status and take appropriate actions to maintain instrument health.

- Develop, verify, and maintain Mission Management System (MMS) Activities, Baseline Activity Profiles (BAP), Command and Activity Constraints, Memory Load files, Stored Command Sequences (SCS), and Relative Time Sequences (RTS).
- Coordinate the generation and implementation of MMS One Day Schedules (ODS) and Short Term Schedules (STS) generated by the Science Scanning Team for special operations.
- Develop, verify, and validate routine stored command loads. This shall include planning and scheduling daily instrument operations via the MMS and verifying the resulting Absolute Time Command (ATC) and Master Load Command (MCL) reports when required before upload to the spacecraft.
- Develop inputs needed to facilitate any required changes to instrument operations databases.
- Develop and monitor execution of real-time commands using Government furnished Instrument Support Terminals.
- Maintain and periodically publish CERES Terra and CERES Aqua as-flown timelines noting significant instrument or spacecraft activities.
- Develop unique scan profiles and/or stored command loads to support targeted validation campaigns such as 'Crystal Face' and instrument characterization.
- Support the development, testing, and implementation of CERES flight software and operational table modifications.
- Support the analysis of trend and performance data during monthly data reviews
- Support and perform ad hoc investigations into trend, performance, and calibration issues as required.
- Coordinate maintenance of the CERES Instrument Support Terminals.
- Document instrument operations activities such as operations modes, software modifications, analysis results, et cetera by technical memorandum.

Schedule timetable:
The Contractor shall perform CERES operations as described subject to CERES project schedule.

Deliverables:

a. CERES Terra and CERES Aqua stored command loads.

b. As-flown timelines for CERES Terra and CERES Aqua instruments.

c. Monthly summary of task activities. The report shall include the instrument's history, operations plans, and a summary of the task activities including, if applicable, anomaly

Task Order Number: 07RFM Revision: 3 Date of Revision: 8/30/2004

Title: CERES Flight Operations

reports.

d. Technical memorandum as required.

Metrics:

a. Satisfactory effort:
- On-orbit operations occur as planned
- Instrument health monitored and maintained according to procedures.
- On-time delivery of monthly report and as-flown timelines

b. Exceeds effort:
- Development of specialized campaign / characterization command loads
- Technical Memorandum describing aspects of CERES operations, trends analysis, performance analysis, or related subject.
- Improvements and/or suggestions that improve the scientific return of the experiment.

3. **Government Furnished Items:**

Access to Instrument Support Terminals, internal project WWW sites, and CERES Project documentation shall be provided.

4. **Other information needed for performance of task**:

Travel:

As many as two, separate, 7-day trips per month to NASA GSFC may be required.

5. **Security clearance required for performance of work**: None.

6. **Period of Performance**:

Planned start date:	[R1] ~~1/1/2001~~	Completion date:	[R1] ~~12/31/2001~~
	[R2] ~~1/1/2002~~		[R2] ~~12/31/2002~~
	[R3] ~~1/1/2003~~		~~12/31/2005~~
Off-site Performance: October 1, 2004			***December 31, 2005***

7. **NASA Technical Monitor**: Michael S. Cisewski.

M/S: 420 Phone: 757-864-1861

Task Order Number: 08RAA Revision: 12 Date of Revision: 04/05/05

Title: Advanced Space Transportation Systems Aerodynamics and Aeroheating Analysis

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

The NASA Langley Research Center - Vehicle Analysis Branch (VAB) develops and applies computer-aided tools in the systems analysis of advanced space transportation and planetary entry system concepts. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, and operations. Contract support is needed, primarily:

(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems, and

(b) to perform analyses in selected disciplinary areas

and may include the review of technical papers within the scope of work (i.e. discipline area) of this task order.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems. Currently, the primary computational platforms are Silicon Graphics (SGI) workstations, Apple Macintosh, and IBM PC or clones also host a few engineering codes critical to the systems analysis work. Security clearances (Secret rating) may be needed in some instances. Specific requirements, deliverables with dates, metrics, and furnished materials are described below. Informal results delivered within this task may be developed into more formal end product(s) and used as appropriate for conference papers and journal articles.

Note: Some of the required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Adds NOR note and designations; rewrites Subtask 3.0 requirements; revises GFI for contract compliance; deletes Subtask 4.0.
Revision 2: Respecifies Subtask 1.2 programming support tasks; rewrites Subtask 3.0

requirements; documents Technical Monitor change; extends period of performance. (Note: Major deletions have been left in as strike-through text for reference.)

Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements within "3.0 Planetary Entry Aerodynamic/Aeroheating" for new period of performance and changes in Program requirements.

Revision 4: Adjusts the 3.1a deliverables schedule to have data available in time to complete several reviewed publications for workshop sessions coming up in August.

Revision 5: Extends the period of performance one year in continuation of NASA's support with no changes in Subtasks 1 and 2 detailed requirements and Subtask 3 requirements redefined for the new period of performance.

Revision 6: Formal conference paper and technical review requirements explicitly stated.

Revision 7: Adds new requirements as Subtask 4.

[R8]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 08RAA, 08RAA01a, and 08RAA02 through 08RAA07.

Revision 8 extends the period of performance from Dec 31, 2003 to October 31, 2004. The requirements for all work elements have been redefined for the new period of performance. In addition, specifically, work element 1.2 has been modified to include programming support with integrated tool environments such as the Adaptive Modeling Language (AML).

(See [R8] above and below.)

Revision 9: Updates Subtasks 3.0 and 4.0 deliverables schedule (see [R9] below).

Revision 10: Extends the period of performance two months to Dec 31, 2004 with new requirements (4.0h), some schedule changes, and new technical monitor (see [R10] below).

Revision 11: Adds Deliverables 3.2e and 4.0i, updates the 4.0 delivery schedule, and extends the period of performance six months to July 1, 2005 (see [R11] below).

Revision 12: Extends the period of performance five months to 12/31/105 in continuation of NASA's support with some new requirements and updates other info (see [R12] below).

2. **Description of the Work to be Performed:**

1.0 Maintenance of Aerodynamics and Aeroheating Analysis Tools

The Contractor shall:

1.1 Maintain and ensure proper performance of the aero family of analysis tools (MINIVER, INCHES, APAS and AVSL) and their support utilities collectively known as the "aero tools." The Contractor shall fix software bugs and problems resulting from modeling errors, programming techniques, or operating system changes. All software deliverables will be consistent with the current programming language for the affected subroutine and/ or program, unless a waiver is granted. The Contractor shall produce sample case outputs and demonstrate that the enhanced code is consistent with previous results. On average, three bug fixes per month and two operating system changes per year are expected.

1.2 (NOR) Provide programming support for aero/ flyability studies including the development of general purpose and specific computer subroutines of aerodynamics, aeroheating, and thermal protection system models. R8General purpose programming support shall also include development using the Adaptive Modeling Language (AML) licensed within VAB via TechnoSoft, Inc. Programming support tasks can be described as simple (model less than 50 lines of executable FORTRAN code), moderate (model between 50 and 500 lines of executable FORTRAN code), or complex (model over 500 lines of executable FORTRAN code). On average, eight simple, three moderate, and one complex tasks per year are expected. The Contractor shall provide documentation of the software formulation, inputs/ outputs, and test cases, and shall produce a user's guide for the above mentioned subroutine models.

1.3 The Contractor shall track these changes using configuration management software (e.g., RCS), transition the software to VAB analysts after its completion, and provide user familiarization during this transition.

Deliverables

1.1 Fully functioning aero tools which are free of known programming errors. (within 1 week of an identified software bug, within 1 week for a simple model (less than 50 lines of executable FORTRAN code), within 2 weeks for a moderate model (between 50 and 500 lines of executable FORTRAN code), 1 month for a complex model (over 500 lines of executable FORTRAN code), and within 1 month of a new operating system/ upgrade installation)

1.2 Instruction on use of the new models. For a simple model within 2 days, for a moderate model within 2 weeks, and for a complex model within 1 month.

1.3 Documentation of specific changes and associated modifications within the configuration management tools.

Metric

1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.
2. Ability to make any previous version of aero code available within one day of such a request.
3. Usability of the interfaces and enhanced tools as measured by the ability of the VAB analysts to operate the tools easily without assistance.

2.0 Aero Tool Transfer to Customers

The Contractor shall:

2.1 (NOR) Provide for the transfer of aero tools and documentation to customers upon request and shall respond to customer inquiries concerning installation and operation of the tools on the customer's computer.

2.2 Maintain a current list of customer contact points to whom tools have been transferred and provide a quarterly update to current users appraising them of the current version of the aero tools and any significant changes in these tools.

2.3 Provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically, such requests are received once every two weeks.

Deliverables

1. Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. (monthly)

2. Delivery of software and documentation to customers. (on request)

3. Updates to current users. (quarterly)

Metric Effectiveness of transfers measured by use of transfer method acceptable to customer and by successful customer reproduction of output from sample cases which have been run on VAB computers. Timeliness of transfers measured by documentation being sent out within 2 days of receiving the request and completion of the transfer of the aero tools within one week, unless otherwise specified.

3.0 Planetary Entry Aerodynamic/Aeroheating

The Contractor shall:

3.1 Complete aerothermodynamic analyses of the 2005 Mars Reconnaissance Orbiter, including DSMC analyses.

(a) Develop [R8]~~initial~~ 2005 Mars Reconnaissance Orbiter aerodynamics databases. These databases will support 3 DOF simulations at LaRC and other. This database covers the free molecular, transitional, and continuum hypersonic flow regimes.

(b) Develop and implement the methodology to validate the2005 MRO aerodynamic database
(c) Support trade studies.
(d) Support telecons, reviews.
(e) Support Planetary team meetings (currently every other Wednesday 10:00-11:00am B1232/R258).

3.2 Develop the aero/aerothermodynamicanalyses and databases for other planetary exploration mission studies, R8~~including Titan and Neptune aerocapture missions,~~ and aerocapture flight experiment missions.

Begin R8block redefinition

(a) The Contractor shall perform aeroheating analysis for aerocapture systems analysis studies.
(b) The Contractor shall perform aero/RCS interaction analysis for Mars Science Laboratory (MSL).
(c) The Contractor shall perform aerothermodynamic analyses for MSL.

End R8block redefinition

(d) Support telecons and reviews, including the weekly Aerocapture Systems Analysis telecons, currently Thursday 1:30-2:30, B1232/R120f.
(e) R11Provide aerothermodynamic analysis and aerodatabase for Huygens
(f) R12 Provide aerothermodynamic analysis and support for Moonrise project

Begin R8block redefinition

Deliverables

3.1MRO 2005 aerothermodynamics analyses, database based upon new geometric models provided via GFI January 2004. (R9~~30MAR04~~ 31May04)
3.2a Complete initial aeroheating analysis for aerocapture systems analysis study. (31May04)
3.2a Complete final aeroheating analysis for aerocapture systems analysis study. (30Sep04)
3.2b Complete initial aero/RCS interaction analyses for MSL. (R9~~31Mar04~~ R10~~5/32/04~~ 12/31/04)
3.2c Complete preliminary aerothermodynamic analyses for MSL (R10~~30Sep04~~ 12/31/04)

Begin R11 block addition

3.2e Complete initial aerothermodynamic analysis and aerodatabase for Huygens (11/30/04)
3.2e Complete updated aerothermodynamic analysis and aerodatabase for Huygens (12/24/04)
3.2e Complete analysis to support reconstruction (07/01/05)

End R11 block addition

R12 3.2f Update the Moonrise database and prepare presentation material for aero Moonrise database (12/31/05)

End R8block redefinition

Metrics

Accuracy of validation.
Accuracy of results.
Completeness of solution sets.
Completeness of documentation.

3.1-3.2 Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.

4.0 Operations and Lifecycle Costing

The Contractor shall:

a.) Complete the benchmarking of RMAT 2004, version 5.0.
b.) Aid in evaluation of the Proration equation set used in RMAT 2004.
c.) Document a process for running the RMAT model that addresses the sequence of option selections for modeling the different type of analysis that can be performed.
d.) Support the development and evaluation of new logistics equations for use in the RMAT/ Logistics Cost Model.
e.) Support a re-evaluation of SLI reference concepts using the updated RMAT analysis process.
f.) Use the newest version of RMAT to develop a matrix of results for a series of concepts consistent with earlier studies.
g.) [R8]Use the newest version of RMAT to assess the effects of reliability growth of selected subsystems on manpower and turnaround time requirements.
h.) [R10]Support for Code T New Initiative Taskers
i.) [R11]Support the Logistics Cost Model (LCM) development through consultation and analytics.

Begin [R8]block schedule update

Deliverables

4.0a -d [R9]~~Benchmark and~~ Proration evaluation documentation.	[R9]~~31Jan04~~ 30Apr04
New analysis process documentation	15Dec03
Logistics Cost equation documentation.	[R11]~~30Sep04~~ 07/01/05
4.0 e-g SLI concepts re-evaluation document.	[R11]~~30Jun04~~ By Request
Matrix results documentation.	[R9]~~31Mar04~~ [R11]~~15May04~~ 07/01/05
Reliability growth documentation	[R9]~~28Feb04~~ 15Jul04
4.0 h [R10] Documentation	[R11]~~31Dec04~~ By Request

End[R8]block schedule update

4.0i [R11]Status report indicating the progression of the Logistics Cost Model development and recommendations — By Request

	on further enhancements Metrics Accuracy and completeness.
3.	**Government Furnished Items:** 1) Access to workstations/computers loaded with specialized task-specific software. 2) Access to codes MINIVER, APAS, I-DEAS, INCHES, SMART, TECPLOT, LaTex, VGM. 3) Configuration geometry for each assessment vehicle, and CAD geometry formats for automated geometry inputs 4) MINIVER, PVWAVE, and windows development tools within VAB. *5)* R8Access to Adaptive Modeling Langluage (AML).
4.	**Other information needed for performance of task:** The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the Contractor may: (a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or (b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product. 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. The Contractor is expected to participate and present papers at technical conferences to support the distribution of results to the technical community as determined by NASA to be technically merited on a case-by-case basis.
5.	**Security clearance required for performance of work:** Security clearances (Secret rating) may be needed in some instances (TBD).
6.	**Period of Performance:** Planned start date: R801/01/04 Completion date: R10R8~~10/31/04~~ R11~~12/31/04~~ R12~~07/01/05~~ ***12/31/05***

7.	**NASA Technical Monitor:** [R10]Trina M Chytka M/S: [R12]***451*** Phone: 757-864-***9407*** **NASA Competency Coordinator:** ***SACD***/ M/S: Phone: 757-864-

Task Order Number: 08RBJ Revision: 1 Date of Revision: 6/28/01

Title: **National Transonic Facility Improvements**

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

The National Transonic Facility (NTF) is a fan-driven, closed-circuit, continuous flow, cryogenic pressure wind tunnel. An extensive effort is underway and is the objective of this task to make significant improvements to the NTF by minimizing the model dynamics and reduce the overall cost of facility operations.

The NTF operationally is restricted by model dynamics. These restrictions can be attributed to the significantly increased load levels utilized to achieve flight Reynolds numbers in the NTF, in conjunction with the unique structural design requirements of a cryogenic pressure wind tunnel. The reduction and possible alleviation of model dynamics is a high priority activity due to pressure from in-house and industry customers.

Additionally the NTF is striving to reduce the cost of operations by making process improvements. These improvements include modifications to existing systems or processes and/or development of new systems or processes that will reduce the overall cost of operating the NTF.

Considerable effort and resources have been expended to acquire knowledge and understanding of the NTF's unique operating modes. In order to maintain continuity without repetition, remain within projected budgets and schedules, the work contained herein requires intimate familiarity with the previously performed work on dynamics, plenum cooling, the cooling coil system, tunnel controls, and the NTF modes of operations. This work must be performed without benefit of extensive on-the-job training and orientation.

Revision 1: Requirements are expanded to include D) Model Protection Safety System and E) Task Specific Engineering Analysis and Assessment with additional deliverables, completion date extended, and some clarifying remarks are added (see R1 below).

2. **Description of the Work to be Performed:**

1. **Dynamics:** The Contractor shall analyze Government-supplied dynamics research data and study the dynamic response characteristics of the NTF high-speed leg (settling chamber, test section, model, model support and high speed diffuser). The Contractor shall use the data analysis results to develop a *Proposal* for tunnel and/or model modifications designed to minimize or alleviate NTF model dynamics.

   Deliverables:

   The Contractor will attend weekly project status/planning/review meetings (~1 hour) and provide status information, comments and recommendations on dynamic project activities. The Contractor shall provide a *Proposal* that contains tunnel and/or model modifications designed to minimize or alleviate NTF model dynamics. All new drawings submitted with the *Proposal* shall be on E-size drawing sheets with NASA Langley drawing numbers and in accordance with NASA Langley drawing standards. The Contractor shall red-line all existing drawings as necessary. Additionally all work performed by the Contractor shall comply with NASA Langley Safety standards.

Schedule of Deliverables:

A preliminary *Proposal* shall be submitted no later than March 5, 2001 for review. The final *Proposal* shall be submitted no later than March 19, 2001.

Performance Metrics:

The *Proposal* shall include feasibility of the modifications, design drawings of modifications, cost estimates and supporting data analysis and engineering calculations along with expected results. Additionally the *Proposal* shall include a test plan for validation of the expected results.

Performance Standards:

Meets: Completed *Proposal* providing several (3 or more) proposed solutions that reduce the model dynamics.

Exceeds: Completed *Proposal* that contains proposed solutions that can be implemented at the facility in FY-01. The Proposal also contains details for implementation of the proposed solutions.

2. **Existing Tunnel Modifications:** The Contractor shall work with the facility staff (Civil Servants and Contractor) in developing action plans, solutions and procedures to overcome unforeseen problems during the existing scheduled modifications at the NTF. These existing scheduled modifications include:
   - **A) Installation of the Plenum Heating/Cooling System**
   - **B) Cooling Coil System Assessment**
   - ***C)* Automatic Test Sequence System Enhancements**
   - ***D)* R1 *Model Protection Safety System***
   - ***E)* R1 *Task Specific Engineering Analysis and Assessment***

During the course of this Task Order's work, the Contractor may have additional or new ideas that produce significant cost savings to the NTF. The Contractor is encouraged to formally submit these ideas to the Technical Monitor. These new ideas will contribute to the Performance Standard ratings.

Deliverables for all modifications:

The Contractor will attend weekly project status/planning/review meetings for these existing tunnel modifications (~1 hour) and provide status information, comments and recommendations on project activities. All drawings from the Contractor shall be prepared on E-size drawing sheets with NASA Langley drawing numbers and in accordance with NASA Langley drawing standards. The Contractor shall red-line all existing drawings as necessary. Additionally all work performed by the Contractor shall comply with NASA Langley Safety standards.

A) Installation of the Plenum Heating/Cooling System

The Plenum Heating/Cooling System is a new system schedule for installation in FY-01 at the facility. This system is designed to provide circulation in the tunnel plenum (around the test section) to help prevent large thermal gradients and flow stratification during a tunnel cool-downs and warm-ups. The system performance requirements are to keep the plenum thermal gradients below 100F.

Deliverables:

The Contractor shall provide a *Design Concepts Report* of the Plenum Heating/Cooling System. The Contractor shall provide procedures and/or processes for installation, operational checkout, operations and maintenance of the Plenum Heating/Cooling system. Additionally, existing Facility Integrated Operating Procedures (IOPs) and Standard Operating Procedures (SOPs) shall be redlined to integrate the operations of the Plenum Heating/Cooling System at the Facility.

Schedule of Deliverables:

1) A preliminary *Design Concept Report* shall be submitted no later than April 9, 2001 for review. The final Design Concept Report shall be submitted no later than April 23, 2001.
2) Installation Procedure/Process shall be submitted by May 7, 2001.
3) Operational Checkout Procedure/Process shall be submitted by June 4, 2001.
4) Operations Procedure/Process and IOP/SOP red-lines shall be submitted by June 18, 2001.

Performance Metrics:

1) The *Design Concept Report* shall include design concept specifications, drawings, detailed information required to fabricate and install the design concept. The *Report* shall include cost estimates and supporting data analysis and/or engineering calculations to demonstrate that the concept will met the desired performance. Additionally the *Report* shall contain any vendor catalog data, and any other information needed to describe the hardware of the design concept.
2) The Contractor shall have all new procedures/processes and IOP and SOP redlines submitted for review and approval by the Facility Safety Head and Technical Monitor prior to their implementation.

Performance Standards:

Meets: Completed *Design Concept Report*.
Exceeds: Completed *Design Concept Report* and completed installation, checkout and operation of the Plenum Heating/Cooling System in FY-01.

B) Cooling Coil System Assessment

A previous Cooling Coil System Assessment at the NTF identified an itemized *Action Plan* to be performed prior to determining the final course of action for the cooling coil work (repair, replace, or other). [R1] ***Based on the findings and recommendations of the first Summary Report and delays in the tunnel operations further detailed assessment and analysis of the Cooling Coil System was requested by NASA prior to commenting funding for Cooling Coil Repair/Replacement or enhancements.***

Deliverables: The Contractor shall provide an *Action Plan Details Report* that contains a detailed approach to complete the implementation of the Cooling Coils System Assessment *Action Plan*. Additionally, the Contractor shall provide a *Summary Report* that contains documentation of the *Action Plan Details Report* findings and a *Proposal* for the final course of action for the cooling coil system assessment work.

Schedule of Deliverables:

1) A preliminary *Action Plan Details Report* shall be submitted no later than February 5, 2001 for review. The final *Action Plan Details Report* shall be submitted no later than February 19, 2001.
2) The *Summary Report* shall be submitted no later than June 29, 2001
3) [R1] ***The Final Report shall be submitted no later than October 29, 2001.***

Performance Metrics:

1) The *Action Plan Details Report* shall include the details required to complete the Cooling Coil Assessment Action Plan. This report shall include procedures, drawings, equipment and instrumentation requirements, testing plan, data collection requirements, configurations and setup schematics or drawings, work force requirements and time estimates.
2) The *Summary Report* shall include documentation of the *Action Plan Details Report* findings and a *Proposal* for the final course of action for the cooling coil system assessment.
3) The *Proposal* section of the *Summary Report* shall contain information to support the final course of action. This *Proposal* shall include any design, operations, or process changes, schematic of the proposed changes, cost estimates, vendor catalog data, and supporting data analysis or engineering calculations along with expected results from the proposed changes. Additionally the *Proposal* section shall include a test plan for validation of any proposed changes.

Performance Standards:

Meets: Completed *Action Plan Detail Report* and *Summary Report*.

Exceeds: Completed *Summary Report* that contains a proposed final course of action for the cooling coil system assessment work that can be implemented at the facility in [R1] ~~FY-01~~ ***FY-02***.

C) Automatic Test Sequence System Enhancements

Significant cost savings can be achieved by making several enhancements to the

Automatic Test Sequence (ATS) and the tunnel controls system. These enhancements will reduce response times of the model attitude system for both pitch-pause testing and continuous pitch sweep testing. [R1] ***As identified in the Report significant time and cost savings can be realized by making enhancements to the tunnel model attitude controls system. Therefore it is desirable to implement these changes***.

Deliverables: The Contract shall provide a *Report* detailing the proposed enhancements required to the ATS and the tunnel controls system to realize these savings. [R1] ***The Contractor shall provide a detailed implementation plan.***
Schedule of Deliverables:
A preliminary *Report* shall be submitted no later than May 21, 2001 for review. The final *Report* shall be submitted no later than June 4, 2001.
[R1] ***Implementation plan September 29, 2001***.

Performance Metrics:

The *Report* shall include a feasibility study, necessary control algorithms for ATS and/or the tunnel controls to implement changes, necessary hardware changes, supporting data analysis and engineering calculations with expected results of cost savings and/or data quality improvements. Additionally the *Report* shall include a test plan for validation the expected results.

Performance Standards:

Meets: Completed *Report*.
Exceeds: Completed *Report* that contains proposed changes that can be implemented and verified at the facility in FY-01.

Begin [R1] block addition

D) Model Protection Safety System

As result of NASA LaRC Tunnel Safety Review all major wind tunnel facilities are now required to have an autonomous system similar to the NTF's existing Balance Dynamic Display Unit (BDDU) and the Critical Point Analyzer (CPA) that automatically reduces the test article loads when pre-established balance load levels (single or multiple components) are exceeded.

A computer-based version of the BDDU and CPA system was developed at the NTF (by Dr. Balakrishna in 1998) called the Model Protection Safety System (MPSS). In addition to BDDU and CPA functions the MPSS also provided a Modal Trip System that automatically reduces the test article loads when pre-established amplitude levels at specific frequencies are exceeded.

This MPSS approach was chosen by the Safety Review Board to be implemented at all

the major facilities. The first implementation will be at the 16ft Transonic Tunnel.

<u>Deliverables</u>: The Contract shall provide initial documentation of the NTF MPSS that includes an initial code listing of the MPSS software, hardware components and configuration, user guide and system documentation.

The Contractor shall review any requests from the 16ft TT to enhance or modify the system. The Contractor shall also review the proposed methods of interfacing the system with the existing tunnel control systems. These reviews shall include review of redlined drawings, code listing, system configuration and procedures. For these reviews the Contractor shall provided informal review summary reports (may be oral) detailing any concerns or possible alternatives.

<u>Schedule of Deliverables</u>:
The initial documentation shall be submitted no later than July 6, 2001.
The Interfacing Review Summary Report for 16ft TT for sub-sonic operations shall be submitted no later than July 2, 2001 (BDDU and CPA Features only).
The Review Summary Report for 16ft TT for sub-sonic operations shall be submitted no later than August 3, 2001 (Modal Trip System Features only).
The Interfacing Review Summary Report for 16ft TT for super-sonic operations shall be submitted no later than August 10, 2001 (BDDU and CPA Features only).

<u>Performance Metrics</u>:
Implementation and checkout of the MPSS (BDDU and CPA features) for sub-sonic operations at 16ft TT.
Implementation and checkout of the MPSS (BDDU and CPA features) for sub-sonic operations at 16ft TT.

<u>Performance Standards</u>:
Meets: Successful implementation, checkout and tunnel operations of the MPSS (BDDU and CPA features) at 16ft TT for sub-sonic operations.
Successful implementation and checkout and operations of the MPSS (Modal Trip System features) at 16ft TT for sub-sonic operations
Exceeds: Design interface for implementation of the MPSS at 16ft TT for super-sonic operations.

<u>E) Task Specific Engineering Analysis and Assessments</u>
This part of the Task Order is designed to allow for the Contractor to perform specific engineering analysis and/or assessments for a Specific Task. The following Tasks are currently identified by the Facility using the Task/Test Request (TTR) System to

identify the work required.

<u>E.1 Focus Schlieren Video System (TTR s16-006-01)</u>
<u>Task</u>: Design an additional supplemental heating system for the focusing schileren camera package for use over the temperature ranges of the NTF.
<u>Deliverables</u>: The Contractor shall provide a Design Report upon closing the TTR.
<u>Schedule of Deliverables</u>:
The Design Report shall be submitted no later than September 1, 2001 for review.
<u>Performance Metrics</u>:
The Design Report shall include heating requirement calculations, heating system design, hardware specifications and a brief summary of the theory of operations.
<u>Performance Standards</u>:
Meets: Completed Design Report.
Exceeds: None.

End [R1] block addition

3. **<u>Government Furnished Items</u>:**

1) Office space in Bld. 1236 (the NTF).
2) MatLab Software from Mathwork for data analysis.
3) Access to the NTF's Dynamic Data Acquisition Unit.

4. **<u>Other information needed for performance of task</u>:**
Applicable documents available at the NTF Archive Center:

<u>Data Analysis Report – NTF Operational Data from Test 100, 107 and 111, Final Report Part A</u>; S. Balakrishna; February 24, 2000

<u>NTF Structural Modifications proposal based on NTF Operational Data Analysis, Final Report Part B</u>; D. Butler; February 2000

<u>NTF Cooling Coil System Study Report</u>; D. Butler; December 2000

Additional specific NTF test reports, equipment manual and facility related documents will be provided by the Government as requested by the Contractor.

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<u>, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation</u>, describing how the IT items demonstrate Year 2000 compliance.

5. **<u>Security clearance required for performance of work</u>:**
Because the NTF operates two shifts, occasionally work will be require on second shift, this

	will require the Contractor to have "After Hours Access" to the NTF.
6.	**<u>Period of Performance</u>:** **Planned start date:** January 2, 2001 **Completion date:** R1 ~~June 29, 2001~~ ***October 29, 2001***
7.	**<u>NASA Technical Monitor:</u>** W. Allen Kilgore **M/S:** 267 **Phone:** 757-864-5033

Task Order Number: 08RCE Revision: 0 Chge 1 Date of Revision: 6/26/01
Title: **Testing and Analysis of Advanced Materials**

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

The purpose of this task is to conduct mechanical testing and microstructural analyses on materials systems, with the primary focus being advanced metallic materials. The objective is to establish processing-microstructure-property relationships for the material systems for aerospace applications.

Change 1: Adds 6/26/01 Contractor-proposed travel and material purchase requirements (see [C1] below).

2. Description of the Work to be Performed:

Note: Some of the required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1 Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written work request basis (NOR). The Government will provide the materials which will primarily be metallic-based, although other materials may be included on a limited basis. Preparation techniques will include sectioning, mounting, mechanical and chemical or electrochemical polishing of specimens suitable for optical metallography, x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis. The Contractor shall ensure equipment is operational prior to and after analyses. Specific analyses and quantities are detailed below:

- Utilize a variety of optical microscopes in conjunction with SEM with energy- and wavelength-dispersive spectrometry (EDS and WDS) systems and a microtexture analysis system to analyze the chemistry, morphology, and orientation of individual grains and/or particles and of the bulk microstructure (up to 120).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to 25).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques

(up to 50).
- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to 75).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to 60).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to 60).
- Conduct hardness and microhardness tests on metallic materials (up to 50).

Deliverables (for 2.1):
- For each analysis request, brief informal statement (written or oral) of types of analyses to be conducted and estimated time for completion to the Requester within 5 working days after receipt of the work request.
- For each analysis request, informal written and oral report of results to the Requester within 5 working days after completion of the analysis. The report shall include description of analyses and interpretation of results. The report shall include any photomicrographs, compositional analyses, x-ray and electron diffraction data relevant to the microstructural characterization performed.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of analyses conducted, standards and procedures used, and any specialized analysis techniques and procedures developed. (12/31/01)

Performance Standards (for 2.1):

MEETS:
- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Work requests completed by requested due date
- Cost

EXCEEDS:
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost

Subtask 2.2: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written work request basis (NOR) to determine the mechanical behavior of materials from cryogenic to elevated temperatures, with the majority of tests being conducted at room temperature. The Government will supply the specimens machined from aluminum- and titanium-based alloys and composites, although other materials may be included on a limited basis. Product forms may include, but not be limited to, foils, sheets, plates, rods, forgings, and extrusions. The Contractor shall ensure equipment is operational prior to and after tests. Specific tests and quantities are detailed below:

- Tensile and compression tests to measure strength, modulus, and elongation (up to 800).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to 200).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to 75).
- S-N fatigue tests on notched and un-notched test specimens (up to 120).
- General and stress corrosion tests in salt solutions (up to 50).

Deliverables (for 2.2):

- For each test request, tested specimens (with fracture surfaces intact and preserved) and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of test procedures, calibrations, specimen dimensions, test anomalies, and electronic data files for each test.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (12/31/01)

Performance Standards (for 2.2):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- work requests completed ahead of requested due date

- "rush" work requests designated by the task monitor expedited
- Completed under cost

Subtask 2.3: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written work request basis (NOR). The materials will comprise primarily aluminum, titanium, and nickel-based alloys, although other materials may be included on a limited basis. Product forms may include, but not be restricted to, foils, sheets, plates, rods, forgings and extrusions. Work assignments shall include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to 2000) limited to 36 inches by 12 inches in dimension, but usually on the order of 1 inch by 4 inches in size. The Contractor shall be responsible for ordering chemical supplies; maintaining chemical cleaning baths, monitoring, neutralizing, and coordinating disposal of hazardous materials, and maintaining a catalog of the appropriate materials safety data sheets.

Deliverables (for 2.3):
- For each work request, an informal written and/or oral report of the results to the Requester within 3 working days after completion of the work. The report shall include description of the surface preparation procedures, results, and anomalies.
- Informal written monthly reports that list work requests completed during the reporting period, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of surface preparation activities conducted, standards and procedures used, and any specialized techniques and procedures developed. (12/31/01)

Performance Standards (for 2.3):

MEETS
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)
- Cost

EXCEEDS
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost.

3.	Government Furnished Items: Specialized surface preparation equipment located in Metals Cleaning Laboratory (Building 1229A) including deionized water supply, chemical cleaning and rinse tanks, anodizing equipment, electroplating equipment and supplies, acids, bases, precleaners, neutralizing chemicals, supplies, and related safety equipment. Specialized mechanical test equipment located in the Light Alloy Laboratory (Building 1205) and the High-Temperature Test Laboratory (Building 1205), including cryogenic and elevated temperature chambers, test machines, strain and displacement measurement instrumentation, and System 4000 and Fracture Testing Associates data acquisition systems. Specialized metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEM's, TEM's, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation apparatus and supplies.
4.	Other information needed for performance of task: [C1] ***Some travel for conference dissemination of new or improved technologies may be appropriate as these advances occur. The Contractor may also be required to make small purchases of materials as necessary to efficiently perform the task order requirements.*** 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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 1/2/01 Completion date: 12/31/01
7.	NASA Technical Monitor: Keith Bird M/S: 188A Phone: 757-864-3512 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 3 Statement of Work

Task Order Number: 08RDB Revision: 3 Date of Revision: 9/29/03

Title: Support of AirSC Web Sites

1. **Purpose, Objective or Background of Work to be Performed:** (RD03, NAS1-96014)

Listed below for subtasks as appropriate.

For original issued version of SOW, see ETOS file *08RDB.doc*

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the requirements for the new period of performance around "Control Law" in lieu of "Blended Wing Body Low Speed vehicle" (see R1).

Revision 2: Extends the period of performance one year in continuation of NASA's support requirements with new requirements added as Subtask 4 (see R2 below).

Revision 3: Extends period of performance one year in continuation of NASA's support requirements and deletes Subtasks 1,2, and 4. Task title changed to "Support of AirSC Web Sites" (see R3 below).

2. **Description of the Work to be Performed:**

Subtask Integration:

Subtask 3 AirSC Branch Web sites

Deliverables:

a) Status reports delivered electronically to the Task Monitor each month. Working days exclude weekends and federal holidays. — monthly

b) Attendance and support of Design Challenge bi-weekly team meetings. — Weekly

Subtask 1 Modeling and Support for R1 Control Law Design Challenge R3 ***Deleted***

Subtask 2 Support for Design Challenge Web site R3 ***Deleted***

Subtask 3 Dynamics & Control Branch (DCB) and Vehicle Dynamics Branch (VDB) Branch Web sites

Background

DCB & VDB WWW servers have been established to provide our stakeholders access to Branch-related information, including branch research programs, technical reports, draft documents, simulation models and data bases, and administrative information. This subtask would develop and maintain DCB & VDB WWW-sites.

Work to Be Performed This subtask shall include developing and maintaining DCB and VDB WWW-sites on an existing Web server. "Maintaining" shall be understood to mean: (1) adding documents to the server, (2) organizing the total document set in a logical-tree

(1) adding documents to the server, (2) organizing the total document set in a logical-tree using hyperlinks, and (3) installing updated server software. On an infrequent basis, the task will involve shutdown and restart of the Web server software; this is accomplished via the console of the host. Automatic translation programs shall be investigated and implemented a to maximum extent possible.

Information that is to be placed on the Branch Web servers includes:

Branch research program information, researcher technical reports, researcher bibliographies, Branch highlights, draft documents, links to related www-sites, simulation models and data bases, and administrative information.

Deliverables:

a) Documents translated to either Hypertext Mark-up Language (HTML) or Portable Document Format (PDF) from a variety of source documents (including text, Microsoft Word 6.0/97, LaTeX, and PostScript files), generally within 24-72 hours of receipt. HTML version shall be proofread and compared to original source document(s) to insure accuracy.

b) Documented hierarchy on Web server together with up-to-date hypertext-based collection of documentation on Web server. Sufficient explanatory HTML pages of instruction to provide navigation capability throughout the Web structure. (By task completion)

c) Capability for users to submit e-mail address for e-mail list. Capability to e-mail information to e-mail list. List of users who have downloaded documents from the Web server. (By task completion)

d) A record of the total number of documents placed on the server along with their size. A record of the time required to provide translation of documents. (By task completion)

Metrics for Deliverables:
Exceeding performance expectations would be for all documents less than 10 pages to be available within one working day of receipt and larger documents within three working days.

Begin R2 block requirements addition
Subtask 4. DCB Computational Database Maintenance R3 ***Deleted***

Task Order Number: 08RDB Revision: 3 Date of Revision: 9/29/03

Title: Support of AirSC Web Sites

	End R2 block requirements addition
3.	**Government Furnished Items**: ~~All subtasks:~~ Access to workstation with MATLAB/Simulink license. ~~Subtask 1 only:~~ ~~a) MATLAB/Simulink version of baseline simulation sufficient to support Simulink Design Challenge model implementation.~~ ~~b) Major component subsystem models definition~~.
4.	**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.
5.	**Security clearance required for performance of work**: All individuals working on this task shall comply with program data sensivity and non-disclosure agreements. ~~The R1 Control Law Design Challenge program is NOT classified. The data in R1 the Design Challenge model is often proprietary.~~
6.	**Period of Performance**: Planned start date: 1 January 2001 Completion date: R1,R2 ~~31 December 2002~~ R3 ~~31 December 2003~~ ***31 December 2004***
7.	**NASA Technical Monitor:** Dr. John B Davidson M/S: 132 Phone: 757-864-4010 NASA Competency/Other Technical Coordinator: AirSC/ M/S: 162 Phone: 757-864-9119

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

1. Purpose, Objective or Background of Work to be Performed: ~~(RF06, NAS1-96013)~~

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~~Electronic Systems Branch (~~FIB~~ESB) at NASA Langley Research Center is responsible for acquiring and recording the data for over 1000 parameters on the B-757 ARIES project utilizing a Data Acquisition System (DAS) developed by ~~FIB~~ESB.

The overall objective of this task is to operate, maintain and upgrade the Data Acquisition System (DAS) and validate data acquired by the DAS.

Note: The test and flight support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

2. Description of the Work to be Performed:

Subtask 1

The Contractor shall operate the government provided Data Acquisition System (DAS) on the ARIES B-757. This will include providing an operator for the DAS during all system and environmental ground test and all research flights (NOR) on the ARIES B-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. It is anticipated that approximately 40 local flight research programs and 30 remote site deployments will be required and that the aircraft will be down for approximately 5 months to perform modifications and upgrades to the DAS to support the flight research programs.

1. 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.

2. The Contractor shall modify, integrate, qualify, and validate the DAS as required (NOR) to support changes/upgrades for scheduled research flights to meet FY01 and FY02 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 (~~Shared Common Random Access Memory Network (SCRAMNet) data block software configuration changes, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.

3. The Contractor shall provide Pulse Coded Modulated (PCM) digital data and IRIG-B time to the Data Display and Processing System (DPDS).

4. For each flight test series (NOR), 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.

5. 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. The Contractor shall also provide a calibration database using Microsoft Access and is compatible with the new Veridian Ground Processing Station

currently under development by ~~FIB~~ESB.

6. 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 B-757 Project Manager when critical flight schedules conflict with accomplishing these calibrations.

7. 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, the DAS quick look computer, and the Veridian System.
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.

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

3. Government Furnished Items:

Access to the following

1. Use of NASA ground station is available for post flight data processing on a scheduled basis.

Hardware:

1. AATIS (Advanced Airborne Test Instrumentation System) data system with documentation
2. AATIS compatible recording media
3. Assorted collection of Sensors
4. Sensor calibration data
5. Access to Flight Simulation Integration Laboratory (FSIL) 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/B-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.

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

4. <u>Other information needed for performance of task</u>:

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 B-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~~ B-757 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 B-757 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.~~ Building1250) 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,

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: December 31, 2001

7. NASA Technical Monitor: F. Keith Harris
M/S: 257 Phone: 757-864-3824

Task Order Number: 04RBB Revision: 12 Date of Revision: 04/07/05

Title: Support of TetrUSS Unstructured Flow Analysis System

1. **Purpose, Objective or Background of Work to be Performed:** (DA21, NAS1-96014)

- *Provide upgrades, version control, and user support for the USM3Dns unstructured Navier-Stokes flow solver*. Primarily new capabilities will be added and an export version of USM3Dns will be maintained by adding and/or certifying software upgrades, providing selected code extensions, and performing systematic testing. An expert knowledge of the USM3Dns code is required for this task.

- *Provide grid generation support for the Configuration Aerodynamics Branch computational studies.* The task will involve the construction of unstructured and structured computational grids around complex aerospace configurations. Grid requirements and specifications will be provided to the Contractor on a case-by-case basis.

Note: The analysis and design support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designation below.)

Revisions 1-4: (For details of previously issued SOWs see ETOS *doc* files *04RBB, 04RBB01, 04RBB02, 04RBB021, 04RBB03, and 04RBB04*, respectively)

Revision 5: Extend Subtask 1 of R4 to investigate improved approaches. Extend delivery dates for Subtask 2 of R4 due to unavailability of a stabilized base code. Extend delivery date of Subtask 3 because of continued need for service. Change Subtask 4 of R4 from a full computational function to a grid-generation only function. Delay Subtask 5 of R4 due to unavailability of a stabilized base code and change in priorities.

Revision 6: Adds 4 additional grids and 20 flow solutions to Subtask 4 (see [R6] below).

Revision 7: Upgrades deliverable 2.b) to a conference paper and extends the period of performance to November 30, 2003 (see [R7] below).

Revision 8: Realigns USM3D upgrade tasks to focus on 1) unsteady, moving-grid flows, 2) Chimera overset moving grids, and 3) low-Mach number preconditioning. It also adds panel/Euler code application support to the Orbital Space Plane configurations. (see [R8] below).

Revision 9: Added grid generation support for the B52/X37 project

Revision 10: Realigns USM3D upgrade tasks to cover maintenance and extensions to the new time-accurate version of USM3D 6.0.

Revision 11: Reduces work requirements for Subtask 5 by 50% due to funding reductions (see

R11 below).

Revision 12: Adds conference attendance requirement for June '05 (see R12 below, Section 4).

2. **Description of the Work to be Performed**:

1. Subtask 1: Implement a turbulent tripping capability into USM3D 6.0.

   a) The Transonic Slotted Wing project needs a USM3D capability to trip flow from laminar to turbulent along a prescribed location on a wing. This involves turning off the turbulence production term in cells above a "laminar" region, then setting turbulent production equal to dissipation in a thin region of cells above the prescribed trip location. A suitable test case will be provided under the Transonic Slotted Wing project.

   Deliverables:

   a) CVS controlled source code of modified parallel USM3Dns code containing turbulent tripping capability.
   b) Demonstration of turbulent tripping on a wing-body transport configuration.

   c) A short summary of the implementation and test case results.

   d) Records of USM3Dns code modifications and testing results sufficient to meet ISO 9000 requirements for low-control software.
   e) All source code and utility files for upgraded USM3Dns version 6.0 parallel flow solver.

   f) HTML source code for turbulent tripping feature USM3Dns web-based documentation.

   Minimum acceptable performance/Schedule:

   a) Complete final upgrade and validation testing of USM3Dns Version 6.0 with turbulent tripping by 12/31/04.
   b) Complete updates on turbulent tripping feature for web-based user's manual for

Deliverables:

a) CVS controlled source code of modified parallel USM3Dns code containing low-mach number preconditioning.
b) Demonstration of low-Mach preconditioning on a ship/airwake configuration.
c) Records of USM3Dns code modifications and testing results sufficient to meet ISO 9000 requirements for low-control software.
d) All source code and utility files for upgraded USM3Dns Version 6.0 code.
e) HTML source code for improved USM3Dns web-based documentation.

Minimum acceptable performance/Schedule:

a) Complete final upgrade and validation testing of USM3Dns Version 6.0 with low-mach preconditioning by 3/31/05.
b) Complete updates for web-based user's manual for USM3Dns, Version 6.0 by 3/31/05.

Exceeds performance: Completion of tasks 2 weeks prior to MAP completion date.

3. Subtask 3: Consolidation and documentation of new capabilities in time-accurate USM3D Version 6.0 Flow Solver. Many recent enhancements to USM3D 6.0 need further testing and user documentation.
   a) Additional systematic testing of Detached Eddy Simulation (DES) shall be conducted on a unit test case. Guidelines shall be documented in the form of a conference paper.
   b) Overset grid capability has been installed in USM3D 6.0. Additional verification testing shall be conducted and user documentation provided. This capability shall also be reported in the form of a conference paper.
   c) Several two-equation turbulence models have been installed into USM3D Version 5.2p and must be ported to USM3D 6.0. The ported capability shall be verified on unit test problems and user documentation provided.
   d) The overset-grid capability will be integrated with the Arnold Engineering Development Center (AEDC) FD-CADRE framework to provide 6-Degree of Freedom capability. The Contractor shall provide testing of this capability and transfer it to Langley Research Center personnel for use.
   e) Configuration control of all USM3D 6.0 capabilities shall be provided by regular and frequent updates to the Concurrent Version System (CVS) repository.

Deliverables:

a cylinder, and a wing with separated flow.

c) All user documentation that meets the requirements of NAVAIR/NASA CHSSI project titled "Integrated Simulation of Air Vehicle Performance, Stability and Control For Test and Evaluation".

d) Summary reports in the form of a scientific conference paper for additional DES guidelines and the overset-grid capability.

e) Regular and frequent updates of USM3D code modifications to the CVS repository.

f) HTML source code for USM3Dns web-based documentation.

g) Records of USM3Dns code modifications and testing results sufficient to meet ISO 9000 requirements for low-control software for all source code and utility files for upgraded USM3Dns Version 6.0 code.

Minimum acceptable performance (MAP)/Schedule:

a) All required user documentation by 3/31/05.

b) All additional testing and summary documentation by 10/31/05.

c) Delivery of tested USM3Dns source code by 10/31/05.

Exceeds performance: Completion of task 2 weeks prior to MAP completion date.

4. Subtask 4: The Contractor shall provide services intended to support of USM3Dns users (an average of 10 requests per month and not to exceed 15 per month). This effort shall include:

a) Maintaining single controlled export versions of the parallel and nonparallel time-accurate USM3Dns unstructured Navier-Stokes flow solvers and accompanying utility codes.

b) Conducting systematic testing and validation on established test cases, and making modifications to the flow solver which enhance robustness toward complex applications,

c) Maintaining web-based user documentation for USM3Dns, and supporting modular capabilities and utility codes,

d) Providing consultation to USM3Dns customer base to help users overcome typical problems encountered due to low experience with the export release version of USM3Dns

Deliverables:

a) Source code of export version of USM3Dns and supporting utilities

b) Records of USM3Dns code modifications reflected in version updates sufficient to meet ISO 9000 requirements for low control software

c) Web-based user documentation for USM3Dns, utility codes, and modular aeroelastic, design, and interactive boundary layer system

d) Documentation of code validation test cases and results
e) Log of customer support activities

Minimum acceptable performance/Schedule:
a) Fully tested export version of USM3Dns 6.0 by 10/31/05
b) Records of version upgrades suitable for ISO 9000 requirements,

Exceeds performance
a) Completion of tasks 2 weeks prior to MAP completion date.

5. Grid Generation and Application Support Activity. (NOR controlled subtask)
The Contractor will generate up to R11 ~~40~~ ***20*** computational grids on selected complex aerospace configurations that require numerical simulation EASI and CEV projects. CAB will coordinate priorities, requirements and specifications for the grids to the Contractor on a case-by-case basis. The grids will be suitable for advanced Euler and Navier-Stokes unstructured flow solvers such as USM3Dns and FUN3D..

Deliverables:
a) Geometry setup files for each activity
b) Computational grid files for each activity
c) Monthly log of grid generation activity

Minimum acceptable performance/Schedule:
a) Numerical grids shall be completed within 2 weeks for an unstructured inviscid Euler application, and 3 weeks for a viscous Navier-Stokes application. Times are with respect to approved NOR date.
c) Computational grids must adequately resolve regions of major flow features.

3. **Government Furnished Items:**

Office space and high-end graphic workstation. Grid generation codes and documentation, flow solver codes and documentation, and graphic post processing codes and documentation, access to advanced supercomputers if needed, access to PC clusters, geometry surface definitions,

	aerodynamic data sets, configuration definitions and specific study objectives.
4.	**<u>Other information needed for performance of task</u>:** R12 ***Required attendance for one at 17th Computational Fluid Dynamics Conference in Toronto, Canada, June 6-9, 2005.***
5.	**<u>Security clearance required for performance of work</u>:** All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with industry. Also, all personnel with access to Government software shall be in compliance with U.S. export control laws.
6.	**<u>Period of Performance</u>:** Planned start date: R3 ~~Jan 2, 2001~~ R5 ~~November 1, 2001~~ ~~November 1, 2002~~ R10 November 1, 2004 Completion date: R3 ~~October 31, 2001~~ R5 ~~October 31, 2002~~ R7 ~~October 31, 2003~~ ~~November 30, 2003~~ R8 ~~October 31, 2004~~ R10 October 31, 2005
7.	. **NASA Technical Monitor:** Neal T. Frink M/S: 499 Phone: 757-864-2864 **NASA Competency/Other Technical Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 04RCE Revision: 6 Date of Revision: 2/24/04

Title: Metals and Thermal Structures Research and Technology Development

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

The objective of this task is: (1) to conduct research and technology development for advanced metallic materials synthesis and processing to enable the fabrication of efficient, high-performance concepts for aerospace applications; and (2) to conduct research and technology development that evaluates concepts, quantifies behavior, durability, and damage tolerance, and validates performance of advanced materials and structures for applications in extreme environments. The Contractor will be expected to perform the following general requirements as applicable to specific subtasks:

- conduct thermal-structural analyses and design studies, CAD design, and analysis of test specimens, and support for testing of advanced TPS (Thermal Protection System) systems, hot structures and cryogenic tanks for use on advanced space transportation and high-speed aircraft in support of Langley Tasks.
- perform specialized environmental fatigue tests, conduct fractography of advanced materials and airframe components, and maintain fractographic analysis laboratory.

[R1] Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, updates the NOR note, and changes the scope of Subtask 4 (see [R1] above and below).
Revision 2: Adds the requirement to perform classified supersonic vehicle performance trade studies (Subtask 1), and adds the requirement to travel in support of 2nd Generation RLV test program (Subtask 3) (see [R2] below).
Revision 3: Adds additional requirements (Subtasks 5 and 6, see [R3] below).
Revision 4: Extends the period of performance through December 31, 2002 in continuation of NASA's support requirements for Subtasks 1-4 at the current support level and adds currently agreed upon schedule (October 31, 2002) to Subtasks 5 and 6 (see [R4] below).
Revision 5: Extends the period of performance through December 31, 2003 in continuation of NASA's support for Subtasks 1-4 with no change in current requirements.
Revision 6: Resets the period of performance to April 30, 2004, in continuation of NASA's

support, with no changes in detailed requirements, to allow some work to reach a technical conclusion (see R6 below, Section 6)

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor for subtasks #1-3 and to the Sub-Task Technical Monitor for subtask #4.

SUBTASK 1: (NOR) Conduct Thermal -Structural Studies of Advanced Space Transportation and High-Speed Aircraft Integrated Thermal-Structural Systems, and Develop Theoretical and Algorithmic/Non-Optimum Structural Weights

1. The Contractor shall conduct thermal-structural analyses and design studies of advanced cryogenic tank, hot structure, and TPS systems in support of advanced concept development and design/analysis methods development/validation with application to advanced space transportation and high-speed aircraft in support of Langley programs. The Contractor shall identify load requirements and will provide initial loads estimates. The analysis shall include aerodynamic, acoustic, thermal, and mechanical loading conditions representative of advanced space transportation or high-speed aircraft as appropriate. Various design options for vehicle concept, structural arrangement, material systems, and integrated wall concepts for cryotanks, wings, other primary structures and TPS will be considered. Thermal and structural analyses are required to size and compare integrated TPS/cryotank systems and to determine response and deflections of the aerosurfaces under load. Analysis will also be required to support design of specific test panels and to support development/ validation of new design/analysis methods. It is anticipated that studies supporting 8 projects will be required.

R2 Perform vehicle conceptual study of a supersonic concept as well as participate as consultant in industry study to include:

- Aerodynamic design trade study to maximize L/D (Classified)
- Vehicle sizing and performance analysis of selected configuration (Classified)

Deliverables: Finite element models and results suitable for presentation. Short written reports of design studies, analyses and weight trades of various concept studies.

Performance Measurements:

Minimum Performance
The finite element models shall accurately represent the system being investigated and be of sufficient resolution to predict the responses of interest. The trade study results shall accurately represent the various thermal-structural concepts.

Exceeding Minimum Performance
Contractor would exceed the minimum performance with: suggestions of design improvements based on their analyses and design studies; development of improved analysis techniques using existing tools, or developing new tools that allows for faster turn-around, or better integration of analysis methods; performing surveys and documenting similar work found in the literature that allow better use of prior technology; or perform studies in a more rapid manner than original time estimates.

2. (NOR) The Contractor shall participate in structural concept, arrangement and design definitions for airframe structural systems. Detailed itemized weight statements shall be developed for individual airframe system options being considered in the trade studies. Output from Finite Element and other structural models, as well as other analytical methods will be integrated as inputs into the itemized weight statements. Knowledge and application of existing weight estimation methodology (including finite element-based, CAD-based, algorithmic, etc.) will be used to develop weight estimates for non-modeled structural items. Methodology for developing total airframe weights based on a limited number of point sizings (at discrete locations) shall be developed and applied to the airframe concepts being considered in the trade studies. It is anticipated that studies supporting 3 projects will be required.

Deliverables: Detailed weight statements for integrated airframe concepts, algorithms for estimating weights of non-modeled structural features, and written reports of analytical results.

Performance Measurements:

Minimum Performance
Development of itemized weight statements and theoretical/algorithmic weight estimates using established analytical weights methods. Integration of outputs from current structural/TPS sizing codes into the detailed weight statements.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance by: suggesting improvements

to structural concepts based on their analyses and design studies; developing weight estimation algorithms for new (non-standard) airframe structural concepts; developing improved weight estimation techniques using existing tools; developing new weight estimation algorithms, tools or interfaces that allow for faster turn-around, or better integration of analysis methods; performing surveys and documenting similar work found in the literature that allow better use of prior technology; or perform studies in a more rapid manner than original time estimates.

SUBTASK 2: CAD Design for Advanced Structures Concepts, Test Hardware, and Metallic Materials Processing Equipment

1. (NOR) The Contractor shall develop designs and hand and/or CAD drawings of NASA-defined structural concepts as required. Drawings may include trade study concepts, structural layouts, and components to be fabricated to demonstrate salient features of a concepts. The Contractor shall be responsible for coordinating the successful fabrication of the designed components through the LaRC fabrication system. It is anticipated that support for 6 projects will be required.

Deliverables: Drawings of designs suitable for presentation or fabrication. Successful implementation of selected designs into hardware.

Performance Measurements:

Minimum Performance
The designs shall clearly illustrate the salient features of the concepts and those intended for fabrication shall be adequate for a competent fabricator to be able to fabricate the concept.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables.

2. (NOR) The Contractor shall develop designs and CAD drawings of the required fixtures based on the requirements for each specific test. Specific items that may be designed include: concepts and drawings for cryo/elevated temperature chambers, load introduction and specimen support fixtures for thermal-structural tests, and preparation jigs for specimen handling and assembly . The Contractor shall be responsible for coordinating the successful fabrication of the designed fixtures through the LaRC fabrication system. The Contractor designer shall provide advice to the NASA technician staff to support final assembly of test hardware. It is anticipated that support for 2 projects will be required.

Deliverables: CAD drawings of fixture designs. Successful implementation of selected designs into hardware.

Performance Measurements:

Minimum Performance
The design for the test fixtures shall be adequate for a competent machinist to be able to fabricate the test fixture. The assembled fixtures shall be delivered to appropriate testing lab in a timely manner.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables

3. (NOR) The Contractor shall develop designs and CAD drawings of required hardware to support/enhance metals processing equipment and capabilities. Specific items that may be designed include: concepts and drawings for materials handling and positioning, and support equipment for direct metals deposition and free-form fabrication efforts. The Contractor shall be responsible for coordinating the successful fabrication of the designed hardware through the LaRC fabrication system. The Contractor designer shall provide advice to the NASA or contractor technician staff to meet the requirements for the advanced capabilities. It is anticipated that support for 1 project will be required.

Deliverables: CAD drawings of equipment designs. Successful implementation of selected designs into hardware.

Performance Measurements:

Minimum Performance
The design for the equipment shall be adequate for a competent machinist to be able to fabricate the design. The fabricated equipment shall be delivered to appropriate processing lab in a timely manner.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables

Subtask 3: Thermal-Structural Test Support

1. (NOR) The Contractor shall, as specified in individual NOR's, perform pre-test analyses, write and/or modify test plans (including a test request form if required by specific facility) for structural and/or thermal-structural test specimens to be tested in test facilities, determine instrumentation layouts to specified test requirements, expedite specimen preparation, assist in final test preparations, track the test series, and perform post-test analysis/test correlation. The NASA technical monitor shall been given periodic reports of progress of the test support activity. It is anticipated that support for 2 projects will be required.

R2 The Contractor shall travel to industry partners' manufacturing facilities to provide technical assistance with tests to be conducted in LaRC facilities.

Deliverables: The Contractor shall deliver the analyses, test plans, and instrumentation layouts in electronic and printed form.
The Contractor shall deliver the test specimens and hardware to the appropriate testing laboratory and support the test series as specified in the NOR.
The Contractor shall deliver progress reports documenting the in electronic form.

Performance Measurements:
Meets- Completes documents for the analyses, test plans, and instrumentation layouts. Monitors progress of preparation of test articles for testing, execution of the test plan, and removal of the test article.
Exceeds- All subtask elements are completed and all deliverables are met ahead of schedule

SUBTASK 4: Study R1 sensory alloys**,** corrosion fatigue and fracture with detailed fractograhic analyses of advanced materials and aircraft components (Subtask POC: Dr. Robert Piascik)

1. (NOR) Contractor shall conduct environmental fatigue tests to simulate the effects of corrosion on small fatigue cracks propagating from rivet holes. Approximately R1 50 fatigue tests per year shall be conducted on specimens supplied by the Government. The tests shall be conducted under test conditions: (1) as received, (2) pre-corroded and (2) under an aqueous condition yet to be determined. Detailed fractography of the tested specimens shall be performed and fractographic records shall be maintained to document the crack length and load cycle based on marker band analysis. The Contractor shall report monthly on the progress of this testing.

2. Contractor shall perform detailed fractographic examinations of airframe components supplied by the Government. The airframe components will contain corrosion and or

cracks. The examinations will include detailed metallographic and scanning electron microscope (SEM) fractographic analysis. Approximately 10 to 20 components per year will be sectioned and examined in detail for evidence of fatigue cracking and corrosion. This will involve the careful dismantling of the structure and preparation of fractographic specimens. Approximately 1000 specimens per year will be prepared and examined for evidence of corrosion and cracking using microscopy. Detailed records will document the location and morphology of each damaged region. A Contractor Report shall be issued upon the completion of work on each panel.

R1 3. The Contractor shall perform special stress/strain tests for sensory alloy development. Approximately 50 load/displacement test per year shall be performed. It is anticipated that the Contractor may need special training for unique tension/compression test methods. The government will supply all specimens.

4. The Contractor shall maintain the fractographic laboratory and coordinate all activities associated with the MTSB fractographic facility. The Contractor shall maintain a monthly laboratory equipment maintenance log. Duties will include familiarizing and certifying up to five researchers who wish to perform SEM studies.

Deliverables: (due at completion of each test, unless noted)

- laboratory maintenance log shall be kept by Contractor
- informal written and oral reports after completion of each analysis
- formal written Contractor Report at end of task (each panel examination and fatigue test series)

Performance Standards:
MEETS:

- perform minimum quantity of fracture analysis (1000 specimens per year)
- perform minimum quantity of fatigue tests (100 fatigue specimens per year)
- adherence to schedule and cost
- adherence to test procedures
- test data reports and laboratory maintenance log
- final written Contractor Report meets NASA editorial standards.

EXCEEDS: completion ahead of schedule

Begin R3 block addition
SUBTASK 5: Documentation of X-33 Thermal Protection System (TPS) and hot structures

development – lessons (Subtask POC: Dr. Max Blosser)

1. Contractor shall prepare documentation on lessons learned from the X-33 TPS and hot structures development.
Deliverables: The Contractor shall deliver an electronic document suitable to be incorporated into a NASA Contractor Report.
R4**Schedule:** Completion by October 31, 2002
Performance Measurements:
Meets- Completes and delivers documentation on schedule.
Exceeds- Completes and delivers documentation ahead of schedule

SUBTASK 6: Documentation of X-33 Thermal Protection System (TPS) and hot structures development – detailed reports compilation (Subtask POC: Dr. Max Blosser)

1. Contractor shall review existing documentation of previously completed X-33 TPS and hot structures development efforts. The Contractor shall then organize, edit, and document the pertinent information into a series of electronic documents suitable for publication as NASA Contractor Reports.
Deliverables: The Contractor shall deliver a series of electronic documents suitable for publication as NASA Contractor Reports as well as any pertinent photographs or video.
R4**Schedule:** Completion by October 31, 2002
Performance Measurements:
Meets- Completes and delivers two detailed reports documentation on schedule.
Exceeds- Completes and delivers more than two detailed reports documentation ahead of schedule

End R3 block addition

3. Government Furnished Items:

The Contractor shall be supplied personal computers and associated software, access to ODIN NAD connections, and access to UNIX workstations and associated CAD/CAE software.
The Contractor shall use existing specialized fatigue testing equipment, optical microscopes, SEM (scanning electron microscopy) equipment, and associated supplies located in the Fatigue and Fracture Laboratory in Building 1205.

4. 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.

5. Security clearance required for performance of work: R2 See Subtask 1 revision above.

6.	**Period of Performance:** Planned start date: January 2, 2001 Completion date: [R1R4] ~~October 31, 2002~~ [R5] ~~December 31, 2002~~ [R6] ~~December 31,2003~~ ***April 30, 2004***
7.	**NASA Technical Monitor:** Stephen J. Scotti M/S: 396 Phone: 757-864-5431 **NASA Competency/Other Technical Coordinator:** S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 04RDM Revision: 4 Date of Revision: 10/19/04

Title: Flight Services Office (METRO) Support

1. Purpose, Objective or Background of Work to be Performed: (GN03, NAS1-96013)

The Langley Research Center (LaRC) 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 (Notice to Airmen) information dissemination, flight plan filing, and interaction with military and commercial flight operations.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see [R1] below).

Revision 2: Extends the period of performance one year in continuation of NASA's support with anticipated total flight hours and individual pilot flying hours increased and new organizational technical coordinator designated for the new period of performance (see [R2] below).

Revision 3: Extends the period of performance one year in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R3] below, Section 6).

Revision 4: Extends the period of performance one year in continuation of NASA's support with no changes in detailed requirements for the new period of performance and documents previous replacement of technical monitor (see [R4] below, Sections 6 and 7).

2. Description of the Work to be Performed:

The Contractor shall perform the following subtasks:

a. Meteorological Briefings, Alerts, and Updates

- Integrate weather information from various sources to produce and deliver both routine and customized weather briefings based upon program or flight profile requirements. It is anticipated that approximately 10 pre-flight briefings per week will be required. These briefings shall be given to flight crews for research aircraft, support aircraft, and transient aircraft, and to 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, and/or warnings.
- Using the public address system in the hangar, announce lightning proximity within ten miles of the Center and repeat announcements with distance updates until the hazard has cleared the area.

b. Langley Air Force Base Field Usage

- Ensure authorization for transient aircraft on NASA business, at the rate of approximately 3 flights per month, but more during LaRC public events
- Serve as point-of-contact for information and documentation required for landing and assigning of landing permit (PPR).

- Be responsible for filing flight plans at the rate of 1-3 per day for research, support, and transient aircraft.

c. Radio Contact and Branch Notification

- 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~~ 6500-7500 hours per year) at this Center.
- Provide notification of incoming aircraft to Aircraft Systems Branch to facilitate marshaling, parking/servicing, and dispatch.

d. LaRC Operations Point-of-Contact

- Serve as the LaRC point-of-contact with Langley Air Force Base operations and other military and commercial airfield operations.
- Report results of monthly Air Traffic Control Board Meetings to the Head, Flight Service Team and Aviation Manager.

e. Flight Office and Aircraft Dispatch

- Provide flight office dispatch support, ramp observation, and security support, with particular emphasis on active taxiway encroachment and failures in traffic hazard warning system.
- Alert proper office of unauthorized encroachment of aircraft area or malfunction of taxi way warning or alert devices during normal duty hours.

f. Flight Hours Database Activity

- 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 R2 ~~300~~ 500 hours per year.
- Submit flight hour data printouts to Aviation Manager each month as the official pilot currency record, historical file, and flight training requirement record.
- Implement any changes to the pilot currency system as might be required without loss of data. (Note: For anything other than minor changes, this is an anticipatory requirement for which a task modification and revised Contractor's plan would be needed.)

Minimum acceptable level of performance:

a. Provide forecasts for the Flight Operation Support Center 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.

3. Government Furnished Items: All office space, work area space, office furniture, and utilities, and specialized equipment required for the performance of this task will be made accessible to the Contractor to include computers specially equipped with Government developed and/or procured software designed specifically for the accomplishment of this task.

4. 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.

5. Security clearance required for performance of work: A secret clearance is required.

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: R1 ~~December 31, 2001~~
R2 ~~December 31, 2002~~
R3 ~~December 31, 2003~~
R4 ~~December 31, 2004~~
December 31, 2005

7. NASA Technical Monitor: R4 ***Luci Crittenden***
M/S 255A Phone (757) 864-***1776***
NASA Competency/Other Technical Coordinator: ***FRSC***/***D102***/Barbara S. Trippe
M/S: 255A Phone: 757-864-3874

Task Order Number: 05RFM Revision: 1 Date of Revision: 12/7/01

Title: Equipment Manager for the CERES Project/EOS-AM Spacecraft

1. Purpose, Objective or 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 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) which will provide three spectral channels over the range of 0.3 to 50.0 micrometers. The CERES ProtoFlight Model (PFM) instrument was delivered to GSFC and integrated onto the Tropical Rainfall Measurement Mission (TRMM) Spacecraft. The CERES Flight Model 1 (FM1) and FM2 instruments were delivered to Lockheed Martin Missiles and Space (LMMS, King of Prussia, Pennsylvania) integrated on to the Earth Observation System AM (EOS-AM) Spacecraft. Both of these spacecraft have completed I&T and were successfully launched into their mission's orbits. The FM 3 and FM4 instruments have been delivered to TRW in Redondo Beach, California for the EOS-PM1 Spacecraft I&T Program for system verification testing. The EOS-PM spacecraft is scheduled to launch in December 2000.

The Contractor shall be responsible for maintaining records of the CERES PFM, FM1, FM2, FM3 and FM4 instruments' ISGE, MGSE and related GSE during the I&T phase and post launch storage. The IGSE consists of Instrument Interface Stations (IIS) and Test Operators Stations (TOS) which allow operation of the CERES instruments either directly or through the Spacecraft Ground Support Equipment (SGSE). These interfaced systems are shown in Figure 1. Additionally, as part of the IGSE, there are Interface Simulation Units (ISU) which are 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 CERES I&T, during the pre-flight environmental tests, launch readiness operations, post launch GSE return and storage.

Revision 1: Extends the period of performance seven months in continuation of NASA's support requirements (see ^{R1} below).

2. Description of the Work to be Performed:

The Contractor shall keep and maintain proper records for the CERES Project's ***PFM***, FM1, FM2, ***FM3***, and ***FM4*** instruments 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, FM2, ***FM3***, and ***FM4*** 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.
e. Respond to remove any CERES Instruments' movement restraints during operations.
f. Verify all contamination control requirements are met per CERES ICD.

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.

Performance Evaluation Criteria:

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.

3. Government Furnished Items:

1. Access to specialized software as determined necessary to support this task.

	2. Access to the CERES IGSE hardware as well as the TRW and CERES Project's documentation as required for record keeping, monitoring and scheduling 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.
4.	**Other information needed for performance of task:** 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 flight cleanroom CERES instrument operations. 4. The CERES Project, prior to execution, will approve all of the CERES operational test procedures. 5. All tests will be scheduled with and coordinated through the CERES Project. Travel: Periodic trips to GSFC, TRW and Vandenberg AFB, California 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.
5.	**Security clearance required for performance of work:** None Required.
6.	**Period of Performance:** **Planned start date:** 1/1/2001 **Completion date:** R1 ~~12/31/2001~~ ***7/31/02***
7.	**NASA Technical Monitor:** Charles E. Jenkins Jr., M/S 424, Phone 757-864-708 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

Appendix

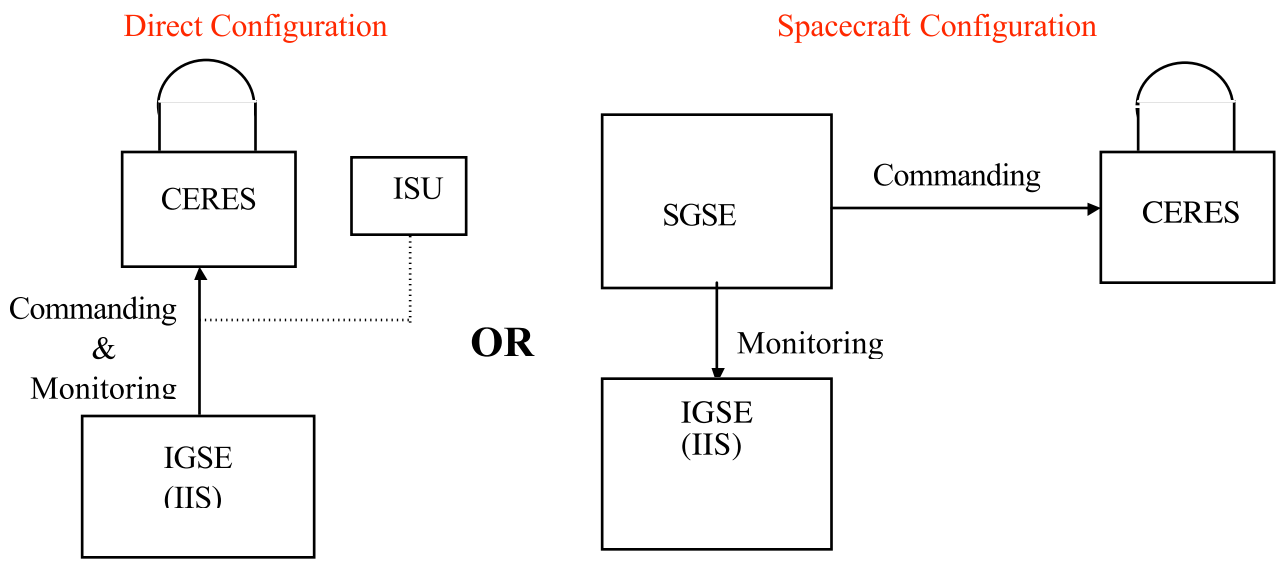

Figure 1: CERES instruments GSE configurations

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 06OCB Revision: 02 Date of Revision: 9/21/04

Title: Wind Tunnel Test of the 1/4 Scale X-43ALS Low Speed Demonstrator Vehicle

1. <u>Purpose, Objective or Background of Work to be Performed</u>:

The NASA Langley Research Center Hyper-X Program Office is actively engaged in the Low Speed Demonstrator Program to define the low speed flight characteristics of hypersonic vehicle shapes.

The general purpose of this task is to provide wind tunnel data from the Vigyan wind tunnel to better ascertain and direct future flight tests of the X-43ALS UAV.

Revision 1: Notes the one-month extended period of performance and schedule of the initial approved Contractor's Task Plan and adds testing requirements (see [R1] below).

Revision 2: Adds testing requirements to fully populate the ground-based simulator capability with X-43B-LS low speed stability tunnel data (see [R2] below).

2. <u>Description of the Work to be Performed</u>:

The Contractor shall conduct up to [R1]~~2~~ [R2]~~3~~ ***4*** weeks (~~10~~ ~~15~~ [R2]***20*** days [R2]***or at least three (3) additional days***) of testing on the 1/4 scale X-43ALS. The test shall be composed of configuration build up and design study parametrics.

1. The Contractor shall provide standard force and moment data in an electronic format by [R1]~~September 2, 2004~~ October 1, 2004. These measured items shall include: 6-component force and moment data, 2-8 base pressures, model attitude, and tunnel flow conditions.
2. The Contractor shall conduct model installation, instrumentation checkout, test, and data acquisition.
3. The parametric test matrix shall consist of, at a minimum, angles of attack from –2 to 20, angles of sideslip from –10 to 10, grit-type boundary layer trips on/off, as well as model configuration changes.

Begin [R1]block addition

4. Expand on data base produced by initial wind tunnel tests by running expanded wind tunnel matrix of data points for X-43B LS, starting with the completion point of the initial test conditions and series of data points. Expanded matrix shall provide sufficient technical information/data to provide necessary database to support ground-based simulations. [R2]***Provide for the final test points required to populate the ground-based simulator capability with X-43B-LS low speed stability tunnel data.***

End [R1]block addition

Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays not under Contractor's control.

Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional runs as requested by customer to supplement agreed upon data.

3. <u>Government Furnished Items</u>:

The government will furnish test article and force and moment balance.

4. <u>Other information needed for performance of task</u>:

	Task Order Number: 06OCB Revision: 02 Date of Revision: 9/21/04 Title: Wind Tunnel Test of the 1/4 Scale X-43ALS Low Speed Demonstrator Vehicle

5.	**Security clearance required for performance of work:** N/A
6.	**Period of Performance:** Planned start date: August 9, 2004 Completion date: R1 ~~September 2, 2004~~ October 1, 2004
7.	NASA Technical Monitor: Dave Reubush M/S: 353X Phone: 757-864-3749 NASA Competency/Other Technical Coordinator: Stan Ward M/S: 353X Phone: 757-864-2476

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	**Page 1 of 2~~22~~**

Task Order Number: __05RBG_____ Revision: ____ Date of Revision:

Title: Electronically Scanned Pressure Measurement (ESP) Modules

1. Purpose, Objective or Background of Work to be Performed: ~~(GH06, NAS1-96013)~~

This task supports the calibration and testing of four 64-channel wide-temperature electronically scanned pressure measurement (ESP) modules. Specifically the subtasks are to (1) calibrate the modules in the cryogenic pressure calibration facility in B1230 per specification, (2) modify the software to accommodate 64-channel modules, and (3) evaluate wind tunnel data taken with the modules. ~~(test to be specified at a later date).~~

Note: As each specific test requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designation below in Subtask 3.)

2. Description of the Work to be Performed:

Subtask 1. The Contractor shall prepare four 64-channel ESP modules for calibration upon their completion by the LaRC Electronics Applications Technology Branch (EATB). The calibration matrix is listed in the Appendix. The Contractor shall calibrate the modules with assistance from the Information Systems Development Branch to meet schedule.
Deliverable: calibration coefficients and uncertainties for each module.
Schedule: 3 months after delivery from EATB.
~~Metrics~~Meets Standard: completion of calibration matrix on schedule.
Exceeds Standard: completion of calibration matrix two weeks ahead of schedule.

Subtask 2. The Contractor shall adapt existing software for 16-channel modules to 64-channel modules. The Contractor shall evaluate the calibration coefficients and uncertainties.
Deliverable: source code in calibration facility computer and applicable code to the National Transonic Facility.
Schedule: 12/31/01
Meets Standard~~Metrics~~: completion of software adapted to 64-channels on time.
Exceeds Standard: completion one month ahead of schedule.

Subtask 3. (NOR controlled subtask) ~~-~~The Contractor shall evaluate data taken with the modules in wind tunnel tests. It is anticipated that there will be one NOR per month for this subtask.
Schedule: Four weeks after approved NOR.
Deliverable: evaluated wind tunnel data using calibration coefficients.
~~Metrics~~Meets Standard: completion of tunnel data evaluation on time.
Exceeds Standard: completion two weeks after approved NOR.

3. Government Furnished Items:

Task Order Number: __05RBG_____ Revision: ____ Date of Revision:

Title: Electronically Scanned Pressure Measurement (ESP) Modules

The Government shall furnish the cryogenic pressure calibration equipment, a computer adjacent to the facility to acquire the data, and a computer in the acoustics calibration laboratory to evaluate the data. ~~The Government shall provide internet access and an email address for transfer of information and data.~~

Contractor shall have access to Government facilities required to support this task, including but not limited to pressure calibration facility, B1230 R138, and the acoustics calibration laboratory, B1200 R110A; to specified wind tunnels to acquire field data; and to the fabrication facility B1238 to consult on fabrication issues.

4. Other information needed for performance of task: The Contractor shall receive Government training in handling liquid nitrogen.

5. Security clearance required for performance of work:

None.

6. Period of Performance:

Planned start date: 1/2/01 Completion date: 12/31/01

7. NASA Technical Monitor: Allan J. Zuckerwar
M/S: 493 Phone: 757-864-4658
NASA Competency/Other Technical Coordinator: Bob Hedgepeth
M/S: 285 Phone: 757-864-8265

APPENDIX: CALIBRATION MATRIX OF 64-CHANNEL MODULES

Reference pressures: 1, 3, 8 atm
Temperatures: +50, 25, 0, -20, -40, -60, -80, -100, -120, -140, -160, -180 (or lowest attainable temperature)
Differential pressure step: 5 psi including 0 (offset) to full scale (45 psi)
No. channels: 64
Recorded outputs: bridge voltage (pressure) and temperature resistor (temperature)

Task Order Number: 05RCC Revision: 6 Date of Revision: 11/19/04

Title: **Analytical and Computational Methods Engineering**

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

While providing support to the Analytical and Computational Methods Branch (ACMB), the overall objective of this task is to develop research and technology of efficient, physics-based analytical and computational methods to enable multidisciplinary design and analysis of advanced materials and structures for aerospace applications.

Begin R4 block background redefinition

Subtask 1.

The objective of this subtask is to provide software engineering, development, and maintenance functions for ABAQUS user subroutines implementing SSA and IFEM methods, Automated Structural Layout software for the EASI project, the Computational Mechanics Testbed (COMET-AR) software system, web-based analysis tools, and the ACMB branch web sites.

**End R4 block background redefinition*

Subtask 2. R4Current funding limitations may impact continued effort on Subtask 2. This issue is expected to be resolved after R6~~January 2004~~ ***February 2005***.

The objective of this subtask is to develop and apply analysis and design methods that account for uncertainties when calculating the loads acting on an aerospace system, when calculating the response to those loads, and when designing the structure to carry those loads. Emphasis is to be placed on probabilistic methods that can be used in reliability-based design. Additional methods – particularly those that could be useful for early design – will also be explored. Procedures will be developed for integrating probabilistic analysis, structural and aeroelastic analysis, and optimization software for the purpose of applying the final product in reliability-based design optimization. The ultimate, long-term goal is reliability-based multidisciplinary design optimization.

Subtask 3.

The purpose of this subtask is to evaluate and improve on the shielding provided to ISS R6~~8A~~ ***11A*** configuration and future concepts for space stations, crew transfer vehicles, and spacesuits. The first steps are to develop realistic radiation shield models of the ISS R6~~8A~~ ***11A*** configuration, space station, crew transfer vehicle, and space suit concepts; to develop computational procedures for the appropriate radiation environments; and to implement parametric and organizational optimization procedures. The targets of the design process are the crew quarters where the astronauts sleep, other areas where astronauts are expected to spend a significant portion of their time, and safe havens from solar particle events. The models as developed will represent basic structural elements for the specific configurations and the space suits that the astronauts will wear during Extra-Vehicular Activity (EVA). Various analyses will combine these shielding models with environment models and human tissue models to produce estimates of the radiation dose that crew members can expect during the various radiation events they may encounter.

Subtask 4.

The objective of this subtask is to develop and apply analysis methods for prediction of the deformation and fracture of polycrystalline metals[R6]~~and to develop new methods for built-up structures that lead to the application of meshless methods~~. Emphasis is placed on work within the Computational Metals [R6]~~and Meshless Methods~~ team to further advance the state-of-the-art in [R6]***this area***.

Subtask 5. [R4]Current funding limitations may impact continued effort on Subtask 5. This issue is expected to be resolved after [R6]~~January 2004~~ ***February 2005***.

The NASA Langley Radiation Physics Group will be using IDS/FACE to enable outside customers to utilize all the radiation shielding tools for spacecraft design, mission analysis, and operational analysis. The IDS/FACE tool is a stable web based platform that allows minimal changes to the Radiation Tools for implementation. The Radiation Tools on the IDS/FACE tool is called the Space Ionizing Radiation Effects and Shielding Tool (SIREST). This is envisioned to be one tool among many to perform total spacecraft design and analysis.

The NASA Langley Research Center Vehicle Analysis Branch (VAB) [R6]***has closed*** out its development of IDS of Planetary Entry Vehicles.

This work was previously performed under task order 04RAA. Incorporation here of continued work addresses [R6]***FY05*** plans for the SIREST site, along with the closeout of the planetary effort.

Begin [R5] block background new requirement

Subtask 6.

The objective of this task is to perform structural analysis and design studies to verify methods and to assess and improve performance of NASA mission critical structures.

End [R5] block background new requirement

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates/redefines the requirements for the new period of performance with previous Subtasks 2, 4, and 6 renumbered as 1, 2, and 3, respectively.

Revision 2: Adds new requirements as Subtask 4.

Revision 3: Extends the period of performance one year in continuation of NASA's support with updated/redefined requirements, new requirements as Subtask 5 (previously task order 04RAA), and change in the overall task technical Monitor for the new period of performance.

[R4]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as “doc” files 05RCC, 05RCC01, 05RCC02, and 05RCC03.

Revision 4: Extends the period of performance one year to December 31, 2004, in continuation of NASA’s support, redefines/updates requirements for the new period of performance, and updates other info (see [R4]above and below).

Revision 5: Adds requirements as Subtask 6 including secret clearance (see [R5] above and below).

Revision 6: Extends the period of performance one year to December 31, 2005, in continuation of NASA’s support, redefines/updates requirements for the new period of performance, and updates other info (see [R6]above and below).

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall provide monthly technical progress and cost reports at the sub-task level to each of the identified sub-task technical monitors. The point of contact for all daily interactions shall be the sub-task technical monitors.

Begin [R4] block subtask 1 rewrite

Subtask 1.

The Contractor shall provide software engineering, development, and maintenance functions for ABAQUS user subroutines implementing Shape Sensing Analysis (SSA) and Inverse Finite Element Method (IFEM), Automated Structural Layout software for the EASI project, the Computational Mechanics Testbed (COMET-AR) software system, web-based analysis tools, and the ACMB branch web sites. These functions are:

1.1 Integration of computational structures and mechanics analytical methodologies into quality working code: SSA and the IFEM will be implemented and integrated in ABAQUS. The new methodologies will be validated by execution of analyses, which exercise the new capabilities on metallic and composite plate and built-up shell structures subject to multi-axial mechanical loading. Software changes that would effect user documentation shall be identified and reported. Contractor reports shall be prepared describing the implementation and validation of new methodologies in ABAQUS. User documentation for new processors and procedures shall be prepared.

1.2 Software engineering and development services will be provided for the Automated Structural Layout (ASL) software as part of the Computational Design Tool system under the EASI program. The task includes development of requirements for an ASL system and implementation of an ASL method in software.

1.2.1 Requirements Analysis:

The purpose of this subtask is to develop requirements for ASL software to meet the needs of the Systems Analysis Branch (SAB).

The contractor shall:

- Evaluate existing structural modeling capabilities of SAB, ACMB, and the Multidisciplinary Optimization Branch (MDOB) and document the evaluation
- Develop R6~~prototype~~ models of structural layouts using existing software in SAB, ACMB, and MDOB to drive out additional requirements

*****Begin R6 block subtask 1 rewrite*****

- Document a comprehensive list of any additional requirements from those specified under last year's effort for an Automated Structural Layout system at the end of FY 2005.

*****End R6 block subtask 1 rewrite*****

1.2.2 Implementation of New Methodologies

*****Begin R6 block subtask 1 rewrite*****

The purpose of this subtask is to implement an ASL method (selected by NASA) into software. By the end of Q3 FY 2005, NASA will select a geometry tool for use in the ASL system.

The Contractor shall:

- Develop software (code/scripts) in the programming language of the selected geometry layout tool to generate a parametric structural layout of subsonic aircraft.
- Validate the selected software by execution of the geometry tool to generate a set of conceptual vehicle test cases approved by NASA.
- Provide user documentation for the ASL software and for the test cases.

*****End R6 block subtask 1 rewrite*****

1.3 The purpose of this subtask is to maintain the source and executable code for the COMET-AR software system: Maintain, make available through the Langley network, and protect the COMET-AR software system by ensuring that applicable software management techniques are applied. The contractor shall maintain the COMET-AR source code under version control utilizing the CVS configuration management system, prepare the code and documentation for distribution to outside parties, and maintain a web-based system to provide access to the source code to ACMB personnel.

COMET-AR has been approved for general release, and distribution to three outside parties is anticipated, following receipt of a signed Software Release Agreement by the requesters to the Center Software Release Authority or to the task monitor. The task monitor will notify the contractor by email of the release request. The contractor shall prepare the code and documentation for the requested code in electronic form and provide the distribution package to the technical monitor within 2 weeks of notification of the request.

The contractor shall prepare an updated version of the report on COMET-AR maintenance and distribution procedures for publication as a NASA CR. At a minimum, the report should document procedures for installation and verification of the software on UNIX and Windows platforms.

1.4 The contractor shall implement Web-based applications for ACMB management functions and research projects within the framework of the ACMB web page.

1.5 The contractor shall develop and deploy ACMB external and internal websites, maintain the web sites by updating existing pages and incorporating new information provided by branch researchers on a monthly basis, and. report changes and additions to the web sites monthly.

1.6 Reporting Requirements: Monthly reports shall be prepared concerning software change requests, problem reports, code distributions, system updates, and web site changes. Quarterly reports shall be prepared on software enhancement, documentation change requests, and acceptance test results.

Deliverables:

1.1 CVS repository of COMET-AR software containing history of changes to all files in the system.
1.2 The ACMB external and internal web sites on an ACMB host computer accessible to larcnet.
1.3 Monthly reports on code and documentation changes and distributions.
1.4 Updated report containing description of configuration management, porting, and installation procedures for COMET-AR, in MS Word format.
1.5 SSA and IFEM methods applied to built-up shell structures shall be integrated and demonstrated in ABAQUS Source code and installation procedures for the implemented SSA and IFEM methods.
1.6 Draft Contractor reports on the implementation and validation of the SSA and IFEM methods in ABAQUS.
1.7 User documentation for processors and procedures developed for the SSA and IFEM methods implemented in ABAQUS, in MS Word format.
1.8 Monthly reports on changes to the ACMB web sites.
1.9 Prototype models of structural layouts

Task Order Number: 05RCC Revision: 6 Date of Revision: 11/19/04

Title: **Analytical and Computational Methods Engineering**

1.10 Comprehensive list of requirements for an Automated Structural Layout system documented in MS Word format.
1.11 ASL software source code
1.12 Demonstration of the ASL method on a UNIX-based platform
1.13 User documentation for code developed for the ASL method
1.14 Verification data derived from validation activities.

Schedule: R6 ***Updated***

Deliverable	Description	Date
1.1	CVS Repository of COMET-AR code	Continuous
1.2	The ACMB external and internal web sites on an ACMB host computer accessible to larcnet.	Continuous
1.3	Monthly reports on code and documentation changes and distributions	Monthly
1.4	Draft Contractor Report	April 30, ***2005***
1.5	SSA and IFEM methods integrated and demonstrated in ABAQUS	June 30, ***2005***
1.6	Draft Contractor reports on the implementation and validation of the SSA and IFEM methods in ABAQUS	***Nov. 30, 2005***
1.7	User documentation for processors and procedures developed for the SSA and IFEM methods implemented in ABAQUS	Dec. 31, ***2005***
1.8	Monthly reports on changes to the ACMB web sites	Monthly
1.9	Prototype models of structural layouts	Oct. 31, ***2005***
1.10	Comprehensive list of requirements for an Automated Structural Layout system	April 1, ***2005***
1.11	ASL software source code	Dec. 31. ***2005***
1.12	Demonstration of the ASL method on a UNIX-based platform	Dec. 31. ***2005***
1.13	User documentation for code developed for the ASL method	Dec. 31. ***2005***
1.14	Verification data derived from validation activities.	Dec. 31. ***2005***

Performance Measurement:

Meets: All deliverables satisfied by Dec. 31, R6 ***2005***

Exceeds (one or more of): innovative contributions to the branch web sites; innovative contributions to code development associated with the shape-sensing analysis techniques and interfacing with the ABAQUS code; innovative contributions to requirements for an ASL system; providing deliverables 1.9 to 1.14 prior to scheduled completion date.

End R4 block subtask 1 rewrite

Subtask 2.

2.1 The Contractor shall develop and apply analysis and design methods that account for uncertainties when calculating the loads acting on an aerospace system, when calculating the response to those loads, and when designing the structure to carry those loads. Emphasis shall be on probabilistic methods that can be used in reliability-based design. Additional methods – particularly those that could be useful for early design – shall also be explored. The Contractor shall develop procedures for integrating probabilistic analysis, structural and aeroelastic analysis, and optimization software for the purpose of applying the final product in reliability-based design optimization.

Deliverables:

2.1 Monthly reports describing progress, issues, and concerns.

2.2 Semi-annual reports that describe new methods and software being developed and that provide results of studies carried out using these methods and software.

2.3 New software, associated upgrades, and documentation.

Schedule:

All work is to be completed by Dec. 31, R4 2005.

Performance Measurement:

Meets: Contractor provides deliverables 2.1, 2.2, and 2.3 and at least one of the following:

Exceeds: Three or more of the following:

- Demonstration of the new reliability-based design (RBD) technology as a part of an experimental program involving, for example, a structural or wind tunnel test.
- Demonstration of the new RBD technology on a problem involving more than twenty random variables.
- Demonstration of the new RBD technology on a problem involving four or more failure

modes.

- Implementation of the new RBD technology in the COMET-AR general-purpose finite element code.
- Demonstration that the new RBD technology provides a substantial reduction in computer time required to perform RBD.
- Demonstration of the new RBD technology on the ACMB "Electra" computer cluster using all 16 computational nodes.

Subtask 3.
(Previous 3.1 and 3.2 discontinued)

3.1 International Space Station Modeling and Analysis

The Contractor shall:
1. Modify and create computerized geometry models which represent the various ISS R6~~8A~~ ***11A*** components to the level of detail appropriate for radiation shielding analysis. This will include the modeling of components which are interior to the modules. These models will be exported to a format that is compatible with ray tracing software used to calculate shielding. Verify that the components created are referenced to the correct coordinate system and modeled in the correct system of units. Verify that the components are added to the overall ISS assembly correctly. Create properly formatted data tables that relate each component to its corresponding material. Complete ray tracing analyses for specified target points and perform dose and shield augmentation analysis. Add modules to the ISS R6~~8A~~ ***11A*** representing shield augmentation of the crew quarters and optimize the shield augmentation design.

Deliverables
1. Fully functioning radiation shielding model of ISS R6~~8A~~ ***11A*** configuration, free of known modeling errors, installed on NASA computers. Shield augmentation components for crew quarters. Component-specific documentation outlining the models delivered and specifying the technical references used.

2. Monthly reports are requested for all work under this task including statements of progress, problems, and resources expended.

Schedule:
Deliver ISS R6~~8A~~ ***11A*** shielding model April R6***2005***
Perform dose analysis by May Rn***2005***

Perform shield augmentation studies Sept [Rn]***2005***

Performance Measurement:

Meets: Delivers all models on schedule

Exceeds: Evaluates dose, dose equivalent, and Gy-Eq for CAM/CAF tissue models and reports in formal publication.

Begin [R4] block subtask 4 rewrite

Subtask 4.

4.1 The Contractor shall develop and apply analysis methods for multiscale modeling of structural materials. Emphasis shall be on development of finite element-based analyses for the micromechanics of deformation and fracture. Analyses shall include those required to predict decohesion along grain boundaries in polycrystalline metals. Analyses for grains with both random and prescribed configurations shall be considered. Other means of predicting damage progression in structural materials will be considered as needed and include fracture mechanics and progressive failure analysis. The Contractor shall also work within the Computational Metals team to further advance the state-of-the-art.

End [R4] block subtask 4 rewrite

Deliverables:

4.1 Monthly reports providing progress, issues, and concerns

4.2 A semi-annual contractor report describing analysis methods results

4.3 New software and associated upgrades

Schedule:

Drafts/revisions of contractor report due quarterly

All work is to be completed by [R6]***December 31, 2005***

Performance Measurement

Meets: Contractor reports delivered [R6]***December 31, 2005***

Begin [R4] block subtask 4 metric rewrite

Exceeds: One or more from below:

- Micromechanics analysis for grain debonding within a polycrystalline metal
- Demonstration of the new analysis on a problem involving a large number of grains and internal load paths
- Micromechanics predictions for several prescribed grain configurations

End R4 block subtask 4 metric rewrite

Subtask 5.

The Contractor shall provide programming support for new radiation modules, maintenance, and documentation for the IDS/FACE system

5.1: Site maintenance

The Contractor shall provide programming support for new radiation modules, support for new IDS features, general cleanup of the programs to enable simpler module creation, and documentation. This could include, but is not limited to,

a) Provide consulting on module creation for radiation tools and related tools
b) Support network configuration changes
c) Supply new tools to enhance collaborative engineering through FACE
d) Enable category configuration via configuration files instead of modifying CGI scripts.

The public accessible SIREST core machine is hosted by LaRC IT Branch. The Remote machine, SIRESTREM, is controlled by the Radiation Physics Group. The Radiation Physics Group also supports the development machine, SIRESTDEV. The contractor will support module creation on the public and development machines and any new features for those modules. This could include, but is not limited to, creating an interface from IDS/FACE to the CAVE, supporting off-site collaborations, and making data transfers between the machines as efficient as possible.

5.2: Repair of any known bugs in the IDS/FACE system.

The Contractor shall repair all known bugs and adequately comment all code so that the system would be usable in the future by other developers not currently knowledgeable of the system. The contractor shall provide the list of known bugs, their criticality and the prioritization for their repair. The government will review the list and provide comments and additions, as appropriate, within thirty days of receipt. The Contractor shall create a CD that will allow the system to be installed on computer systems not yet in the IDS/FACE system.

5.3: Documentation of the IDS/FACE system.

Task Order Number: 05RCC Revision: 6 Date of Revision: 11/19/04

Title: **Analytical and Computational Methods Engineering**

The Contractor shall develop a comprehensive integrated web-based user's manual, programmer's guide, and "how to"/FAQ document covering the capabilities and features of the FACE infrastructure, as well as integrated modules for both the planetary and SIREST sites.

Deliverables: R6 ***Updated***

ELEMENT	DELIVERABLE	DATE
1.0	Fully functioning upgrades to SIREST	R4 11/30/***05***
2.0	CD containing all software	R4 11/30/***05***
3.0	Completed documentation	R4 06/30/***05***
4.0	List of known bugs	R4 03/30/***05***

Schedule:

Drafts/revisions of contractor report due quarterly

All work is to be completed by R6 ***December 31, 2005***

Performance Measurement

Meets: Contractor reports delivered June 30, R6 ***2005*** and software delivered R6 ***December 31, 2005.*** In addition, Contractor repairs 75% of identified bugs

Exceeds: Contractor repairs 95% of known bugs

Begin R5 block subtask 6 new requirement

Subtask 6.

The Contractor shall carry out structural analysis and design studies to verify methods and to assess and improve performance of NASA mission critical structures. These tasks shall include:

6.1 The Contractor shall develop Finite Element Method (FEM) models of various metallic and composite structures. Meshes of varying fidelity may be required to address global behaviors and local high stress issues. Static, dynamic, heat transfer and stability analyses shall be performed. Linear and nonlinear deformations and stress analyses shall be predicted. The Contractor may need to conduct design modifications and perform analyses to evaluate the design improvements.

6.2 The Contractor shall create local FEM models for investigating design concepts, damage tolerance, thermal cracking, and thermal mismatch.

6.3 Drawings, boundary conditions, and loading conditions will be provided by the NASA monitor.

6.4 Finite element models will be reviewed by NASA technical monitor and the Contractor shall incorporate the comments into the structural model.

Deliverables:

6.1 All the finite element models that have been created.
6.2 The results (e.g., plots of deformed shape, stresses, and strains) of the finite element analyses.
6.3 Monthly progress reports.
6.4 A final report documenting the analysis results.

Performance Measurement:

Meets- Complete structural analyses and document results for various design concepts [R6]***delivered throughout contract performance and completed by December 31, 2005***.
Exceeds- Provide design modifications which can result in significant reduction in the structural weight or the life-cycle cost or which can result in an increase in the reliability of the design.

End [R5] block subtask 6 new requirement

3. **Government Furnished Items:**

Subtask 1.

- Computer accounts on ACMB workstations
- COMET-AR source code, test cases, and documentation
- [R4]Access to ACMB's ABAQUS and PATRAN licenses
- [R4]Access to ACMB's, MDOB's, and SAB's software development environment
- CVS software for configuration management
- Web page development software
- Office space, (specialized) desktop computer for code maintenance, shared printers for Contractor personnel

Subtask 2.

- Computer accounts on ACMB Workstations.
- Access to LaRC software that is required to perform the work on this task.
- Access to COMET-AR source code, test cases and documentation.
- Office space, desktop computer, shared printers for Contractor personnel.

Subtask 3.

Furnished for Modeling and Analysis

1) Access to SGI workstations, (specialized) personal computers (Apple and PC's), and the SDRC I-DEAS CAD software.
2) Data necessary to generate models and analyses.

Subtask 4.

- Computer accounts on ACMB Workstations.
- Access to LaRC software that is required to perform the work on this task.
- Office space, shared printers for Contractor personnel.

Subtask 5.

1) Access to IT public Web Server (SIREST).
2) Access to development machine (SIRESTDEV), remote machine (SIRESTREM), and computational machines (HESB3 to date).
3) Access to any programs needed to implement SIREST.
4) Access to SUN and SGI workstations, IBM PC and Macintosh computers, and printers.
5) Access to the internet via Netscape.
6) Access to the following software: I-DEAS, TECPLOT, LaTEX, and POST (3- and 6-DoF).

End R5 block subtask 6 new requirement

Subtask 6.

- CAD drawings of NASA mission critical structures or structural components to be analyzed.
- ABAQUS, NASTRAN, PATRAN, and LS-DYNA and other codes access as required to complete the subtask.
- Computers access to ACMB workstations

End R5 block subtask 6 new requirement

4. **Other information needed for performance of task:**

Task Order Number: 05RCC Revision: 6 Date of Revision: 11/19/04

Title: **Analytical and Computational Methods Engineering**

[R4]Travel: Trip for one person to present a paper at SDM conference in [R6]***Austin, TX**, **April, 2005***; ***Trip for one person to attend program meeting in Denver, CO, May 2005***.

All Subtasks

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.

5. Security clearance required for performance of work:

Subtasks 1 through 5

Unclassified. US citizenship or Permanent Resident status is required for access to government computers.

[R5]**Subtask 6**

Secret clearance required.

6. Period of Performance:

Planned start date: Jan. 1, [R1]~~2001~~ [R3]~~2002~~ [R4]~~2003~~ [R6]~~2004~~ ***2005***

Completion date: Dec. 31, [R1]~~2001~~ [R3]~~2002~~ [R4]~~2003~~ [R6]~~2004~~ ***2005***

7. NASA Technical Monitors:

Jonathan B. Ransom M/S: 240 Phone: 757-864-2907

Subtask 1: Christine G. Williams, M/S 240, Phone: 757-864-2911
Subtask 2: W. Jefferson Stroud, M/S 240, Phone 757-864-2928
Subtask 3: John W. Wilson, M/S 188B, Phone 757-864-1414
Subtask 4: [R4]Edward H. Glaessgen, M/S 240, Phone 757-864-8947
Subtask 5: Robert C. Singleterry, Jr. , M/S 188B, Phone 757-864-1437
[R6]***Subtask 6: Thiagarajan, Krishnamurthy , M/S 240, Phone 757-864-3207***

NASA Competency/Other Technical Coordinator: Laurie W. Johansen M/S 285, Phone: 757-864-1757

Task Order Number: 05RDM Revision: 4 Date of Revision: 10-19-04
Title: Flight Operations Support Center

1. Background: The Flight Operations Support Center (FOSC) 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 FOSC for use by NASA, contractor, and industry researchers. Each flight typically requires approximately 130-250 data parameters, 1-2 video sources and 6-11 audio channels.

In performance of this task the Contractor will have the following responsibilities:

- Provide operations support for controlling and monitoring research flights data linking to the FOSC. This service has become increasingly important as new technology facilitates more off-site research data collection for local researchers.
- Provide Shuttle support on a mission-by-mission basis in the form of data and comm (voice/ coordination circuits) services.
- Coordinate the installation and the operation and maintenance of the LaRC Datalink Infrastructure Facility (DIF) located in the FOSC, as well as, the operation of the mobile DIF that is presently under construction. This mobile DIF may deploy to Wallops Flight Facility (WFF) or airports located in Virginia.
- Provide operations coordination and flight operations implementation support for NASA's flight activities to enable NASA LaRC to conduct flight research programs for both internal and external customers. This support is required on a program-by-program basis as well as continuous support to the planning and coordination functions. Research requirements are mutually agreed upon by the researcher and the Contactor early in the program and often refined prior to delivery based upon preflight briefings. A log of flight service activity is maintained by the Contactor and reviewed by the Technical Monitor.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see [R1] below).
Revision 2: Extends the period of performance one year in continuation of NASA's support with no changes to detailed requirements and newly designated organizational technical coordinator for the new period of performance (see [R2] below).
Revision 3: Extends the period of performance one year in continuation of NASA's support with no changes to detailed requirements for the new period of performance (see [R3] below, Section 6).
Revision 4: Extends the period of performance one year in continuation of NASA's support with no changes in detailed requirements for the new period of performance and documents previous replacement of technical monitor (see [R4] below, Sections 6 and 7).

2. Description of the Work to be Performed:

a. Install, checkout, operate, maintain, and troubleshoot all computer systems within the FOSC, as well as interface subsystems (ITAS Series 10, ITAS Series 20, Graphics, 586, Combat Monitor, and System Support). Provide consultation services in the setup and operation of DOS and UNIX computer systems.

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Title: Flight Operations Support Center

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 FOSC.

d. Operate and maintain all video and data recording systems within the FOSC, 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 parameters, 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 Johnson Space Center, Dryden Flight Research Center, Wallops Flight Facility, Kennedy Space Center, and Vandenberg Air Force Base.

g. Operate and maintain the LaRC DIF and the mobile DIF.

h. All systems within the FOSC will fall under the FOSC Configuration Control System. The Contractor shall meet with the FOSC Configuration Control Board once every 2 weeks for approximately 2 hours. The Contractor shall present any configuration changes of systems or equipment in the FOSC 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% FOSC systems availability; no less than of 98% data and video documentation recorded.

3. Government Furnished Items: The Contractor will have access to all Government provided data, video, audio, and maintenance equipment in the FOSC.

4. 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.

5. Security clearance required for performance of work: A secret clearance will be required.

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: R1 ~~December 31, 2001~~

Task Order Number: 05RDM Revision: 4 Date of Revision: 10-19-04
Title: Flight Operations Support Center

	R2 ~~December 31, 2002~~ R3 ~~December 31, 2003~~ R4 ~~December 31, 2004~~ ***December 31, 2005***
	7. NASA Technical Monitor: R4 ***Luci Crittenden*** M/S 255A Phone (757) 864-***1776*** NASA Competency/Other Technical Coordinator: ***FRSC***/***D102***/Barbara S. Trippe M/S: 255A Phone: 757-864-3874

	Task Order Number: 06RAB Revision: 1 Date of Revision: 12/11/01 Title: Aircraft Structural Weight Sensitivity Calculation Capability

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

The purpose of this task is to continue development of the SUITCASE (SUITe of codes for Conceptual Aeroelastic Sizing using Elaps) program system. SUITCASE is an integrated system of computer codes to calculate the sensitivity of optimized structural weight to aircraft configuration shape changes. The system includes capabilities for performing parametric model geometry changes, aeroelastic loads calculations and structural member sizing.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by adding a new element to the task that addresses improving the speed and precision of the system. Also, a series of system demonstration activities are to be conducted. (See R1 below.)

2. **Description of the Work to be Performed:**

Subtasks

1. Investigate alternatives for an improved flutter sizing capability for SUITCASE. New method should improve speed and robustness of the flutter solution.
2. Identify and implement speed and efficiency improvements for SUITCASE. Investigation shall include search for an improved eigensolver, utilization of program profiling, and a study of the feasibility of utilizing design variable based definition for the ELAPS model.
3. Investigate the requirements for integrating the system described in task 1 with a graphical user interface that could provide display and manipulation of input data, analysis process control, and display of key result data. Simplify and streamline the model development and non-dimensionalization process to enable integration with a graphical user interface.
4. Develop guidelines and procedures for development of structural models which make effective use of the ELAPS methodology.
5. Investigate sources and methodology for non-optimum structural weight increments that can be incorporated in SUITCASE. Method should be capable of providing a reasonable estimate of the major components of non-optimum weight.
6. Finalize system software documentation including a description of the overall system organization and operation, description of the functionality of the system modules, and definition of all input variables
7. R1***Initiate the development of a new structural analysis computer code to correct deficiencies in the ELAPS program that lead to the requirement for quadruple precision analysis.***
8. R1***Examine the robustness of the SUITCASE system by developing models for and performing structural sizing with flutter for two supersonic business jet configuration concepts. The first of these concepts embodies NASA High Speed Research Program derived structural arrangement. The second concept employs a variable sweep wing to***

improve low speed performance characteristics.

Deliverables:

1. Subtask 1: Recommendation for new flutter methodology. Implementation plan.
2. Subtask 2: Recommendations for new eignsolver. A report on feasibility of implementing design variable definition for ELAPS model. Implementation plan if feasible. Report on the results of application of profiling. Summary and recommendations for other speed improvements.
3. Subtask 3: Recommendation and implementation plan for SUITCASE GUI.
4. Subtask 4: Report describing guidelines for developing SUITCASE/ELAPS Models
5. Subtask 5: Recommendations and implementation plan for SUITCASE non-optimum weights methodology.
6. Subtask 6: Final documentation
7. All subtasks: Updated SUTICASE software, including completed modifications as per subtasks 1-6
8. R1***Subtask 7: Initial implementation of the new structural analysis program***
9. R1***Subtask 8: Structural sizing results for the two supersonic business jet configurations. Summary of performance of the SUITCASE system during these studies and recommendations for improvements.***

Deliverable due dates

Subtask 1
- Recommendations and implementation plan by 3/31/01

Subtask 2
- Recommendations and implementation plans by 3/31/01
- Profiling results by 5/31/01
- Summary and speed improvement recommendations

Subtask 3
- Recommendations and implementation plan by 5/31/01

Subtask 4
- GUI Definition and implementation plans by 7/31/01

Subtask 5
- Recommendations and implementation plan by 6/30/01

Subtask 6
- Documentation by 12/31/01

R1***Subtask 7***
- ***Initial software implementation 12/31/02***

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	R1 ***Subtask 8*** - ***Structural sizing results and performance summary with recommendations 12/31/02*** All Subtasks - Software upon completion of implementation tasks, complete updated software by R1 ~~12/31/01~~ ***12/31/02*** Metrics: Meets: Deliverables on time Exceeds: Deliverables one month prior to due date
3.	**Government Furnished Items:** NASA shall furnish a copy of the most up to date version of the ELAPS, and linear aerodynamics analysis computer programs. NASA shall furnish access to computer workstations, CPU time, FORTRAN and C compiler and report writing software required to complete this task. NASA shall furnish geometry and data descriptions for NASA owned configuration models when required for validation.
4.	**Other information needed for performance of task:** None.
5.	**Security clearance required for performance of work:** Unclassified. Proprietary Data.
6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R1 ~~12/31/01~~ ***12/31/02***
7.	**NASA Technical Monitor:** Peter G. Coen M/S: 348 Phone: 757-864-5991 NASA Competency Coordinator: M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 06RBG Revision: 6 Date of Revision: 2/10/05
Title: Advanced Model Instrumentation System Development

1. **Purpose, Objective or Background of Work to be Performed**: (RB02, NAS1-96013)

This task includes characterization and application of MEMS (MicroElectroMechanical Systems) [R1] ~~and NEMS (NanoElectroMechanical Systems)~~ based [R4]devices such as sensors and actuators and fabrication and preliminary characterization of NEMS (NanoElectroMechanical Systems) [R5R3] ~~and MEMS~~ devices, [R4]~~at Cornell Nanofabricaion Facility at Cornell University~~. [R6]***and development of a software program for control over a mechanical actuator scheme for an active skin system***.

Revision 1: Clarifies NEMS requirements, adds travel, adds meets/exceeds standards omitted at task issuance (see [R1] above and below).
Revision 2: Deletes a previously revised GFI thus requiring Contractor to arrange and purchase usage of CNF facility for fabrication of NEMS devices (see [R2] above and below).
Revision 3: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the new period of performance: pressure measurement replaces those of temperature and viscous drag in wind tunnels, and adds characterization of MEMS devices fabricated at CNF.
Revision 4: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance around sensor and actuator systems in LaRC facilities (see [R4] above and below).
Revision 5: Extends the period of performance and schedule one year in continuation of NASA's support with no changes in detailed requirements for the new period of performance and updates sections 1 and 3 (see [R5] above and below).

Change 1: Contractor-initiated change that adjusts for NASA's forward funding and plans to continue the task order, extends the period of performance two months to February 28, 2005 (see [R5.1] below, Section 6).

Revision 6: Extends the period of performance and schedule one year in continuation of NASA's support and updates requirements and other info (see [R6] above and below).

2. **Description of the Work to be Performed**:

The Contractor shall characterize MEMS based [R4]sensor and actuator systems in LaRC facilities. The systems consist of a MEMS [R3]device, a data acquisition, and control board. In particular, the Contractor shall characterize the [R3]MEMS sensors and test the performance of the sensors in LaRC [R6]***facilities***. Requirements for the sensor system characterization and evaluation efforts are:

*****Begin [R6]block update*****

a. Integration of the Government furnished actuators and actuation control software developed for transonic shock mitigation active bump skins at a LaRC Facility.
b. Command and control characteristics of the actuator system with repeatability data.
c. Calibration of actuator system with the control software in a PC / workstation environment.

****End R6 block update****

R4 R1 ~~The Contractor shall fabricate NEMS/R3MEMS devices at Cornell Nanofabrication Facility (CNF) of Cornell University in Ithaca, NY. Design and fabrication instructions will be provided to the Contractor, and the CNF staff will give the necessary training for the use of CNF facility by the Contractor working at CNF.~~ Also the Contractor shall characterize NEMS based R3 device system in a laboratory. The system consists of NEMS or R3 MEMS devices, a data acquisition and control board, and a host computer. Requirements for the NEMS/ R3 MEMS device system characterization efforts are:

d. Integration of the Government furnished NEMS/ R3 MEMS R4 device system in a LaRC laboratory.
e. Characterization of the NEMS/R3 MEMS device system over a temperature range from 10 degree C to 45 degree C.
f. Repeatability evaluation of the NEMS/R3 MEMS devices in a LaRC laboratory.

Deliverables: There are R1 ~~three~~ R4 ~~four~~ three components of the deliverables. The first one is an informal written report of a laboratory based R4 device characterization, the second is a report is on the R1 ~~tunnel~~ evaluation results of the R1 MEMS/R3 NEMS device performance data, and the third R4R1 ~~report is on the results of NEMS/R3MEMS device fabricated at CNF, and the fourth~~ is an informal report about the sensor long term stability over a period of 30 days. R6 ***Development of one or more actuation programs for a mechanical actuator cam bump skin configuration, and documentation of actuation controls and sensors incorporated into an actuator-sensor system concept.***

Schedule of Deliverables: The first report is due 5 months from the commencement of this contract, the second report is due 5 months from the completion date of the first report. The third report is due R1 ~~upon completion of device fabrication at CNF. The fourth report is due~~ December 31, R3 ~~2001~~ R4 ~~2002~~ R5 ~~2003~~ R6 ~~2004~~***, 2005.***

R6 ***Detailed actuator control programs are due according to the model task schedule set by the Government, and a final documentation of the control program is due December 31, 2005.***

Metrics for Deliverables: The reports shall include all of the following laboratory and tunnel evaluation requirements:

- System Integration - Integration and operation of government furnished MEMS/NEMS Systems in Room 124, B-1200.
- Sensor Characterization – Determine sensor response characteristics R4 in a LaRC laboratory and a wind tunnel. as ~~a function of temperature and pressure over a temperature range from 10 degree C to 45 degree C with increasing and decreasing incremental temperature change of 3 degrees from the set temperatures and a pressure range from 8 psia to 30 psia. Also included are pressure sensor calibration results over temperature and pressure ranges specified above.~~

	• [R1] MEMS Sensor Repeatability Evaluation [R6]~~in Tunnel~~ - Test data of temperature corrected voltage outputs from the sensors [R6]~~for fluid flow velocities from 0 to 160 feet per second~~ • Results of two 30-day period [R1] MEMS/[R3]NEMS device stability tests with the two tests separated by a minimum of 30 days and analysis of sensor long-term stability. [R1] Meets Standard: All measurements within [R3]15% accuracy of known values with deliverables on time. Exceeds Standard: No measurements deviating from known values by more than [R3]10% with deliverables provided one month early**.**
3.	**Government Furnished Items**: Laboratory and tunnel facilities in B-1200 [R5]~~and B-1247B~~ [R6]***and B-1242 that includes a set of actuator and*** sensor clusters, associated data acquisition and testing systems, and necessary parts and components for the completion of the task. [R2] ~~[R1] NASA will make arrangements for fabrication of NEMS devices at Cornell Nanofabrication Facility.~~
4.	**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 Y2KCompliance Verification Form" and its supporting documentation, describing how the IT items demonstrate Year 2000 compliance.
5.	**Security clearance required for performance of work**: No security clearance is required for this task.
6.	**Period of Performance**: Planned start date: January 2, 2001 Completion date: [R3]~~December 31, 2001~~ [R4]~~December 31, 2002~~ [R5]~~December 31, 2003~~ [R5.1]~~December 31, 2004~~ [R6]~~February 28, 2005~~ ***December 31, 2005***
7.	**NASA Technical Monitor**: Seun K. Kahng M/S: 493 Phone: 757-864-7553 **NASA Competency/Other Technical Coordinator**: Bob Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 06RCD Revision 12 Date of Revision: 2/9/2005

Title: Material/Structural Mechanics Analysis and Testing

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

The objective of this task is to conduct research and technology development that evaluates concepts, quantifies behavior, durability, and damage tolerance, validates analysis tools, and validates performance of advanced materials and structures for aerospace applications.

Revisions 1-5: (For details see electronic task order system [ETOS] files *06RCD01.doc, 06RCD02.doc, 06RCD03.doc, 06RCD04.doc, and 06RCD05.doc, respectively*).
Revision 6: Task Order extended through November 30, 2003. Subtasks renumbered, added, and modified with updated requirements to reflect NASA's need for continued support (see [R6] below).
Revision 7: Subtasks 9 and 10 are discontinued. Subtask 20 is added. Period of performance is extended to 12/30/03. (see [R7] below)
Revision 8: Deleted subtasks 11 and 16. Extended the period of performance ten months to October 31, 2004. Adjusted schedules of all active subtasks except 15 and 20. Added short-term Subtask 21. Plan to do further definitions of subtasks after the beginning of the new fiscal year (see [R8] below).
Revision 9: Extends Subtasks 20 and 21 schedules to March 31, 2004, and January 31, 2004, respectively (see [R9] below).
Revision 10: Discontinues Subtasks 6 and 13, and replaces Subtask 17 with a new subtask. Annotates Subtask 16 as Completed. Extends schedules for Subtasks 15, 20, and 21. Extends the overall completion date two weeks to accommodate Subtask 17 schedule. Adds POC for Subtask 20 and changes Technical Monitor to Dr. T.S. Gates. See [R10] below for changes to current requirements. For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files *06RCD through 06RCD09.*
Revision 11: Extends the period of performance one year to October 31, 2005 with updated requirements (see [R11] below).
Revision 12: Extends the period of performance two months to December 31, 2005, reduces and updates requirements and other info (see [R12] below).

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall provide technical progress reporting and full financial reports at the individual subtask level in the monthly reports to the Task Technical Monitor

Subtask 1. Composite aircraft structural response with and without stiffness discontinuities.
POC: Dr. Mark Hilburger, 4-3106/ Dr. Cheryl Rose, 4-5419

a. The Contractor shall design test fixtures and coordinate test-specimen and test-fixture preparation for [R12]~~an estimated~~ [R6]~~60 to 70 nominal structural element and panel tests~~ [R6]~~and 10 to 20~~ tailored panel tests that will be used to evaluate the influence of structural details and [R6]damage on the [R11]~~compression~~ response of composite structures. The Contractor shall also coordinate test-specimen and test-fixture preparation for [R12]~~an estimated 10 to 15 laboratory scale composite cylindrical shells~~ [R6]~~that will be loaded in compression, or subjected to internal pressure. Panel and cylindrical shell test specimen preparation shall include preparation for~~ full-field displacement measurement during [R11]~~compression~~ testing using the VIC3D measurement system. The imperfection measurement of selected specimens also shall be done by the Contractor. The Contractor shall reduce the test data [R6]obtained during the performance period for comparison with analytical results. The Contractor shall assist NASA personnel in coordinating and conducting tests.

Begin [R6] block addition
b. The Contractor shall develop finite element models [R12]~~for an estimated 5-10 panels with notches~~ to determine critical loading conditions for notch-tip damage growth and panel residual strength. The Contractor shall conduct nonlinear analyses of the panels using the finite element models for an estimated 1 to 2 different loading configurations for each [R12]~~notched~~ panel configuration [R12]***when necessary***. The structural analyses [R12]***may*** include damage progression analyses.
End [R6] block addition

Deliverables: Test specimens prepared for testing, test fixtures, support fixtures, and reduced test data. [R6]Finite element models and analytical results.

R6 **Schedule:** Complete test preparation of nominal specimens by September 30, R8 ~~2003~~ R11 ~~2004~~ 2005. Complete test preparation of tailored specimens by September 30, R8 ~~2003~~ R11 ~~2004~~ ***2005***. Finite element models and analysis results shall be provided by March R12 ***30***, R8 ~~2003~~ R11 ~~2004~~ 2005.

Metrics: Test specimens and test fixtures shall be compatible and adequate for testing in government testing machines with loaded ends and fixtures prepared to assure adequate load introduction into the test specimens. Design work shall conform to appropriate standards. R6 The finite element models shall have adequate fidelity to represent global and local critical response and failure modes.

Begin R6 block addition/redefinition

Subtask 2. (was Subtask 5) Evaluation of the effects of manufacturing defects, impact damage on structural residual strength
POC: Dr. Cheryl Rose, 4-5419

a. R11 ~~The Contractor shall develop finite element models of an estimated 1-2 standard fracture toughness tests to validate decohesion elements and delamination growth models for Mode I and mixed mode loadings. The Contractor shall conduct nonlinear analyses of the fracture toughness tests using the finite element models and compare the analysis predictions with existing test data provided by the Government.~~(Completed) R12 ~~The Contractor shall develop finite element models of an estimated 10 to 15 flat and curved laminated composite panels to evaluate the influence of implanted delaminations on the residual strength of panels loaded in compression.~~ R12 ~~R11 The Contractor shall modify progressive failure analysis routines to reflect recent advances in failure criteria development and delamination growth modeling for composite structures. The Contractor shall conduct nonlinear, progressive failure analyses of the panels using the finite element models to determine residual strength, and the mode and extent of delamination growth. Refined analysis models shall include fixturing to determine test load and restraint conditions.~~

b. The Contractor shall coordinate test-specimen preparation for an estimated 10 to 15 flat and curved panels to evaluate the influence of implanted delaminations on the residual strength of panels loaded in compression. Panel test specimen preparation shall include imperfection measurement of the specimens, and preparation for full-field displacement measurement during testing using the VIC3D measurement system. The Contractor shall assist NASA personnel in coordinating and conducting tests. The Contractor shall reduce the test data obtained during the performance period for comparison with analytical results.

c. R12 ~~The Contractor shall develop finite element models of an estimated R11 5 ***20*** to 10 ***125*** flat and curved laminated composite panels to evaluate the impact damage resistance of these panels. The Contractor shall conduct nonlinear, transient, progressive failure analyses using the finite element models to determine contact forces, displacements, and damage resulting from the impact event.~~ R11 ~~The analytical results shall be compared with existing test data provided by the government.~~
Begin R11 block addition
d. The Contractor shall design test fixtures and coordinate test-specimen and test-fixture preparation for an estimated R6 20 to 25 flat and cylindrical panels that will be used to evaluate the impact damage response of composite structures. The Contractor shall assist NASA personnel in coordinating and conducting tests. The Contractor shall reduce the test data obtained during the performance period for comparison with analytical results. The Contractor shall coordinate post-impact inspection of the impact-damaged panels.
End R11 block addition

Deliverables: Test specimens prepared for testing, and reduced test data. Finite element models and analytical results.

Schedule: R11 ~~Finite element models and analytical results for fracture toughness tests shall be provided by March 31, 2003.~~ All flat and curved panel specimens for impact testing shall be prepared for testing by March 31, 2005.

R12~~Finite element models and analytical results for flat and curved panels with an initial delamination and for impact damage modeling shall be provided by September 30, R8 2003 R11 2004 2005. All flat and curved panel specimens with an initial delamination shall be prepared for testing by September 30, R8 2003 R11 2004 2005. All impact testing of flat and curved panel specimens shall be completed by September 30, 2005.~~

Metrics: Test specimens shall be compatible and adequate for testing in government testing machines and loaded ends and fixtures prepared to assure adequate load introduction into the test specimens. Design work shall conform to appropriate standards. The finite element models shall be detailed enough to represent the global and local response of the panels, delamination growth, and to determine instrumentation patterns. The analysis results shall accurately correlate with test results when test data are available during the period of performance of the task.

Subtask 3. Evaluation of failure criteria for laminated composite structures.
POC: Dr. Cheryl Rose, 4-5419

*****Begin R12 block update*****
The Contractor shall perform the following requirements:

a. Develop finite element models and conduct analyses in support a study of failure criteria for laminated composite material.
b. Coordinate test specimen preparation.
c. Correlate tests/analyses as test data becomes available.

This effort will concentrate on materials used for space such as the woven Reinforced Carbon-Carbon Composite used for the leading edge of the space shuttle and will include:

- An estimated 10 to 15 finite element models of damaged or cracked laminated composite panels shall be developed to evaluate damage and fracture models in tension and compression. Progressive failure subroutines shall be modified to reflect the developed failure models. Nonlinear progressive failure analyses shall be performed to predict the residual strength. Refined finite element models shall be developed incorporating the test fixturing to determine test load and restraint conditions.
- Preparation of an estimated 1 or 2 full leading edge space shuttle panel models. These models shall be used to evaluate the effect of different damage levels and locations.
- Preparation of an estimated 10 to 15 impacted or cracked test specimens will be coordinated. These specimens shall be used to evaluate the influence damage on the residual tension and compressive strength of laminated composite panels. This specimen preparation shall include coordinating the measurements of various imperfections and preparation for full-field displacement measurements using the VIC 3-D measurement system. Assistance shall be provided as requested by the Government in coordinating and conducting the tests. Test data shall be reduced, as it becomes available for comparison with analytical results.

Deliverables: Test specimen and fixture requirements, test plans, and drawings defining geometry and materials for all test specimens and test fixtures.

Schedule: The estimated schedule for all deliverables is dependent on receipt of Government-furnished items mentioned above. The estimated completion date for preparation of all damaged panels for residual strength testing is May 31, 2005. The estimated completion date for finite element modeling and analyses related to the tests of damaged panels panels is September 30, 2005. Status Reports of work accomplished are due by the following dates: January 1, 2005 and July 1, 2005.
*****End R12 block update*****

Metrics: Test specimens and test fixtures shall be adequate for testing in government testing machines with loaded ends prepared to assure adequate load introduction into the test specimens.

Subtask R6 5 (was Subtask 2): Metallic aircraft structural response with and without stiffness discontinuities. R11 Discontinued

Subtask R6 6 (was Subtask 4) : Evaluation of Ultra Lightweight Multifunctional Structures. R10 Discontinued

Subtask R6 7 (was Subtask 6): Morphing Technologies for Subsonic Aircraft Wing Structures
R11 Discontinued

Subtask R6 8 (was Subtask 7): Upgrades to VICONOPT analysis tool.
The Contractor shall further extend the capability of the VICONOPT composite panel sizing code, which is resident in the Mechanics and Durability Branch of Langley Research Center to include the following:

a. Demonstrate improved post buckling analysis capability for built-up structures where reduced stiffnesses for the structure are analytically obtained and taken into account well the into postbuckling regime.
b. Verify methods that include first failure prediction in the postbuckled structure.
c. Document results and train government personnel in the usage of the above capabilities.

Special requirements: To implement Langley's mission, performance of this subtask requires special skills and in-depth experience in the stability of shells and a thorough knowledge of the VICON and VICONOPT codes. The dependence of the mission on the subtask requirements will not allow time for normal on-the-job training and familiarization. For compatibility issues, the Contractor shall program the analysis methods using standard FORTRAN coding practices.

Deliverables: The Contractor shall provide engineering and technical modifications to the analysis methods and programs and document code capabilities before the end of September 30, 2002.

Schedule: Studies, documentation and training to be completed by R12 ***March 31, 2005***. Status Report of work accomplished by R12 ***March 31***, R6 ~~2001~~ R8 ~~2003~~ R11 ~~2004~~.2005**.**

Metric: The results from the Contractor developed code comparing within 2 percent of the existing results on existing benchmark problems.

Performance Standards:

MEETS:
- adherence to schedule and cost
- completion of all analysis
- final written Contractor Reports to meet NASA editorial standards

EXCEEDS:
- completion ahead of schedule
- completion under cost

Subtask R6 9 (was Subtask 11): Y-Joint Test Facility Modifications. -- R7 Discontinued

Subtask R6 10 (was Subtask 12): (Delay start until June 1, 2002) Y-Joint analysis for combined mechanical and thermal loading conditions. – R7 Discontinued**.**

Subtask R6 11 (was Subtask13): Bondline analysis. R8 DISCONTINUED after October 31, 2003

Subtask R6 12 (was Subtask 14): Structural integrity of friction stir-welded aerospace materials.
POC: Dr. Scott Forth, 4-3823

Purpose: Experimentally evaluate friction stir-welded panels for aerospace applications.
Objective: Conduct fatigue, fatigue-crack growth and fracture tests on friction-stir-welded specimens to assess the structural integrity for fuselage and wing applications in commercial

aviation.

Description of the Work to be Performed:

Begin R11 block requirements update
a. The Contractor shall conduct experiments to support the damage tolerance certification of friction-stir welded structure for primary aircraft structure. The development of relative damage tolerance data and interpretation of the failure modes of the specimens will be critical to the safe certification of an aircraft. The number of tests and complete description of the effort are included in the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications." (To be provided by NASA).

Deliverables: (due at completion of the task unless noted)

- Documentation of experimental data as required by the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications."

End R11 block requirements update
- brief written summary of each test (noting any testing anomalies)
- brief informal written monthly report
- formal written Contractor Report at the end of the task.

Performance Period: R11~~Nov . 1,~~ R8~~2001 2002 through~~ R8~~March 31,~~ R6 ~~2002 2003 September 30, 2004~~ Oct 1, 2004 through September 30, 2005

Performance Standards:
MEETS
- adherence to schedule and cost
- adherence to test and safety procedures
- R11data developed in accordance to the document "Fatigue and Damage Tolerance Coupon Test Plan for the Eclipse 500" in support of Space Act Agreement SAA1-560 "Mini-Jet Applications."
- final written Contractor Report to meet NASA editorial standards.

EXCEEDS:
- completion of tests ahead of schedule
- completion under cost
- R11completion of additional tests not included in test matrix

Subtask R6 13 (was Subtask 15): BOSOR4, PANDA2, VICONOPT, and FASOR development for PCs.
R10Discontinued

Subtask R6 14 (was Subtask 16): R11 Fatigue and Fracture Testing of Aerospace Structures.
POC: R6Dr. Scott Forth , 4-3823

Purpose: Determine R11fatigue crack growth and residual strength behavior of aerospace materials and structural configurations.

Objective: Conduct tests on R11~~aluminum alloys,~~ laboratory coupons and integrally stiffened specimens R11~~riveted stiffener specimens, and biaxial cruciform specimens.~~

Description of the Work to be Performed:
Begin R11 block requirements update
a. The Contractor shall perform fatigue crack growth tests on an aerospace alloy to identify the effects of specimen

configuration, laboratory environment and loading profile. These experiments will be used to support aerospace dynamic component damage tolerance research and modification of the ASTM testing standards as needed.

b. R12~~The Contractor shall perform fracture tests on integrally-stiffened specimens to develop new methods for determining residual strength. The results will be compared to existing residual strength information for built-up structure and be used as a baseline for the development of a new residual strength method for integral structure.~~

Deliverables (for each item): (due at completion of each test, unless noted)

- fatigue crack growth rate data
- integrally-stiffened structure residual strength data and methodology

End R11 block requirements update

- brief written summary of each test (noting any testing anomalies)
- brief informal written monthly report
- formal written Contractor Report at the end of the task.

Schedule: All work to be completed by September 30, R6~~2002~~ R8~~2003~~ R11~~2004~~ 2005.

Performance Standards:

MEETS

- adherence to schedule and cost
- adherence to test and safety procedures
- test data reports
- all tests in subtasks R11a R12~~and b~~ above complete
- final written Contractor Reports to meet NASA editorial standards.
- presentation and paper meet conference standards

EXCEEDS:

- completion ahead of schedule
- completion under cost
- R11completion of additional tests not included in test matrix

Subtask R615 (was Subtask 17): Characterization of Advanced Materials.
POC: Dr. Tom Gates, 4-3400

Purpose, Objective or Background:
As part of the Computational Materials Program, R11***Return to Flight***, and the R11***Advanced Vehicles*** program, LaRC has been tasked to evaluate the behavior of polymers, foams, polymeric composites, and nanostructured materials over a range of thermal, mechanical, and environmental conditions. The specific objective is to perform tests, reduce data, and analyze the results to establish performance of existing and new materials under a variety of loading conditions.

Description of the Work to be Performed:
a. Contractor shall conduct mechanical/environmental tests to simulate the effects of load, temperature, and moisture, and other environmental factors on stiffness and strength of advanced polymers, R11***foams***, polymeric composites, and nanostructured materials. Test specimen mechanical loading conditions shall be tension and compression over a range of static and time-dependent conditions. NASA shall supply all test articles. Detailed measurements on mechanical and physical properties shall be performed on specimens. Records shall be maintained to document the material properties. The Contractor shall report monthly on the progress of this testing.

b. Contractor shall perform as needed detailed data reduction and associated analysis to determine the final engineering-level properties of the test specimen. The analysis shall be used to guide the selection of applied loads and test apparatus. Analysis methods may include the use of concepts from elasticity, viscoelasticity, strength of materials, and damage mechanics. A Contractor report shall be issued upon the completion of work.

c. The Contractor shall assist as needed in development of environmental/mechanical test apparatus for use in the materials characterization work. This apparatus shall be located in the R12***MSMB*** materials characterization laboratory. The Contractor shall report monthly on the progress of test apparatus development.

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

Deliverables:

- laboratory test log shall be kept by Contractor
- informal written and oral reports after completion of each round of testing/analysis
- formal written Contractor report at end of task

Schedule: Completed by October 31, R6 ~~2002~~ R10~~2003~~ R11~~2004~~ ***2005***.

Performance Standards:

MEETS

- perform from 10 to 50 material property tests
- adherence to schedule and cost
- adherence to test and data reduction procedures
- test data reports and laboratory maintenance log
- final written Contractor Report meets NASA editorial standards

EXCEEDS:

- completion ahead of schedule

Subtask R616 (was Subtask 19): Cryogenic tank structural analysis and concepts development
R8DISCONTINUED after September 30, 2003 R10Completed

Subtask R617 (was Subtask 22): Automated finite element analysis of elastically-tailored laminates.
R10Discontinue and replace with new Subtask17 as described below

Begin R10 block replacement subtask

Subtask 17: Tow-steering design work

POC: D. C. Jegley, 4-3185

Task Description: This task will concentrate on extending several novel design techniques to alternative geometries and loading conditions using the *OLGA* software, the *STAGS* finite element code, and the *Cellular Automata (CA)* continuum partitioning concept.

The Contractor shall perform the following design and analysis requirements:

1) Employing the tow-steering design approach, design flat panels with central holes subjected to combined in-plane normal and shear load using the existing design environment that implements *STAGS* as the analysis tool. Panel stacking sequence shall be optimized for a given loading configuration using the parallel; tow-drop; and overlap methods of construction.

2) Employing *CA* techniques and the same loading and boundary conditions used in the tow-steered designs, design flat panels with sparsely distributed plies. Designs shall be verified to meet required loadings using finite elements. .

3) Design flat panels to be constructed using selective reinforcement of metals. This design approach shall be integrated with the tow-steering design methodology. Subroutines within the *STAGS* analysis code shall be modified to implement these new selective reinforcement components. Initial design studies shall be conducted for

a flat panel with a central hole and compared to the tow-steered design approach.

4) Modify the existing *OLGA* design software to allow for design of curved panels and cylinders using the tow-steering approach and design curved panels with and without a central hole based on required loading and specimen geometry provided by the government.

Begin R11 block addition

5) Enhance the topology design optimization tool to produce manufacturable designs composed of multiple layers with different orientations through the use of lamination parameters. A topology design tool based on the Cellular Automata paradigm shall be used. Fiber angle shall be used in a spatially continuous design optimization design problem with the lamination parameters as design variables instead of the fiber angles. With this new formulation, the stacking sequence of the optimal laminate with multiple layers is expected to be determined efficiently and reliably. Stacking sequences corresponding to the optimal lamination parameters shall be determined. These laminates shall be analyzed using the *STAGS* finite element program to determine the best laminates with respect to buckling performance.

End R11block addition

Deliverables and Schedule:

1) *Monthly progress reports detailing the progress of the work delivered electronically for all months of the task except the first and last month.* R11~~May 31, June 30~~, July 31, Aug 31, Sept 30, Oct 31, R11Nov. 30, Dec. 31, 2004 R11and Jan 31 2005

2) *A midterm report and presentation giving details of the designs for the tow-steered, the sparse coverage, and the selectively reinforced flat panels with holes*. This report shall summarize the expected buckling loads and responses for each panel, and indicate the avenues that possess the most potential for flat panels that utilize these approaches. Recommendations for parts to be manufactured and tested to best support the potential of the design concept shall also be included. R11~~June 30~~ Dec. 15, 2004

3) *All new software functional on NASA Langley computers and demonstrated to NASA personnel. and a user's manual*. R11~~Nov~~ Dec. 15, 2004

4) *A final report detailing the OLGA extension to curved panel geometries, presented in suitable form to be published as a NASA-CR.* R11~~Oct~~ Jan. 31, 2004

5) *A final presentation to NASA-Langley personnel introducing the extensions to the analysis and design tools for three-dimensional shell geometries* R11~~Nov. 15~~ Feb. 28, 2004

Government Furnished Items:

1) A software usage agreement for the use of *STAGS* by Contractor personnel will be provided by NASA-Langley.

2) NASA will provide boundary and loading conditions and models suitable for insertion into the STAGS finite element code for all panels to be designed

3) Contractor personnel will have access to Langley computers for checkout and installation of all new software.

End R10 block replacement subtask

***Period of Performance*:**

Planned start date: June 15, 2004 Completion date: R12~~Oct. 3, 2005~~ March 30,2005

Begin R6 block addition/redefinition

Subtask 18. Column Test and Analysis Support

Point of contact: Judith Watson 43116

1 R12 ***Deployable/rigidizable column test activities*** 6/30/R8 ~~03~~ R11 ~~04~~ 05

The Contractor shall support the integration of test fixtures and test specimens in the test facilities (building 1293 room temperature and cold temperature test cells). Participation in the testing of the specimens shall include coordination of the preparation and setup of the data acquisition system and test specimen instrumentation, operation of test equipment, operation of data acquisition equipment (Labview/VXI based), and reduction and analysis of data.

PERFORMANCE METRIC: Integration of test specimens into test fixtures for at least R12 ***75*** specimens and support, at a minimum, compression, tension, and bending tests for the R12 ***75*** specimens and reduction of data.

R11 Additional support shall be provided for incorporation of columns into a truss structure. Test support will be provided for deployment and load testing of the truss.

Begin R11 block deletion

~~2.~~ ~~***Support column analysis***~~ ~~10/31/R8 03 04~~

~~The Contractor shall use finite element code to model and compare analytical results to experimental test results for the deployable rigidizable columns under axial compression and tension, and bending loads. The analysis shall include parametric studies of variables in the column geometry that influence the columns structural behavior.~~

- ~~PERFORMANCE METRIC: A finite element model of a typical column specimen and comparison results for the experimental load regimes, and the structural behavior results of varying up to 3 geometry parameters of the column.~~

End R11 block deletion

One trip to Fredrica, Delaware. The trip is a single day to confer with the manufactures of the inflatable columns.

. Period of Performance:

Planned start date: Oct. 1, 2002 Completion date: ***December 31***, R8 ~~2003~~ R11 ~~2004~~ 2005

Subtask 19: Structural behavior of high-temperature adhesives and composite materials.
POC: Timothy J. Collins, 4-3113 R11 ~~/ Stanley S. Smeltzer, 4-3120~~
*****Begin R11 block requirements update*****
The Contractor shall perform analyses of advanced heat-shield (aeroshell) structural concepts, including sandwich construction test panels and subscale prototype aeroshell structures. The subtask will include the following components:

1) The Contractor shall perform analyses of the thermal expansion characteristics of advanced thermal protection system (TPS) materials. The TPS material systems to be considered consist of an ablative material embedded in E-Glass reinforcing honeycomb. Using supplied properties for the constituent components (E-Glass honeycomb and ablative material), and the known geometry of the honeycomb cells, the contractor shall perform analyses to determine the equivalent coefficient of thermal expansion (CTE) of several TPS material systems.

2) The Contractor shall validate the analyses performed in (1) above by performing limited laboratory tests using an 18"x24" (approximate) sample of TPS material. This will include gross CTE measurements of the sample TPS panel. The contractor shall recommend a suitable test procedure for determining the panel CTE and shall coordinate and execute the test.

3) The Contractor shall perform analyses of the thermal expansion behavior of advanced heatshield structural concepts subjected to heating loads representing the loads that will be applied to the structures during ground testing (designed to simulate typical planetary entry loads). The temperature profiles for these analyses will be

supplied by NASA. These analyses will consist of flat sandwich panels, curved sandwich panels, and subscale prototype aeroshell structures, all of which consist of a primary load-bearing structure with bonded TPS material. The analyses will be similar for each set of analyses, but the geometry and boundary conditions may vary (depending on anticipated test conditions). The test conditions and test article geometries to be modeled will be supplied by NASA. The primary result of interest is the shear stress at the adhesive bond line (between TPS and composite facesheet) created by differential expansion of the sandwich structure and the TPS material. Note that the CTE for the TPS materials in these analyses will come from the analytical results derived from work item (1) above.

Deliverables:

1) Analytical models and equivalent CTE analysis results for the following for at least five TPS materials to be selected and specified by NASA.

2) CTE experimental test results for one sample TPS material panel (approximately 18”x24”), including data reduction and correlation with the CTE predicted analytically under item (1) above.

3) Analyses models and results for at least five flat and two curved panel structural concepts subjected to radiant heating profiles representative of those expected during tests at the Air Force's Sandia Solar Tower facility. (panel geometries and heating profiles to be provided by NASA).

4) Analyses models and results for at least three subscale prototype aeroshell structural concepts subjected to heating profiles representative of those expected during arc-jet testing. (geometries and heating profiles to be provided by NASA).

Schedule: Monthly informal progress reports and a final report of work accomplished by October 1st, 2005 (final written report, Microsoft Word Format).

Metrics: Analyses shall be performed using suitable finite-element codes (such as MSC/NASTRAN, ABAQUS, and/or STAGS).

*****End R11 block requirements update*****

Performance Standards:

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- completion of all design, test, and analysis activities
- test data and analysis reports
- R11***monthly progress reports***
- final written R11~~Contractor Report (informal)~~ ***report***

EXCEEDS:

- completion ahead of schedule
- completion under cost
-

End R6 block addition/redefinition

Begin R7 block addition

Subtask 20: Subtask: Development of a small-crack monitoring system in metallic materials subjected to cyclic loading conditions

R10POC: Andy Newman, 4-8945

DESCRIPTION:

These specifications are being defined to develop an automated small-crack measurement system. Small cracks are herein defined as cracks that occur under cyclic fatigue loadings in metallic materials where the length of these small cracks is 20 microns or less. This system needs to be electronically linked to an electronic controller that is a part of a closed-loop fatigue testing system to allow stopping of a crack growth test in order to take small-crack measurements during cyclic fatigue loading. The electronic controller sends a control signal that causes a load, strain, or displacement to be applied to the test specimen. The small-crack measurement system being developed shall be capable to being linked to both a MTS-458 or Instron 8500 closed-loop electronic controller. The following specifications are required in this system.

System Specifications:

1. Resolution:
The measurement of small cracks with total crack lengths of 20 microns or less is required. The x-y coordinates of the crack tip for each crack measured must be determined and recorded.

2. Typical Area of Measurements:
A typical area where these small-cracks will be measured is for a standard single-edge-notch tension specimen configuration. A typical radius for the edge notch in this specimen configuration is between 3 and 5 millimeters, mm. The area to be considered for possible small-crack measurements is plus and minus 1 mm about the notch centerline. Crack measurements would be recorded up to when the small-cracks have coalesced into a primary crack and the primary crack breaks through the specimen thickness. Test specimen thickness could be up to 10 mm.

3. Frequency of Measurements:
Frequency of measurements should be automated at specified time or cycle intervals with up to 40 intervals per test.

4. Number of Measurements Required:
Up to 20 separate small cracks in the measurement area, see specification number 2, could be measured per test at any given measurement interval.

5. Data to be Recorded:
   a) Crack lengths.
   b) Incremental length of crack growth between succeeding crack lengths.

6. Data Storage Requirements:
Crack lengths, crack-growth increments, and crack-tip x-y coordinates must be stored on a PC hard disk.

7. Load Control During Crack Length Measurements.
This system needs to be capable of being electronically linked to both a MTS-458 closed-loop electronic controller and an Instron 8500 closed-loop electronic controller to allow the crack-growth test to be stopped in order to take small-crack measurements during cyclic fatigue loading. Only one of these electronic controllers will be used doing a given test. After the crack-growth test has been stopped for crack length measurements, a signal needs to be sent to the electronic controller, commanding the controller to increase the load to a certain percentage of the test systems maximum load to allow for the crack to open adequately in order to obtain an accurate crack length measurement. Before restarting the cyclic loading another command must be sent to the controller to return to the mean load that has been set for the cyclic fatigue loading being commanded. After the load has been returned to mean load, a signal needs to be sent to the electronic controller restarting the cyclic fatigue loading.

DELIVERABLES and SCHEDULE:

Aug. 15, 2003: Development of a prototype crack detection system and verification against alternative method on samples provided by LaRC.

R10 ~~Sept. 30, 2003~~ June 15, 2004: Phase 1: Manual system to identify and track growing cracks. Delivery shall include on-site installation, system validation and training.

R9 ~~Dec. 30, 2003~~, R10 ~~March 31, 2004~~ R11 ~~August 30, 2004~~ R12 ~~December 30, 2004~~ ***April 30, 2005***: Phase 2:

Automated system to identify and track growing cracks integrated with MTS-458 or Instron 8500 closed-loop controller. Delivery shall include on-site installation, system validation and training.

Performance Standards:

MEETS:

- adherence to schedule and cost
- adherence to test and safety procedures
- completion of all design and test activities
- test data reports
- Contractor User Report (informal)

EXCEEDS:

- completion ahead of schedule
- completion under cost

**End R7 block addition **
Begin R8 block addition

Subtask 21: Real-Time Structural Response Measurement and Visualization System

R11Discontinued

**End R8 block addition **

3. **Government Furnished Items:**

Test specimens

Test specimen instrumentation

Specialized measurement R6and testing equipment

STAGS nonlinear structural analysis code

Desk-top computers with specialized software

Computer CPU time for structural modeling and analyses

Access to appropriate test equipment

Office space (as required)

4. **Other information needed for performance of task:**

- All Langley safety procedures shall be followed.
- 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.
- Subtasks 10, 11, 16, and 17: Applicable documents may include:

  LMS CP-5518 Granting Foreign Nationals and Foreign Representatives Computer Accounts.
  LMS-CP-5549 Responding to Reports of Information Technology Security Incidents and Inappropriate Activity.
  LMS-CP-5519 Requesting Access to Information Technology Resources.
- Subtasks 12 and 13: **SPMP REQUIREMENT:** The Contractor shall comply with the responsibilities described by LMS-CP-5528 and LMS-CP-5532, as well as the requirements specified in the Data Acquisition and Information Management Branch (DAIMB) software plans for any new software developed or purchased. These software project management plans (SPMP), if required, shall be reviewed and accepted by DAIMB.
- R6Subtask 18: One trip to Fredrica, Delaware. The trip is a single day to confer with the manufactures of the inflatable columns.

5. **Security clearance required for performance of work:**

	Subtasks 10 and 11: ITAR and ADP clearances
6.	**Period of Performance:** Planned start date: 1/2/01 Completion date: R6 ~~10/31/2002~~ R7 ~~11/30/03~~ R8 ~~12/30/03~~ R10 ~~10/31/2004~~ R11 ~~11/15/04~~ R12 ~~10/31/2005~~ ***12/31/05***
7.	**NASA Technical Monitor**: R10 Dr. Thomas S. Gates M/S: 188E Phone: 757-864-3400 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

	Task Order Number: 06RDM Revision: 7 Date of Revision: 7-28-04 Title: Flight Operations - Coordination and Implementation

1.	**Background:** This task provides contract pilot services for flight operations support for NASA's flight activities to enable NASA LaRC to conduct flight research projects for both internal and external customers. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see [R1] below). Revision 2: Extends the period of performance one year in continuation of NASA's support with no changes to detailed requirements and newly designated organizational technical coordinator for the new period of performance (see [R2] below). Change 2: Specifies previously omitted aircraft, tail numbers, and pilot-in-command duties (see [R2.2] below). [R3]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 06RDM, 06RDM01, 06RDM02, and 06RDM022. Revision 3: Revises the task to include contract pilot services only and extends the period of performance for 3 months in continuation of NASA's support requirements (see [R3] above and below). Revision 4: Extends the period of performance one month to April 30, 2004 in continuation of NASA's support with no other changes to detailed requirements (see [R4] below, Section 6) Revision 5: Extends the period of performance five months to September 30, 2004 in continuation of NASA's support with no other changes to detailed requirements (see [R5] below, Section 6) Revision 6: Extends the period of performance three months to December 31, 2004 in continuation of NASA's support with no other changes to detailed requirements (see [R6] below, Section 6) Revision 7: Extends the period of performance six months to June 30, 2005, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R7] below, Section 6).
2.	**Description of the Work to be Performed:** Operations Engineering [R3](Deleted) Provide the services of a contract pilot to support research and/or support fights and simulation studies as required to support NASA research goals [R2.2]to include the following aircraft: Raytheon/Beechcraft Be-200 King Air – N529NA, Cirrus SR22X – N501NA, Cessna 206X – N504NA, and the Lancair LC40X – N507NA. Duties will be requested on short notice and will include serving as in-flight [R2.2]pilot-in-command and/or copilot-in-command for in-type aircraft ratings, or as approved by NASA's flight operation organization. Pilot and mission information on each flight shall be documented, maintained, and reported on a monthly basis. Deliverables:

	Task Order Number: 06RDM Revision: 7 Date of Revision: 7-28-04 Title: Flight Operations - Coordination and Implementation

	Contract pilot services as required and defined by flight operation organization R3not to exceed 200 flight hours per year. Metrics: Timely and accurate preparation and delivery of R3pilot services so as to preclude research schedule cancellations and/or delays. Acceptable level of performance: 95% of assigned missions conducted on schedule. Exceeds: 98% of assigned missions conducted on schedule.
3.	**Government Furnished Items:** Contractor will be provided access to Government supplied equipment required for task completion, including flight personal equipment and office furnishings.
4.	**Other information needed for performance of task:** Contractor may be required to work outside of normal duty hours, weekends or holidays as required to support flight missions. Contractor may be required to travel to deployment locations in the conduct of flight activities.
5.	**Security clearance required for performance of work**: Although a Secret Clearance is not required on a continuing basis, Contractor must be able to reinstate such clearance when required by the nature of the flight activity or as an access requirement at off-site locations.
6.	**Period of Performance:** Planned start date: R3~~January 2, 2001~~ January 2, 2004 Completion date: R1 ~~December 31, 2001~~ R2~~December 31, 2002~~ R3~~December 31, 2003~~ R4~~March 31, 2004~~ R5~~April 30, 2004~~ R6~~September 30, 2004~~ R7~~December 31, 2004~~ ***June 30, 2005***
7.	**NASA Technical Monitor:** Luci Crittenden M/S 256 Phone (757) 864-1776 NASA Competency/Other Technical Coordinator: ***FRSC/D102/***Barbara S. Trippe M/S: 255A Phone: 757-864-3874

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 06RFM Revision: 1 Date of Revision: 12/7/01

Title: Conduction of Tests and Instrument Operations for the CERES Project/EOS-PM Spacecraft

1.	**Purpose, Objective or Background of Work to be Performed:** The Clouds and Earth's 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 3 (FM3) and Flight Model 4 (FM4) instruments will be delivered to TRW, Redondo Beach, California, integrated on to the Earth Observation System PM (EOS-PM) spacecraft and complete the system verification and pre-launch environmental testing (See the attached EOS-PM I&T schedule). The EOS-PM spacecraft is scheduled for launch on December 31, 2000. The Contractor will be responsible for all of the CERES instruments' performance verifications, flight readiness testing and health operations. This is done by developing and executing procedures to operate and monitor the CERES Instruments via the Instrument Ground Support Equipment (IGSE) while connected in the Direct Configuration, or through the Spacecraft Configuration (Figures 1 & 2 show both of these configurations). In either configuration, The CERES instruments will be commanded to perform various test operations to collect information which defines and verifies the instruments' performance. Revision 1: Extends the period of performance seven months in continuation of NASA's support requirements (see R1 below).
2.	**Description of the Work to be Performed:** 1. The Contractor shall modify existing CERES test procedures required for EOS-PM test operations. Additionally, the Contractor will develop special test procedures to troubleshoot and verify instrument performance operations as required to resolve anomalous Spacecraft and CERES Instrument operations. The procedural content of the day to day EOS-PM test operations will vary according to specific test objectives and may include the following activities: a. Verification of the CERES instruments' functional status and readiness for I&T operations. This will be accomplished through the execution of the "CERES Aliveness Test Procedure. b. Verification that the CERES instruments' 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 instruments' components and subsystems are fully

functional with respect to their operational designed specifications. This will be accomplished through the execution of the "CERES Comprehensive Performance Test (CPT) Procedure".

d. Verification that specific CERES instruments' components and subsystems are operational within their designed specifications post any anomalous performance detected during I&T operations. This will be accomplished through the execution of approved special test procedures developed specifically to troubleshoot a performance problem revealed during normal I&T operations.

e. All instrument powered operations in support of S/C Integration and Testing.

f. Instrument unpowered operations in coordination with S/C operations, such as: Cleaning and Inspection, Alignment, Mechanical preparations for moving, Acoustic and Shock Tests, etc.

NOTE: It is anticipated that the normal CERES test operations, and therefore the procedures, will not change significantly following an initial test period. As part of this task, the Contractor shall provide current information regarding execution of the above mentioned test procedures and instrument operations to the LaRC CERES project personnel and to TRW S/C test personnel. Test information will be provided to GSFC project personnel on request or as needed.

2. The Contractor shall provide operations monitoring via IGSE when the above mentioned test procedures are executed by the TRW Operations Team via the SGSE. All of these operations will occur according to the attached TRW/EOS-PM I&T schedule, or the schedule updates.

3. The Contractor shall operate the IGSE or a computer with CERES Bench Checkout Unit (BCU) software and appropriate Archiving Media Drives to play back data files for analysis of recorded normal and anomalous operations.

4. The Contractor shall maintain Log Records at LaRC or the operations sites (i.e. TRW and VAFB) tracking all of the operating time of the CERES instruments, executed test procedures, operations data files and operations
anomalies.

5. The contractor shall maintain a CERES I&T test data archive on the LaRC DMSS computer in Building 1268 of all BCU Archived test data files.

6. The Contractor shall maintain a hard copy or electronic copy, as appropriate, of all CERES I&T Test procedures.

7. The Contractor shall develop and maintain standard operations procedures (SOP) required for

IGSE and instrument operations for both bench and spacecraft testing.

8. The Contractor shall have at least one representative participate in scheduled LaRC CERES Project meetings dealing with the EOS-PM schedule, CERES schedule and instrument operations, as test schedules permit.

9. The Contractor shall participate in TRW's EOS-PM meetings that pertain to CERES Instrument operations and schedule of I&T at TRW and the launch site.

10. The Contractor shall review EOS-PM I&T test procedures and schedules, SOP's, 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 instruments. 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 instruments operations.

11. The Contractor shall setup the CERES IGSE as necessary to support the I&T effort at TRW.

12. The Contractor shall pack in government furnished shipping containers all of CERES IGSE and documentation necessary to support launch activities at Vandenberg AFB in California. Also, the Contractor shall unpack and set up the IGSE at Vandenberg Air Force Base, California to support EOS-PM/CERES pre-launch, launch and post-launch operation activities.

NOTE: The timetable is defined according to the attached table of EOS-PM/CERES Integration and Test events as well as the events necessary to prepare the CERES instrument and IGSE for shipment to Vandenberg 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 CERES procedures four weeks (20 working days) prior to the scheduled test. If the procedural changes are not identified in a timely manner to allow complete procedure modification four weeks prior to a scheduled test, then the completed modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test.

2. Final copy of the above mentioned CERES procedures two weeks (10 working

days) prior to the actual test. If the procedural changes are not identified in a timely manner to allow complete final procedure modification two weeks prior to a scheduled test, then the completed final modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test. The Final copy, once approved, will be the CERES Test Procedure used to conduct the scheduled 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 instruments 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 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 instruments, CERES IGSE.

NOTE: The financial status of this task order will be part of the NYMA monthly status report summary.

Metrics:
1. Satisfactory effort:

a. All of the CERES instrument and IGSE operations are executed in a manner such that the CERES instruments' operational readiness is maintained and the spacecraft I&T and Launch schedules are met.

Note: 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 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 instruments' 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 CERESProject or Contractor's control. b. All of the above mentioned procedures and reports are delivered 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 and reports 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.
3.	**<u>Government Furnished Items</u>:** 1**.** Access to specialized software as determined necessary 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.

4.	**Other information needed for performance of task:** 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 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 TRW/EOS-PM personnel. Travel: Travel to GSFC, Redondo Beach, California, and Vandenberg Air Force Base, California will be required to conduct instrument operations in support of this task.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:** **Planned start date:** 1/1/01 **Completion date:** R2 ~~12/31/01~~ ***7/31/01***
7.	**NASA Technical Monitor:** Charles E. Jenkins Jr.; M/S: 424 ; Phone: 757-864-7080 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

Direct Configuration

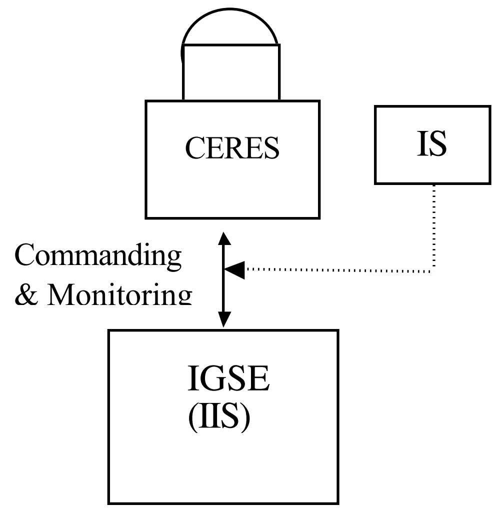

Figure 1: CERES instrument Direct GSE configuration

Spacecraft Configuration

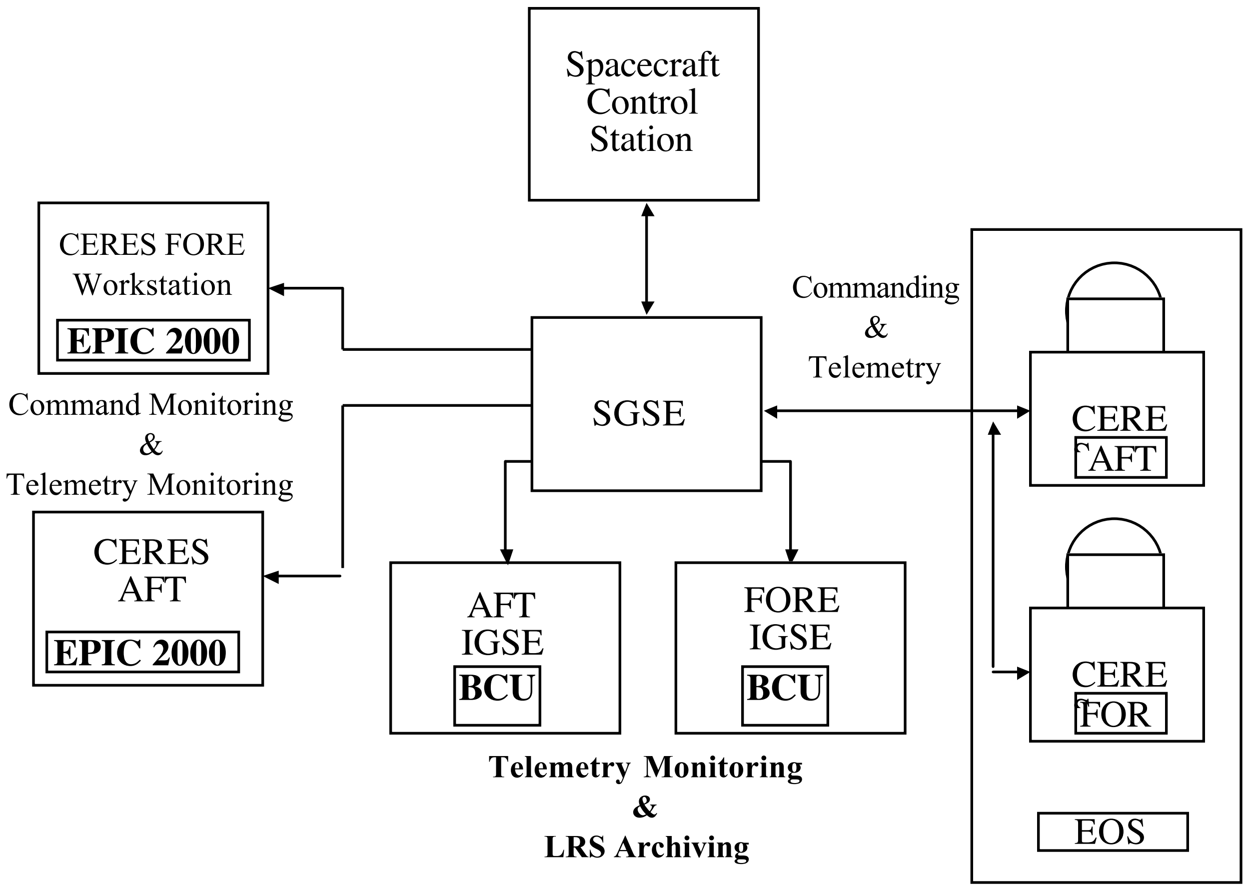

Figure 2: CERES instrument Spacecraft GSE configuration

Task Order Number: 07RAC Revision: 1 Date of Revision: 12/11/01

Title: Flight Optimization System (FLOPS) Support

1. **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.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by revising deliverable dates for the FLOPS update and maintenance task and by revising the development subtasks. (See R1 below.)

2. **Description of the Work to be Performed:**

Subtasks

1. 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.
2. 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.
3. Prepare methodology documentation for the FLOPS Operational Modules. Documentation shall be accessible on-line
4. Develop an improved takeoff and landing noise capability for FLOPS. Implement available HSR developed noise prediction modules. R1 ***Contact Mr. Bob Golub of NASA Langley's Acoustics Branch to obtain the necessary software and documentation.*** Implement new jet noise modules to be provided by NASA. Study available methodology for supersonic nozzle sizing for feasibility of implementation in FLOPS.
5. Study the potential for using the closed form wave drag analysis method developed in NASA grant NAG-1-1160 as an improved wave drag scaling module. R1 ***Contact Professor Bill Mason of Virginia Polytechnic Institute for source code and available documentation related to this grant.*** If applicable, incorporate this method as an improved module. Examine the utility of other simplified analysis techniques developed in NAG-1-1160 to improve the FLOPS aerodynamic data scaling
6. Review FLOPS algorithms for efficiency and accuracy. Provide improved algorithms for program subroutine elements if efficiency and accuracy can be enhanced.
7. Review available literature on simplified high lift aerodynamic analysis. Develop strategy for implementation of an improved high lift aerodynamics analysis capability in FLOPS

Deliverables:

1. 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.

2. 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.

Deliverable due dates

Subtask 1 R1 ~~12/31/01~~ ***12/31/02***
Subtask 2 R1 ~~12/31/01~~ ***12/31/02***
Subtask 3 R1 ~~12/31/01~~ ***12/31/02***
Subtask 4
- R1 ***HSR noise module implementation 3/31/02***
- Nozzle sizing recommendations R1 ~~4/30/01~~ ***4/30/02***
- R1 ***New noise module implementation 12/31/02***

Subtask 5
- Feasibility recommendation R1 ~~4/30/01~~ ***4/30/02***

Subtask 6 R1 ~~12/31/01~~ ***12/31/02***
Subtask 7
- Implementation recommendation 8/31/01

Metrics:
Meets: Deliverables on time
Exceeds: Deliverables one month prior to due date

3. Government Furnished Items:

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

NASA will furnish required source code for subtasks 4 and 5

4. Other information needed for performance of task:
None.

5. Security clearance required for performance of work:

	Unclassified. Proprietary Data.
6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R1 ~~12/31/01~~ ***12/31/02***
7.	**NASA Technical Monitor:** Peter G. Coen M/S: 348 Phone: 757-864-5991 NASA Competency Coordinator: M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 07RBL Revision: 1 Date of Revision: 7/9/01

Title: Blended Wing Body – Low Speed Vehicle Specialized Technical Service

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

[R2] ***Originally***, NASA LaRC [R1] ~~along with Dryden Flight Research Center (DFRC)~~ and industry partner Boeing, [R2]***had*** committed to develop a subsonic, remotely piloted, horizontal take-off and landing, [R1] jet-engine-powered vehicle called the Low Speed Vehicle (LSV). The vehicle is [R1] a composite material, 14.2 percent scale version of a transport-type Blended Wing Body (BWB) configuration [R1] concept aircraft. The [R1] BWB LSV [R2]***was to*** be designed, fabricated, and integrated at LaRC. DFRC [R1] [R2]***would ultimately have been*** responsible for the [R1] test flight operations.

The purpose of this task is to acquire a third party review of the engineering design concepts, [R1] ***as well as associated engineering analysis and design support,*** for the airframe and mechanical integration of various systems [R1] ***and subsystems*** of the LSV. This task is a follow-on to Task GK23 begun under contract NAS1-96013, approximately April 7, 1999. The subject task duration is from January 2, 2001 [R1] ***through September 30, 2002.***

Revision 1: Updates and clarifies the background description and existing requirements, adds requirements for the Contractor to provide specific analysis/design items, extends the completion date, and identifies a new Technical Coordinator (see [R1] above and below).
Revision 2: Alters the scope of the work required by the Contractor due to the changes NASA has made to the overall BWB research effort. The Contractor shall provide specific analysis/design of the Wing Proof Testing System (see [R2] above and below).

2. **Description of the Work to be Performed:**

The Contractor shall provide a third party independent review of the LaRC BWB-LSV engineering team's concepts for mechanical integration designs and analysis of the Low Speed Vehicle to [R1] ensure appropriate use of material technology, manufacturing processes, and engineering principles in reference to flight hardware, [R1] systems, and subsystems.

Begin [R1] block

The Contractor shall perform analyses and/or designs of airframe hardware. The analysis and design activity shall include the winglet[R2]***/wing*** attachment**,** , proof testing system, and generation of drawings of ***the Proof Wing Testing*** System components for fabrication purposes.

Detailed requirements :

1. It is essential that airframe fabrication activities proceed without delays.
2. The generation of drawings shall adhere to the following standards and specifications: MIL-STD-100, DoD standard practice for engineering drawings, ASME Y14.100M, engineering drawing practices and MIL-T-31000, technical data packages.
3. Some analysis will be for composite structures and metal applications.
4. The engineering services provided shall be internally coordinated within the

Contractor's own third party independent review function such that the Contractor is responsible for coordinating the priority, content, information exchange/assimilation, level of detail, and schedule of the assigned analysis, design, and drawing work associated with subsystems/components.

5. All activities shall be integrated within the overall Project requirements, including technical, schedule, and programmatic.

End [R1] block

To ensure currency with all aspects of the review areas, it is anticipated that the Contractor will need to [R1] have representation at the Technical Interchange Meetings (TIM) two days per week, as well as at system level peer and design reviews, the schedule of which are to be determined. In addition, the Contractor may be required to participate in periodic team status meetings, which will take place no more frequently than the normal TIM schedule.

Begin [R1,R2] block

Deliverables and Schedule:

2.1 Design and analyze the following components for the composite airframe:

(1) The winglet/wing attachment, , completion date ***March 31, 2002.***

(2) A proof load testing system for the LSV ***Proof Test Wing,*** including ***a) Bending test components, b) Torsion(+) and (-) test components, c) Ground support system, and d) Backstop support system test components.*** required drawings for fabricating proof load testing hardware, completion date ***March 29,200 .***

~~(3) Upper and lower radomes, completion date February 28, 2002.~~

~~(4) Upper and lower antenna farms with ground planes, completion date February 28, 2002.~~

~~(5) Antenna electronics mounting within the antenna farm complex, completion date February 28, 2002.~~

~~(6) Line replaceable unit (LRU) mountings, completion date March 30, 2002.~~

~~(7) Landing gear mounting design and installation support, completion date March 30, 2002~~

~~(8) The environmental control system (ECS) ducting and flow control registers. Completion date April 30, 2002~~

(9) Fabrication liaison in support of Proof Wing and Proof Wing Test System, completion date June 28, 2002.

End [R1, R2] block

Note: For compatibility with standing LaRC processes, it is anticipated that all of the above work will involve ProE and Mechanica software use. Use of NASTRAN/PATRAN software will be beneficial as well.

2.2 Generate drawings of the LSV [R2]***Proof Wing Test*** components for use in the fabrication process utilizing existing Pro-E solid model designs, completion date February 28, 2002.

2.3 [R1] Recurring Deliverables**:**

(1) Summary monthly report of all reviewed activities to include, as a minimum, the following:
Summary of the reviewed activities
Summary of [R1] progress on assigned analysis and/or design work
Summary of all applicable results
Recommendations
Impacts to design and fabrication schedule and cost
A Preliminary Configuration Description Document

(2) [R2] Bi-weekly review report. This report shall be provided by the end of [R1] the week following the [R1] bi-weekly reviews. This report shall include all recommendations, findings, and/or suggested changes to the design or analysis. The recommendations may be in the form of written specifications or conceptual drawings. The acceptance of recommendations is at the discretion of the LaRC Technical Project Engineer.

Begin [R1] block

(3) Documented engineering analyses and design results of assigned subsystems/components, including [R2]***the proof testing system and winglet/wing attachment. .*** Delivery requirements and schedule shall be as coordinated with the LaRC Technical Project Engineer by the Contractor via their third party independent review activities.

(4) Engineering drawings and drawing revisions of assigned subsystems/components, including the winglet [R2]***attachment,*** proof testing system, , and fabrication components. Delivery requirements and schedule shall be as coordinated with the LaRC Technical Project Engineer by the Contractor via their third party independent review activities.

2.4 Performance Measurements (Standards):

Deliverable (1) shall meet project technical and system requirements [R1] as set forth herein and in NASA-provided (section 4 below) project documentation and shall be

delivered within 5 working days after the end of the calendar month
Deliverable (2) shall be delivered within [R1] ~~two~~ five working days of the [R1] bi-weekly review meeting.
[R1] Deliverables (3) and (4) shall be delivered within the timeframe set forth by the individual work packages.

"Meets" would be if the required document dates and contents are met, [R1] and if no major revisions are required to final reports, documents, or drawings.

"Exceeds" would be if the required document dates and contents are met [R1] or bettered, and: if recommendations are made and at least 75% of them are implemented [R1] with no modifications required; or if recommendations are made and at least 90% of the recommendations are accepted with only minor modifications [R1] and no major revisions are required for any final report, document, or drawing, and at least 90 percent of them require no revisions.

3. **Government Furnished Items:** The Contractor will have access to existing databases, and, [R1] as available, to applicable software programs which may be required during the performance of this task, as well as [R1] existing data, analyses and drawings related to the task work, and office space in [R1] ~~room 137C of~~ Building 1209 [R1] and/or other on-site office space .

4. **Other information needed for performance of task:**

Documents that apply:

Blended Wing Body-LSV Project Requirements Documents-0104 Series
Vehicle Configuration Requirements Document-0101-3 Draft
Project Plan-0100-1 Rev C Draft
Research Goals & Objectives-0101-2 Rev B Approved

5. **Security clearance required for performance of work:** None; however, the Contractor employees [R1] will be required to sign a Boeing Standard Non-Disclosure Agreement, along with any Contract-applicable Conflict of Interest Avoidance Plan certification.

6. **Period of Performance:**

Planned start date: January 2, 2001 Expected Completion date: [R1] ~~June 30, 2002~~ September 30, 2002

7.	**NASA Technical Monitor:** William M. Langford M/S: 432 Phone: 757-864-7144 **NASA Competency/Other Technical Coordinator:** [R1] Kurt Detweiler M/S: 246 Phone: 757-864-2566

Task Order Number: 07RCG Revision: 11 Date of Revision: 03/09/2005

Title: Structural Dynamics Analysis and Testing

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

The Structural Dynamics Branch (SDB) conducts research and technology development to quantify and control impact dynamics, ground operations, and structural dynamics of aerospace systems. SDB: *confirms* validity of approaches by conducting tests on full-scale structures, structural elements and scaled structural models; *conducts* research to advance the technology for improving the safety and handling performance of aircraft during all-weather ground operations, including takeoff, landing impact, and ground handling phenomena; *develops* fundamental understanding of crash behavior and crash-mitigating design; *develops and validates* predictive tools for crash dynamics; *conceives and confirms* new dynamic test techniques; *operates* the Structural Dynamics Research Facility, the Impact Dynamics Research Facility (IDRF), and the Aircraft Landing Dynamics Facility. In particular, the IDRF is used to conduct dynamic testing of full-scale aircraft and space structures. IDRF studies the response of the aircraft/space structures under crash loads so that better energy absorbing systems and better energy management systems can be incorporated into future structures. The IDRF uses Finite Element Modeling (FEM) and sub-scale and sub-component testing to support the design efforts. Programs that the IDRF support are The Aviation Safety Program (AvSP) and Mars Exploration Rover (MER).. The Contractor [U1] will be required to develop FEM and perform analyses to support crashworthiness tests and/or analytical studies for structures such as the Fokker 28 aircraft or other AvSP specific projects.

Update 1: Adds NOR feature and other wording changes for requirement clarification, adds an omitted travel/conference requirement to agree with January 2, 2001 approved Task Plan, and revises GFI for contract compliance (see [U1] above and below).
Revision 1: Closes Subtask 1 and extends Subtasks 2 and 3 to continue work on the commuter aircraft analysis and modeling and the foam testing.
Revision 2: Extends the period of performance six months and updates requirements for Subtasks 2 and 3 to continue work on the commuter aircraft analysis and modeling and to complete the development of the foam testing apparatus (see [R2] below).
Revision 3: Adds new requirements as Subtask 4(see [R3] below).
Revision 4: Modifies Subtask 2 to extend the completion date to September 30, 2003 to allow time to incorporate additional model modifications developed by Fokker. Subtask 4 is modified as follows: 1) Extends delivery date for meshed model due to delays in receiving data from FAA and computer network problems. 2) Adds requirements to include masses in FE model and to conduct pretest impact analyses and convert the finite element model to LS-DYNA format. The overall task order period of performance is extended to September 30, 2003. (see [R4] below).
Change 1: Extends Subtask 2 schedule and overall period of performance to 11/15/03 to complete NASA documentation edit/review process (see [R4.1] below).

Revision 5: Adds new requirements as Subtask 5, extends the period of performance to October 31, 2004, annotates Subtasks 3 and 4 as completed, and changes the Technical Monitor (see [R5] below).
Revision 6: Modifies requirements in Subtask 5 to reflect new analysis schedule, shortens the period of performance to June 30, 2004, and annotates Subtask 2 as completed. (see [R6] below).

Revision 7: Updates requirements in Subtask 5 to reflect new analysis schedule and extends the period of performance three months to September 30, 2004 (see [R7] below).
Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as doc files 07RCG, 07RCGu1, 07RCG01, 07RCG02, 07RCG03,07RCG04, 07RCG05 and 07RCG06.
Revision 8: Extends the schedule and period of performance three months to December 31, 2004 (see [R8] below).
Revision 9: Adds requirements as new Subtask 6 and extends the period of performance three months to March 30, 2005 (see [R9] below).
Revision 10: Adds requirements to Subtask 5, extends the period of performance for Subtask 5 to March 31, 2005, and resets the task order completion date accordingly (see [R10] below).
Revision 11: Adds requirements to Subtask 5, extends the period of performance for Subtasks 5 and 6 to September 30, 2005, and resets the task order completion date accordingly (see [R11] below).

2. **Description of the Work to be Performed**:

Begin [U1] block

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

End [U1] block

Overall Requirement: The Contractor shall provide technical progress reporting and [U1] financial reports at the individual subtask level in the monthly reports to the Task Technical Monitor. [U1] The financial reporting at the subtask level will be used only for cost sharing and/or accrual determination within the user organization.

The Contractor shall perform the following subtasks:

Subtask 1. (Completed)

Begin [R2] block requirements update
Subtask 2. [R6](Completed)

Subtask 3. [R5](Completed)
End [R2] block requirements update

Begin R3 block addition
Subtask 4. R5(Completed)
End R3 block addition

**Begin R5 block requirements addition **
Subtask 5. Analysis of Space Shuttle Wing Leading Edge Impact Scenarios. The CAIB ruled that foam debris from the external tank impacting the Reinforced Carbon-Carbon RCC wing leading edge caused the Columbia disaster. One of the major space shuttle return-to-flight (RTF) activities is to determine the damage threshold to the wing leading edge RCC panels. The RCC material is a complex layered composite material and fails similarly to Ceramic Composite Materials. The impact velocities of the debris range from 700 ft/s to over 1000 ft/s. The teams working impact scenarios are located at LaRC, GRC, and at Boeing. This work is sponsored by NASA JSC and is highly schedule driven.

1) The Contractor shall create, run, analyze, post-process and validate multiple LS-Dyna dynamic finite element models to predict the threshold of impact damage to the Shuttle wing leading-edge from various debris including foam, ice, and ablator material. Models may require updating or refinement such as re-meshing using MSC-Patran with the LS-Dyna preference. Most post-processing will be done with LS-Post. Use of EnSight to make enhanced animations will be needed for some cases.

2) The models shall be validated for different debris material, material geometries, impact velocities, impact trajectories, locations on the RCC panels, and for a number of different RCC panels. In addition, subcomponent models shall be created to compare with impact test data of RCC panels, test coupons, etc.

3) The Contractor shall coordinate with test engineers and use test data from impacts onto foam and onto RCC to determine and/or modify the inputs for material models in LS-Dyna. Models include complex failure mechanisms and strain-rate effects.

4) Models shall be created using the MSC.Patran pre-processor using both explicit and implicit formulations of LS-Dyna. For example, the implicit version of LS-Dyna will need to be run to apply flight loads before impact (pre-stressing).

**Begin R10 block requirements addition **
5) The Contractor shall investigate boundary conditions for flat plate RCC panels including modeling of rod supports.

6) The Contractor shall complete the SwRI Panel 8 LS-DYNA model.
**End R10 block requirements addition **

*****Begin R11 block requirements addition *****
7) The Contractor shall model using LS-DYNA ice and other debris impacts onto RCC full

scale panels and impacts onto smaller test RCC panels. Models shall be correlated with test data.
****End R11 block requirements addition *****

Deliverables: (1) Monthly progress reports
(2) Reports summarizing each LS-Dyna analysis with digital charts, graphs, animations, and jpeg pictures from LS-Post or other post-processing software such as Patran, EnSight, Excel, MatLab, and Kaleidagraph.

Schedule:

**Begin R6 block requirements update **
Review LS-Dyna, Post,& RTF models
12/31/2003

Help set up Documentation and Quality Control for Production Runs
1/26/2004
**Begin R7 block requirements update **
Support LS-Dyna Damage Threshold Studies
1/27/2004
**Begin R10 block requirements update **
LS-Dyna Damage Threshold Studies Complete
R10 R8 ~~9/30/2004~~ ~~12/31/04~~ 3/31/2005

Document RTF work
R10 R8 ~~9/30/2004~~ ~~12/31/04~~ 3/31/2005

Complete SwRI Panel 8 LS-DYNA Model
R10 12/31/2004
**End R10 block requirements update **
**End R7 block requirements update **
**End R6 block requirements update **

****Begin R11 block requirements update *****
Test/Analysis correlation for ice and other debris impacts 09/30/2005
****End R11 block requirements update *****

Performance Measurements:

Minimum Performance
Work completed accurately and on time

Exceeding Minimum Performance
Work completed ahead of schedule, or suggestions by Contractor to make model development and/or analysis easier, more accurate, or more efficient.
**End R5 block requirements addition **

Begin R9 block addition
Subtask 6. Revision of ATR42 Patran Model for Impact Simulation.
Technical Monitor: Karen E. Jackson M/S 495 Phone: 757-864-4147
The ATR42 is a high-wing, twin turbo-prop, commuter-category aircraft. The FAA performed a vertical drop test of this aircraft in July 2003. A finite element model of the airframe was developed and transient dynamic simulations were executed to generate predictions of structural response. This task involves revising and upgrading the existing model of the aircraft to improve its accuracy, fidelity, and efficiency. The following subcomponents are included:

1.) The existing model contains a large number of nodal discontinuities, which cause problems with the contact algorithms in the model. As a result, the model cannot be executed on the multiple-parallel processing version of LS-Dyna and instead must be executed on the single-processor version of the code, thus requiring as much as 3 to 4 times the CPU to execute a single run. These nodal discontinuities also cause errors in the model results. The Contractor shall remove the nodal discontinuities, thereby providing a more robust and accurate model.
2.) The existing mesh is fairly crude, especially in regions of high stress, e.g. the heavy fuselage frames at FS 25 and FS27 that support the high wing. The original coarse mesh in the model was dictated by the geometry that was supplied by the FAA. The Contractor shall refine the mesh, especially for the two fuselage frames mentioned.
3.) In addition to remeshing the model in general, the Contractor shall remesh and copy the two fuselage frames at FS25 and FS27 separately into a Patran database, and execute a NASTRAN model to evaluate failure behavior under quasi-static loading applied through the brackets. This work shall include development of detailed models of the support brackets.

Deliverables: The Patran database of the remeshed and corrected ATR42 finite element model. A Patran database containing only the remeshed fuselage frames at FS25 and FS27 with supporting brackets and results from Nastran simulations to determine the load at failure of the frame/bracket assembly when loaded quasi-statically through the brackets.

Schedule:
Planned start date - September 1, 2004 Completion date - R11 ~~March 30, 2005~~ ***September 30, 2005***

- Removal of nodal discontinuities by R11 ~~December 30, 2004~~ ***April 30, 2005***
- Model remeshing by R11 ~~March 30, 2005~~ ***September 30, 2005***
- Nastran analysis of fuselage frames by December 30, 2004

Performance Measurements:

	Minimum Performance Work completed accurately and on time. **Extended Minimum Performance** Work completed ahead of schedule, or suggestions by contractor to make model development easier, more accurate, or more efficient. **End R9 block addition**
3.	**Government Furnished Items**: Test specimens Test specimen instrumentation U1 Access to NASA specialized structural analysis software, including MSC/NASTRAN, MSC/PATRAN and MSC/DYTRAN, R6LS-Dyna, LS-Post, etc. Computer CPU time for structural modeling and analyses Office space *****Begin R9 block addition***** Subtask 6 Existing Patran database of ATR42 model Example output file (d3hsp) from LS-Dyna simulation that lists nodal discontinuities Advise on model remeshing efforts and Nastran analysis study Access of a piece of the fuselage frame at FS25 and FS27 for modeling details Access to NASA specialized structural analysis software including MSC.Patran, MSC.Nastran, and LS-Dyna. *****End R9 block addition*****
4.	**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. U1 Dissemination of significant results through an international forum along with associated travel may be required as appropriate.
5.	**Security clearance required for performance of work**: *None*
6.	**Period of Performance**: Planned start date:01/01/2001 Completion date: R2 ~~12/31/2002~~ R4 ~~6/30/2003~~ R2.1 ~~9/30/2003~~ R5 ~~November 15, 2003~~ R6 ~~October 31, 2004~~ R7 ~~June 30, 2004~~ R8 ~~September 30, 2004~~ R9 ~~December 31, 2004~~ R10 ~~March 30, 2005~~

	R11 ~~March 31, 2005~~ ***September 30, 2005***
7.	**NASA Technical Monitor** R5 Ed Fasanella M/S 495 Phone: 757-864-4345 **NASA Competency/Other Technical Coordinator** S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 07RDE Revision: 6 Date of Revision: 11/17/04

Title: **ATC/NAS Operations Research Support**

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

The R6 ***Crew Systems and Operations Branch (CSOB)*** of Langley Research Center (LaRC) is engaged in research activities that involve aircraft operations in the National Airspace System (NAS) as well as flight deck and flight display design. These activities require expert operations input into simulation development and simulation support in the form of realistic representations of the air traffic system and other air traffic in the experimental airspace R4 and occasionally include day to day flight planning and coordination with the air traffic control R4 (ATC) system. For validity, that research requires the realism of high fidelity simulation hardware and the support of personnel who have extensive experience in aircraft operations from an ATC perspective combined with an understanding of air traffic flow management. The research requirement also involves providing expert advice in the design of experimental facilities and procedures, as well as assistance in planning and coordinating flight deployments.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, changes the title, and redefines the requirements for the new period of performance.

Revision 2: Adds requirements (Subtask 5 and metrics/standards), clarifications, and a technical coordinator for OLEO.

Change 1: Re-designates Task 5 as Subtask 5 and adds its previously omitted planned completion date.

Revision 3: Extends Subtask 5 completion date 3 months and adds deliverables 4 and 5.

Revision 4: Deletes OELO technical coordinator and some associated requirements and extends the period of performance one year in continuation of NASA's support with updated requirements. (For Revision 4 see R4 above and below. For complete details of original, Revision 1, Revision 2, Change 1, and Revision 3 SOWs see ETOS *doc* files *07RDE, 07RDE01, 07RDE02, 07RDE021, and 07RDE03*, respectively.)

Revision 5: Extends the period of performance one year in continuation of NASA's support with updated travel requirements and other info for the new period of performance (see R5 above and below).

Revision 6: Extends the period of performance one year to December31, 2005, in continuation of NASA's support with updated requirements and other info (see R6 above and below).

2. Description of the Work to be Performed:

The Contractor shall provide support for these areas: simulation and laboratory development and operation, scenario development and flight deployment planning and coordination, R2 current and future ATC/NAS operations.

Begin R1 block – requirements redefinition

The Contractor shall perform the following subtasks:

Subtask 1: ATC simulation facility development and maintenance - The Contractor shall provide inputs to the development of simulation facilities and creation of a realistic ATC communications and procedural environment for the conduct of real-time piloted-cockpit simulation studies and flight test/demonstrations. The development of simulation facilities shall include designing and implementing communications systems, display and video map development; participation in simulation check-out and real-time simulations.

Subtask 2: Provision of realistic [R2]ATC/NAS environment – The Contractor shall provide realistic [R2]ATC/NAS environment for piloted simulation activities that include [R2]air traffic flow management, [R6]***and representation of*** ATC towers, terminal radar facilities, en route centers, state-of-the-art consolidated facilities and oceanic operations. Accepted ATC procedures shall be applied using standard controller/pilot phraseology and jargon. A cursory understanding of flight characteristics of the various aircraft involved in the operations will be needed.

Subtask 3: Flight operations review - Reports for specific research simulation and flight test projects shall be provided to ensure ATC considerations are adequately reflected in the plan of test. The overall goal of this task is to ensure that research conducted is appropriately designed and executed to ensure that the value of the resulting data is maximized with respect to realistic current, and foreseeable future, ATC operations. ATC operations review reports shall included appropriate scenarios. Scenarios shall either be modified from existing scenarios provided by the researchers, or completely new scenarios based on research requirements.

Subtask 4: Investigation of NAS/ATC state and procedures - Reports shall be submitted in response to requests for investigation of current or future NAS/ATC state or procedures. The Contractor shall gather facts/figures as needed in order to frame the research as well as provide a realistic environment for simulations.

End [R1] block – requirements redefinition

Begin [R2] block requirements addition

[C1]**Subtask 5: Flight Operations ATC Support** – Provide planning and coordination for research flights from an air traffic controller perspective to include all research programs using LaRC's research aircraft and other aircraft to support LaRC research activities. Provide training, operational, and technical support to programs and to OELO to facilitate integration of projects with Federal Regulations procedures, National Airspace System (NAS), ATC and pilot/cockpit crew procedures, other R&D projects, and technologies/systems as required.

End [R2] block requirements addition

Metrics: [R2]*Simulation.* Minimum acceptable performance shall be based on availability and realism of controller performance and the degree to which the task is successfully completed as documented in informal reports. [R1]In addition, minimum acceptable performance will include timeliness and completeness of ATC operation reports. [R2] *Flight activities***.** Minimum acceptable performance shall be based on documentation which indicates that the necessary planning and coordination has been affected to facilitate research flight activities.

Meets Standards: [R2]*Simulation.* Maximum acceptable number of either check-out or data production simulation runs canceled, because of Contractor supplied controller/pseudo-pilot non-availability, shall be no more than 3 % of a study's real-time sessions. In addition 90 % of simulation flight crews shall rate the ATC support realism as at least adequate (3) on a post experiment questionnaire with a five point rating scale. The possible ratings of ATC realism shall be: 1 - seriously deficient, 2 - somewhat deficient, 3 - adequate, 4 - more than adequate, 5 - highly realistic. [R1]In addition, [R2]~~ATC documents shall be delivered on time, and~~ ATC operations reports shall be received within 2 weeks of established delivery dates. [R2]*Flight activities.* No delays or cancellations of research flights are attributable to inadequate planning or coordination on the part of individuals providing those services under this task.

Exceeds Standards: [R2]*Simulation.* Greater percentage of availability and higher realism ratings will be used to assess the level of performance exceeding the acceptable level. [R1]ATC operations document delivered 2 weeks ahead of schedule. [R2]*Flight activities.* Value added to the research flights through the negotiation of maximum latitude for flight activities in operational airspace. Evaluation from principal investigator for applicable research project results in an "exceeds requirements" that is accompanied by adequate justification based on exceptional contributions to planning and flight coordination.

Deliverables: The availability and participation of Contractor supplied controllers in specified real-time-piloted simulation studies check-out, all data-gathering production runs, experimental design requirements, and flight activities when required. Informal documentation of experiment planning, conduction, and evaluation. [R1]Formal operations documents providing ATC operations information to optimize anticipated research results. ATC operations documents shall include proposed maneuvers and scenarios to optimize the relevance of research results to current aircraft operations and conceptualized future aircraft operations. [R4]Documentation is due within one month following completion of specified activity.

3. **Government Furnished Items:**

The controller display interfaces and communication interfaces available in the LaRC Mission Oriented Terminal Area Simulator (MOTAS) facility, the Free Flight Simulation, [R1]General Aviation Work-Station (GAWS), NASA [R4]aircraft, or similar facilities. Access to computers

Task Order Number: 07RDE Revision: 6 Date of Revision: 11/17/04

Title: **ATC/NAS Operations Research Support**

loaded with specialized software, and lab or office space required to complete the tasks.

4. Other information needed for performance of task:

It is anticipated that the task will run to the completion date indicated below. Personnel will, on occasion, be required to work R2irregular hours (i.e., 17:00 to 24:00), although the normal expected hours will be between 8:00 to 17:00.

Travel:

The Contractor will be required to perform several trips during the period of performance as listed below. All trips are single person trips with durations indicated.

1. ~~Juneau Alaska - support Capstone-2 (1 week)~~
2. ~~Roanoke Va. region – support SVS-GA (R41 2-day trip)~~
3. ~~R4Domestic US – Additional trip envisioned – location TBD~~
4. R6R5~~EAA (Experimental Aircraft Association) Air Venture (Oshkosh, WI), 1 week, July 2004.~~

****Begin R6 block update*****

5. SV Roanoke Flight Demonstration: Roanoke, VA, three weeks (21 days), April, 2005. Transportation shall be provided by NASA.
6. Oshkosh Air Show: Oshkosh, WI, One week (seven days), June 2005.

****Begin R6 block update *****

5. Security clearance required for performance of work:

All work will be unclassified however personnel will be required to obtain an ADP clearance for access to the MOTAS lab.

6. Period of Performance:

Planned start date:		Completion date:	
	R1~~January 2, 2001~~		R1~~December 31, 2001~~
	R4~~January 1, 2002~~		R4~~December 31,2002~~
	R5~~January 1, 2003~~		R5~~December 31, 2003~~
	R6~~January 1, 2004~~		R6~~December 31, 2004~~
	January 1, 2005		***December 31, 2005***

7. NASA Technical Monitor: Gary Lohr

M/S: 152 Phone: 757-864-2020

Task Order Number: 07RFM Revision: 3 Date of Revision: 8/30/2004

Title: CERES Flight Operations

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

The NASA LaRC CERES project team, with extensive SAMS contractor support, successfully developed and commissioned five CERES instruments on three NASA spacecraft. The first CERES instrument, the proto-flight model, was operated on the NASA TRMM spacecraft until September 1998. The CERES Flight Model 1 (FM1) and Flight Model 2 (FM2) instruments were successfully launched December 18, 1999 on the NASA Terra spacecraft. The CERES Flight Model 3 (FM3) and Flight Model 4 (FM4) instruments were successfully launched May 4, 2002 on the NASA Aqua spacecraft. These instruments have successfully completed the on-orbit-commissioning phase and are performing routine scientific measurements.

CERES instrument operations are performed by a SAMS contractor team located at the NASA Langley Research Center (LaRC) in conjunction with spacecraft control centers for Terra and Aqua at the NASA Goddard Space Flight Center. SAMS support of CERES operations is anticipated for the life of the mission currently scheduled through 2008.

Change 1: Notes increase in travel and support required as indicated in Contractor's June 4, 2001 plan and clarifies GFI for overall contract compliance.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements.

For details of original, Change 1, and Revision 1 SOWs see ETOS *doc* files *07RFM*, ***Error! Reference source not found.***~~*07RFM*~~*001*, and ***Error! Reference source not found.***~~*07RFM*~~*01*, respectively.

Revision 2: Extends the period of performance through December 31, 2005 (SAMS contract completion date) in continuation of NASA's support with extensively redefined requirements and a newly appointed NASA Technical Monitor (see R2 below).

Revision 3: Requires re-planning for off-site performance beginning October 1, 2004 (see R3 below).

2. Description of the Work to be Performed:

*****Begin R3 Constraint*****

Beginning October 1, 2004 all Contractor work shall be off-site performance.

*****End R3 Constraint*****

The Contractor shall perform CERES instrument flight operations for duration of the EOS-Terra mission and the EOS-Aqua mission. CERES Flight operations shall be coordinated with the CERES Flight Operations Manager. CERES flight operations tasks include, but are not limited, to the following:

- Monitor CERES health and status and take appropriate actions to maintain instrument health.

- Develop, verify, and maintain Mission Management System (MMS) Activities, Baseline Activity Profiles (BAP), Command and Activity Constraints, Memory Load files, Stored Command Sequences (SCS), and Relative Time Sequences (RTS).
- Coordinate the generation and implementation of MMS One Day Schedules (ODS) and Short Term Schedules (STS) generated by the Science Scanning Team for special operations.
- Develop, verify, and validate routine stored command loads. This shall include planning and scheduling daily instrument operations via the MMS and verifying the resulting Absolute Time Command (ATC) and Master Load Command (MCL) reports when required before upload to the spacecraft.
- Develop inputs needed to facilitate any required changes to instrument operations databases.
- Develop and monitor execution of real-time commands using Government furnished Instrument Support Terminals.
- Maintain and periodically publish CERES Terra and CERES Aqua as-flown timelines noting significant instrument or spacecraft activities.
- Develop unique scan profiles and/or stored command loads to support targeted validation campaigns such as ‘Crystal Face’ and instrument characterization.
- Support the development, testing, and implementation of CERES flight software and operational table modifications.
- Support the analysis of trend and performance data during monthly data reviews
- Support and perform ad hoc investigations into trend, performance, and calibration issues as required.
- Coordinate maintenance of the CERES Instrument Support Terminals.
- Document instrument operations activities such as operations modes, software modifications, analysis results, et cetera by technical memorandum.

Schedule timetable:
The Contractor shall perform CERES operations as described subject to CERES project schedule.

Deliverables:

a. CERES Terra and CERES Aqua stored command loads.

b. As-flown timelines for CERES Terra and CERES Aqua instruments.

c. Monthly summary of task activities. The report shall include the instrument’s history, operations plans, and a summary of the task activities including, if applicable, anomaly

	reports. d. Technical memorandum as required. **Metrics**: a. Satisfactory effort: • On-orbit operations occur as planned • Instrument health monitored and maintained according to procedures. • On-time delivery of monthly report and as-flown timelines b. Exceeds effort: • Development of specialized campaign / characterization command loads • Technical Memorandum describing aspects of CERES operations, trends analysis, performance analysis, or related subject. • Improvements and/or suggestions that improve the scientific return of the experiment.
3.	**Government Furnished Items:** Access to Instrument Support Terminals, internal project WWW sites, and CERES Project documentation shall be provided.
4.	**Other information needed for performance of task**: **Travel:** As many as two, separate, 7-day trips per month to NASA GSFC may be required.
5.	**Security clearance required for performance of work**: None.
6.	**Period of Performance**: Planned start date: [R1]~~1/1/2001~~ Completion date: [R1]~~12/31/2001~~ [R2]~~1/1/2002~~ [R2]~~12/31/2002~~ [R3]~~1/1/2003 12/31/2005~~ ***Off-site Performance: October 1, 2004*** ***December 31, 2005***
7.	**NASA Technical Monitor**: Michael S. Cisewski. M/S: 420 Phone: 757-864-1861

Task Order Number: 08RAA Revision: 12 Date of Revision: 04/05/05

Title: Advanced Space Transportation Systems Aerodynamics and Aeroheating Analysis

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

The NASA Langley Research Center - Vehicle Analysis Branch (VAB) develops and applies computer-aided tools in the systems analysis of advanced space transportation and planetary entry system concepts. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, and operations. Contract support is needed, primarily:

(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems, and

(b) to perform analyses in selected disciplinary areas

and may include the review of technical papers within the scope of work (i.e. discipline area) of this task order.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems. Currently, the primary computational platforms are Silicon Graphics (SGI) workstations, Apple Macintosh, and IBM PC or clones also host a few engineering codes critical to the systems analysis work. Security clearances (Secret rating) may be needed in some instances. Specific requirements, deliverables with dates, metrics, and furnished materials are described below. Informal results delivered within this task may be developed into more formal end product(s) and used as appropriate for conference papers and journal articles.

Note: Some of the required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Adds NOR note and designations; rewrites Subtask 3.0 requirements; revises GFI for contract compliance; deletes Subtask 4.0.
Revision 2: Respecifies Subtask 1.2 programming support tasks; rewrites Subtask 3.0

requirements; documents Technical Monitor change; extends period of performance. (Note: Major deletions have been left in as strike-through text for reference.)

Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements within "3.0 Planetary Entry Aerodynamic/Aeroheating" for new period of performance and changes in Program requirements.

Revision 4: Adjusts the 3.1a deliverables schedule to have data available in time to complete several reviewed publications for workshop sessions coming up in August.

Revision 5: Extends the period of performance one year in continuation of NASA's support with no changes in Subtasks 1 and 2 detailed requirements and Subtask 3 requirements redefined for the new period of performance.

Revision 6: Formal conference paper and technical review requirements explicitly stated.

Revision 7: Adds new requirements as Subtask 4.

[R8]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 08RAA, 08RAA01a, and 08RAA02 through 08RAA07.

Revision 8 extends the period of performance from Dec 31, 2003 to October 31, 2004. The requirements for all work elements have been redefined for the new period of performance. In addition, specifically, work element 1.2 has been modified to include programming support with integrated tool environments such as the Adaptive Modeling Language (AML).

(See [R8] above and below.)

Revision 9: Updates Subtasks 3.0 and 4.0 deliverables schedule (see [R9] below).

Revision 10: Extends the period of performance two months to Dec 31, 2004 with new requirements (4.0h), some schedule changes, and new technical monitor (see [R10] below).

Revision 11: Adds Deliverables 3.2e and 4.0i, updates the 4.0 delivery schedule, and extends the period of performance six months to July 1, 2005 (see [R11] below).

Revision 12: Extends the period of performance five months to 12/31/105 in continuation of NASA's support with some new requirements and updates other info (see [R12] below).

2. **<u>Description of the Work to be Performed</u>:**

1.0 Maintenance of Aerodynamics and Aeroheating Analysis Tools

The Contractor shall:

1.1 Maintain and ensure proper performance of the aero family of analysis tools (MINIVER, INCHES, APAS and AVSL) and their support utilities collectively known as the "aero tools." The Contractor shall fix software bugs and problems resulting from modeling errors, programming techniques, or operating system changes. All software deliverables will be consistent with the current programming language for the affected subroutine and/ or program, unless a waiver is granted. The Contractor shall produce sample case outputs and demonstrate that the enhanced code is consistent with previous results. On average, three bug fixes per month and two operating system changes per year are expected.

1.2 (NOR) Provide programming support for aero/ flyability studies including the development of general purpose and specific computer subroutines of aerodynamics, aeroheating, and thermal protection system models. R8General purpose programming support shall also include development using the Adaptive Modeling Language (AML) licensed within VAB via TechnoSoft, Inc. Programming support tasks can be described as simple (model less than 50 lines of executable FORTRAN code), moderate (model between 50 and 500 lines of executable FORTRAN code), or complex (model over 500 lines of executable FORTRAN code). On average, eight simple, three moderate, and one complex tasks per year are expected. The Contractor shall provide documentation of the software formulation, inputs/ outputs, and test cases, and shall produce a user's guide for the above mentioned subroutine models.

1.3 The Contractor shall track these changes using configuration management software (e.g., RCS), transition the software to VAB analysts after its completion, and provide user familiarization during this transition.

Deliverables

1.1 Fully functioning aero tools which are free of known programming errors. (within 1 week of an identified software bug, within 1 week for a simple model (less than 50 lines of executable FORTRAN code), within 2 weeks for a moderate model (between 50 and 500 lines of executable FORTRAN code), 1 month for a complex model (over 500 lines of executable FORTRAN code), and within 1 month of a new operating system/ upgrade installation)

1.2 Instruction on use of the new models. For a simple model within 2 days, for a moderate model within 2 weeks, and for a complex model within 1 month.

1.3 Documentation of specific changes and associated modifications within the configuration management tools.

Metric

1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.
2. Ability to make any previous version of aero code available within one day of such a request.
3. Usability of the interfaces and enhanced tools as measured by the ability of the VAB analysts to operate the tools easily without assistance.

2.0 Aero Tool Transfer to Customers

The Contractor shall:

2.1 (NOR) Provide for the transfer of aero tools and documentation to customers upon request and shall respond to customer inquiries concerning installation and operation of the tools on the customer's computer.

2.2 Maintain a current list of customer contact points to whom tools have been transferred and provide a quarterly update to current users appraising them of the current version of the aero tools and any significant changes in these tools.

2.3 Provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically, such requests are received once every two weeks.

Deliverables

1. Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. (monthly)

2. Delivery of software and documentation to customers. (on request)

3. Updates to current users. (quarterly)

Metric Effectiveness of transfers measured by use of transfer method acceptable to customer and by successful customer reproduction of output from sample cases which have been run on VAB computers. Timeliness of transfers measured by documentation being sent out within 2 days of receiving the request and completion of the transfer of the aero tools within one week, unless otherwise specified.

3.0 Planetary Entry Aerodynamic/Aeroheating

The Contractor shall:

3.1 Complete aerothermodynamic analyses of the 2005 Mars Reconnaissance Orbiter, including DSMC analyses.

(a) Develop R8~~initial~~ 2005 Mars Reconnaissance Orbiter aerodynamics databases. These databases will support 3 DOF simulations at LaRC and other. This database covers the free molecular, transitional, and continuum hypersonic flow regimes.

(b) Develop and implement the methodology to validate the2005 MRO aerodynamic database
(c) Support trade studies.
(d) Support telecons, reviews.
(e) Support Planetary team meetings (currently every other Wednesday 10:00-11:00am B1232/R258).

3.2 Develop the aero/aerothermodynamicanalyses and databases for other planetary exploration mission studies, [R8]~~including Titan and Neptune aerocapture missions,~~ and aerocapture flight experiment missions.
Begin [R8]block redefinition
(a) The Contractor shall perform aeroheating analysis for aerocapture systems analysis studies.
(b) The Contractor shall perform aero/RCS interaction analysis for Mars Science Laboratory (MSL).
(c) The Contractor shall perform aerothermodynamic analyses for MSL.
End [R8]block redefinition
(d) Support telecons and reviews, including the weekly Aerocapture Systems Analysis telecons, currently Thursday 1:30-2:30, B1232/R120f.
(e) [R11]Provide aerothermodynamic analysis and aerodatabase for Huygens
(f) [R12] Provide aerothermodynamic analysis and support for Moonrise project

Begin [R8]block redefinition
Deliverables
3.1MRO 2005 aerothermodynamics analyses, database based upon new geometric models provided via GFI January 2004. ([R9]~~30MAR04~~ 31May04)
3.2a Complete initial aeroheating analysis for aerocapture systems analysis study. (31May04)
3.2a Complete final aeroheating analysis for aerocapture systems analysis study. (30Sep04)
3.2b Complete initial aero/RCS interaction analyses for MSL. ([R9]~~31Mar04~~ [R10]~~5/32/04~~ 12/31/04)
3.2c Complete preliminary aerothermodynamic analyses for MSL ([R10]~~30Sep04~~ 12/31/04)
Begin [R11] block addition
3.2e Complete initial aerothermodynamic analysis and aerodatabase for Huygens (11/30/04)
3.2e Complete updated aerothermodynamic analysis and aerodatabase for Huygens (12/24/04)
3.2e Complete analysis to support reconstruction (07/01/05)
End [R11] block addition
[R12]3.2f Update the Moonrise database and prepare presentation material for aero Moonrise database (12/31/05)
End [R8]block redefinition
Metrics

Accuracy of validation.
Accuracy of results.
Completeness of solution sets.
Completeness of documentation.

3.1-3.2 Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.

4.0 Operations and Lifecycle Costing

The Contractor shall:

a.) Complete the benchmarking of RMAT 2004, version 5.0.
b.) Aid in evaluation of the Proration equation set used in RMAT 2004.
c.) Document a process for running the RMAT model that addresses the sequence of option selections for modeling the different type of analysis that can be performed.
d.) Support the development and evaluation of new logistics equations for use in the RMAT/ Logistics Cost Model.
e.) Support a re-evaluation of SLI reference concepts using the updated RMAT analysis process.
f.) Use the newest version of RMAT to develop a matrix of results for a series of concepts consistent with earlier studies.
g.) [R8]Use the newest version of RMAT to assess the effects of reliability growth of selected subsystems on manpower and turnaround time requirements.
h.) [R10]Support for Code T New Initiative Taskers
i.) [R11]Support the Logistics Cost Model (LCM) development through consultation and analytics.

Begin [R8]block schedule update

Deliverables

4.0a -d	[R9]~~Benchmark and~~ Proration evaluation documentation.	[R9]~~31Jan04~~ 30Apr04
	New analysis process documentation	15Dec03
	Logistics Cost equation documentation.	[R11]~~30Sep04~~ 07/01/05
4.0 e-g	SLI concepts re-evaluation document.	[R11]~~30Jun04~~ By Request
	Matrix results documentation.	[R9]~~31Mar04~~ [R11]~~15May04~~ 07/01/05
	Reliability growth documentation	[R9]~~28Feb04~~ 15Jul04
4.0 h	[R10] Documentation	[R11]~~31Dec04~~ By Request

End[R8]block schedule update

4.0i	[R11]Status report indicating the progression of the Logistics Cost Model development and recommendations	By Request

	on further enhancements Metrics Accuracy and completeness.
3.	**Government Furnished Items:** 1) Access to workstations/computers loaded with specialized task-specific software. 2) Access to codes MINIVER, APAS, I-DEAS, INCHES, SMART, TECPLOT, LaTex, VGM. 3) Configuration geometry for each assessment vehicle, and CAD geometry formats for automated geometry inputs 4) MINIVER, PVWAVE, and windows development tools within VAB. ***5)*** [R8]Access to Adaptive Modeling Langluage (AML).
4.	**Other information needed for performance of task:** The "metrics" included in the task descriptions above describe minimum acceptable performance. To exceed minimum performance, the Contractor may: (a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or (b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product. 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. The Contractor is expected to participate and present papers at technical conferences to support the distribution of results to the technical community as determined by NASA to be technically merited on a case-by-case basis.
5.	**Security clearance required for performance of work:** Security clearances (Secret rating) may be needed in some instances (TBD).
6.	**Period of Performance:** Planned start date: [R8]01/01/04 Completion date: [R10R8]~~10/31/04~~ [R11]~~12/31/04~~ [R12]~~07/01/05~~ ***12/31/05***

7.	**NASA Technical Monitor:** R10Trina M Chytka M/S: R12***451*** Phone: 757-864-***9407*** **NASA Competency Coordinator:** ***SACD***/ M/S: Phone: 757-864-

Task Order Number: 08RBJ Revision: 1 Date of Revision: 6/28/01

Title: **National Transonic Facility Improvements**

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

The National Transonic Facility (NTF) is a fan-driven, closed-circuit, continuous flow, cryogenic pressure wind tunnel. An extensive effort is underway and is the objective of this task to make significant improvements to the NTF by minimizing the model dynamics and reduce the overall cost of facility operations.

The NTF operationally is restricted by model dynamics. These restrictions can be attributed to the significantly increased load levels utilized to achieve flight Reynolds numbers in the NTF, in conjunction with the unique structural design requirements of a cryogenic pressure wind tunnel. The reduction and possible alleviation of model dynamics is a high priority activity due to pressure from in-house and industry customers.

Additionally the NTF is striving to reduce the cost of operations by making process improvements. These improvements include modifications to existing systems or processes and/or development of new systems or processes that will reduce the overall cost of operating the NTF.

Considerable effort and resources have been expended to acquire knowledge and understanding of the NTF's unique operating modes. In order to maintain continuity without repetition, remain within projected budgets and schedules, the work contained herein requires intimate familiarity with the previously performed work on dynamics, plenum cooling, the cooling coil system, tunnel controls, and the NTF modes of operations. This work must be performed without benefit of extensive on-the-job training and orientation.

Revision 1: Requirements are expanded to include D) Model Protection Safety System and E) Task Specific Engineering Analysis and Assessment with additional deliverables, completion date extended, and some clarifying remarks are added (see R1 below).

2. **Description of the Work to be Performed:**

1. **Dynamics:** The Contractor shall analyze Government-supplied dynamics research data and study the dynamic response characteristics of the NTF high-speed leg (settling chamber, test section, model, model support and high speed diffuser). The Contractor shall use the data analysis results to develop a *Proposal* for tunnel and/or model modifications designed to minimize or alleviate NTF model dynamics.

   Deliverables:

   The Contractor will attend weekly project status/planning/review meetings (~1 hour) and provide status information, comments and recommendations on dynamic project activities. The Contractor shall provide a *Proposal* that contains tunnel and/or model modifications designed to minimize or alleviate NTF model dynamics. All new drawings submitted with the *Proposal* shall be on E-size drawing sheets with NASA Langley drawing numbers and in accordance with NASA Langley drawing standards. The Contractor shall red-line all existing drawings as necessary. Additionally all work performed by the Contractor shall comply with NASA Langley Safety standards.

Schedule of Deliverables:

A preliminary *Proposal* shall be submitted no later than March 5, 2001 for review. The final *Proposal* shall be submitted no later than March 19, 2001.

Performance Metrics:

The *Proposal* shall include feasibility of the modifications, design drawings of modifications, cost estimates and supporting data analysis and engineering calculations along with expected results. Additionally the *Proposal* shall include a test plan for validation of the expected results.

Performance Standards:

Meets: Completed *Proposal* providing several (3 or more) proposed solutions that reduce the model dynamics.

Exceeds: Completed *Proposal* that contains proposed solutions that can be implemented at the facility in FY-01. The Proposal also contains details for implementation of the proposed solutions.

2. **Existing Tunnel Modifications:** The Contractor shall work with the facility staff (Civil Servants and Contractor) in developing action plans, solutions and procedures to overcome unforeseen problems during the existing scheduled modifications at the NTF. These existing scheduled modifications include:

   A) Installation of the Plenum Heating/Cooling System

   B) Cooling Coil System Assessment

   ***C)* Automatic Test Sequence System Enhancements**

   D)* R1 *Model Protection Safety System

   E)* R1 *Task Specific Engineering Analysis and Assessment

During the course of this Task Order's work, the Contractor may have additional or new ideas that produce significant cost savings to the NTF. The Contractor is encouraged to formally submit these ideas to the Technical Monitor. These new ideas will contribute to the Performance Standard ratings.

Deliverables for all modifications:

The Contractor will attend weekly project status/planning/review meetings for these existing tunnel modifications (~1 hour) and provide status information, comments and recommendations on project activities. All drawings from the Contractor shall be prepared on E-size drawing sheets with NASA Langley drawing numbers and in accordance with NASA Langley drawing standards. The Contractor shall red-line all existing drawings as necessary. Additionally all work performed by the Contractor shall comply with NASA Langley Safety standards.

A) Installation of the Plenum Heating/Cooling System

The Plenum Heating/Cooling System is a new system schedule for installation in FY-01 at the facility. This system is designed to provide circulation in the tunnel plenum (around the test section) to help prevent large thermal gradients and flow stratification during a tunnel cool-downs and warm-ups. The system performance requirements are to keep the plenum thermal gradients below 100F.

Deliverables:

The Contractor shall provide a *Design Concepts Report* of the Plenum Heating/Cooling System. The Contractor shall provide procedures and/or processes for installation, operational checkout, operations and maintenance of the Plenum Heating/Cooling system. Additionally, existing Facility Integrated Operating Procedures (IOPs) and Standard Operating Procedures (SOPs) shall be redlined to integrate the operations of the Plenum Heating/Cooling System at the Facility.

Schedule of Deliverables:

1) A preliminary *Design Concept Report* shall be submitted no later than April 9, 2001 for review. The final Design Concept Report shall be submitted no later than April 23, 2001.
2) Installation Procedure/Process shall be submitted by May 7, 2001.
3) Operational Checkout Procedure/Process shall be submitted by June 4, 2001.
4) Operations Procedure/Process and IOP/SOP red-lines shall be submitted by June 18, 2001.

Performance Metrics:

1) The *Design Concept Report* shall include design concept specifications, drawings, detailed information required to fabricate and install the design concept. The *Report* shall include cost estimates and supporting data analysis and/or engineering calculations to demonstrate that the concept will met the desired performance. Additionally the *Report* shall contain any vendor catalog data, and any other information needed to describe the hardware of the design concept.
2) The Contractor shall have all new procedures/processes and IOP and SOP redlines submitted for review and approval by the Facility Safety Head and Technical Monitor prior to their implementation.

Performance Standards:

Meets: Completed *Design Concept Report*.

Exceeds: Completed *Design Concept Report* and completed installation, checkout and operation of the Plenum Heating/Cooling System in FY-01.

B) Cooling Coil System Assessment

A previous Cooling Coil System Assessment at the NTF identified an itemized *Action Plan* to be performed prior to determining the final course of action for the cooling coil work (repair, replace, or other). R1 ***Based on the findings and recommendations of the first Summary Report and delays in the tunnel operations further detailed assessment and analysis of the Cooling Coil System was requested by NASA prior to commenting funding for Cooling Coil Repair/Replacement or enhancements.***

Deliverables: The Contractor shall provide an *Action Plan Details Report* that contains a detailed approach to complete the implementation of the Cooling Coils System Assessment *Action Plan*. Additionally, the Contractor shall provide a *Summary Report* that contains documentation of the *Action Plan Details Report* findings and a *Proposal* for the final course of action for the cooling coil system assessment work.

Schedule of Deliverables:

1) A preliminary *Action Plan Details Report* shall be submitted no later than February 5, 2001 for review. The final *Action Plan Details Report* shall be submitted no later than February 19, 2001.
2) The *Summary Report* shall be submitted no later than June 29, 2001
3) R1 ***The Final Report shall be submitted no later than October 29, 2001.***

Performance Metrics:

1) The *Action Plan Details Report* shall include the details required to complete the Cooling Coil Assessment Action Plan. This report shall include procedures, drawings, equipment and instrumentation requirements, testing plan, data collection requirements, configurations and setup schematics or drawings, work force requirements and time estimates.
2) The *Summary Report* shall include documentation of the *Action Plan Details Report* findings and a *Proposal* for the final course of action for the cooling coil system assessment.
3) The *Proposal* section of the *Summary Report* shall contain information to support the final course of action. This *Proposal* shall include any design, operations, or process changes, schematic of the proposed changes, cost estimates, vendor catalog data, and supporting data analysis or engineering calculations along with expected results from the proposed changes. Additionally the *Proposal* section shall include a test plan for validation of any proposed changes.

Performance Standards:

Meets: Completed *Action Plan Detail Report* and *Summary Report*.

Exceeds: Completed *Summary Report* that contains a proposed final course of action for the cooling coil system assessment work that can be implemented at the facility in R1 ~~FY-01~~ ***FY-02***.

C) Automatic Test Sequence System Enhancements

Significant cost savings can be achieved by making several enhancements to the

Automatic Test Sequence (ATS) and the tunnel controls system. These enhancements will reduce response times of the model attitude system for both pitch-pause testing and continuous pitch sweep testing. [R1] ***As identified in the Report significant time and cost savings can be realized by making enhancements to the tunnel model attitude controls system. Therefore it is desirable to implement these changes***.

Deliverables: The Contract shall provide a *Report* detailing the proposed enhancements required to the ATS and the tunnel controls system to realize these savings. [R1] ***The Contractor shall provide a detailed implementation plan.***
Schedule of Deliverables:
A preliminary *Report* shall be submitted no later than May 21, 2001 for review. The final *Report* shall be submitted no later than June 4, 2001.
[R1] ***Implementation plan September 29, 2001***.

Performance Metrics:
The *Report* shall include a feasibility study, necessary control algorithms for ATS and/or the tunnel controls to implement changes, necessary hardware changes, supporting data analysis and engineering calculations with expected results of cost savings and/or data quality improvements. Additionally the *Report* shall include a test plan for validation the expected results.

Performance Standards:
Meets: Completed *Report*.
Exceeds: Completed *Report* that contains proposed changes that can be implemented and verified at the facility in FY-01.

Begin [R1] block addition

D) Model Protection Safety System

As result of NASA LaRC Tunnel Safety Review all major wind tunnel facilities are now required to have an autonomous system similar to the NTF's existing Balance Dynamic Display Unit (BDDU) and the Critical Point Analyzer (CPA) that automatically reduces the test article loads when pre-established balance load levels (single or multiple components) are exceeded.

A computer-based version of the BDDU and CPA system was developed at the NTF (by Dr. Balakrishna in 1998) called the Model Protection Safety System (MPSS). In addition to BDDU and CPA functions the MPSS also provided a Modal Trip System that automatically reduces the test article loads when pre-established amplitude levels at specific frequencies are exceeded.

This MPSS approach was chosen by the Safety Review Board to be implemented at all

the major facilities. The first implementation will be at the 16ft Transonic Tunnel.

<u>Deliverables</u>: The Contract shall provide initial documentation of the NTF MPSS that includes an initial code listing of the MPSS software, hardware components and configuration, user guide and system documentation.

The Contractor shall review any requests from the 16ft TT to enhance or modify the system. The Contractor shall also review the proposed methods of interfacing the system with the existing tunnel control systems. These reviews shall include review of redlined drawings, code listing, system configuration and procedures. For these reviews the Contractor shall provided informal review summary reports (may be oral) detailing any concerns or possible alternatives.

<u>Schedule of Deliverables</u>:
The initial documentation shall be submitted no later than July 6, 2001.
The Interfacing Review Summary Report for 16ft TT for sub-sonic operations shall be submitted no later than July 2, 2001 (BDDU and CPA Features only).
The Review Summary Report for 16ft TT for sub-sonic operations shall be submitted no later than August 3, 2001 (Modal Trip System Features only).
The Interfacing Review Summary Report for 16ft TT for super-sonic operations shall be submitted no later than August 10, 2001 (BDDU and CPA Features only).

<u>Performance Metrics</u>:

Implementation and checkout of the MPSS (BDDU and CPA features) for sub-sonic operations at 16ft TT.

Implementation and checkout of the MPSS (BDDU and CPA features) for sub-sonic operations at 16ft TT.

<u>Performance Standards</u>:

> ***Meets: Successful implementation, checkout and tunnel operations of the MPSS (BDDU and CPA features) at 16ft TT for sub-sonic operations.***
> ***Successful implementation and checkout and operations of the MPSS (Modal Trip System features) at 16ft TT for sub-sonic operations***
> ***Exceeds: Design interface for implementation of the MPSS at 16ft TT for super-sonic operations.***

<u>E) Task Specific Engineering Analysis and Assessments</u>
This part of the Task Order is designed to allow for the Contractor to perform specific engineering analysis and/or assessments for a Specific Task. The following Tasks are currently identified by the Facility using the Task/Test Request (TTR) System to

identify the work required.

E.1 Focus Schlieren Video System (TTR s16-006-01)
***Task:* Design an additional supplemental heating system for the focusing schileren camera package for use over the temperature ranges of the NTF.**
***Deliverables*: The Contractor shall provide a Design Report upon closing the TTR.**
***Schedule of Deliverables*:**
The Design Report shall be submitted no later than September 1, 2001 for review.
***Performance Metrics*:**
The Design Report shall include heating requirement calculations, heating system design, hardware specifications and a brief summary of the theory of operations.
***Performance Standards*:**
Meets: Completed Design Report.
Exceeds: None.

End R1 block addition

3. Government Furnished Items:

1) Office space in Bld. 1236 (the NTF).
2) MatLab Software from Mathwork for data analysis.
3) Access to the NTF's Dynamic Data Acquisition Unit.

4. Other information needed for performance of task:
Applicable documents available at the NTF Archive Center:

Data Analysis Report – NTF Operational Data from Test 100, 107 and 111, Final Report Part A; S. Balakrishna; February 24, 2000

NTF Structural Modifications proposal based on NTF Operational Data Analysis, Final Report Part B; D. Butler; February 2000

NTF Cooling Coil System Study Report; D. Butler; December 2000

Additional specific NTF test reports, equipment manual and facility related documents will be provided by the Government as requested by the Contractor.

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.

5. Security clearance required for performance of work:
Because the NTF operates two shifts, occasionally work will be require on second shift, this

	will require the Contractor to have "After Hours Access" to the NTF.
6.	**Period of Performance:** **Planned start date:** January 2, 2001 **Completion date:** R1 ~~June 29, 2001~~ ***October 29, 2001***
7.	**NASA Technical Monitor:** W. Allen Kilgore **M/S:** 267 **Phone:** 757-864-5033

Task Order Number: 08RCE Revision: 0 Chge 1 Date of Revision: 6/26/01
Title: **Testing and Analysis of Advanced Materials**

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

The purpose of this task is to conduct mechanical testing and microstructural analyses on materials systems, with the primary focus being advanced metallic materials. The objective is to establish processing-microstructure-property relationships for the material systems for aerospace applications.

Change 1: Adds 6/26/01 Contractor-proposed travel and material purchase requirements (see [C1] below).

2. Description of the Work to be Performed:

Note: Some of the required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1 Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written work request basis (NOR). The Government will provide the materials which will primarily be metallic-based, although other materials may be included on a limited basis. Preparation techniques will include sectioning, mounting, mechanical and chemical or electrochemical polishing of specimens suitable for optical metallography, x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis. The Contractor shall ensure equipment is operational prior to and after analyses. Specific analyses and quantities are detailed below:

- Utilize a variety of optical microscopes in conjunction with SEM with energy- and wavelength-dispersive spectrometry (EDS and WDS) systems and a microtexture analysis system to analyze the chemistry, morphology, and orientation of individual grains and/or particles and of the bulk microstructure (up to 120).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to 25).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques

(up to 50).

- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to 75).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to 60).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to 60).
- Conduct hardness and microhardness tests on metallic materials (up to 50).

Deliverables (for 2.1):

- For each analysis request, brief informal statement (written or oral) of types of analyses to be conducted and estimated time for completion to the Requester within 5 working days after receipt of the work request.
- For each analysis request, informal written and oral report of results to the Requester within 5 working days after completion of the analysis. The report shall include description of analyses and interpretation of results. The report shall include any photomicrographs, compositional analyses, x-ray and electron diffraction data relevant to the microstructural characterization performed.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of analyses conducted, standards and procedures used, and any specialized analysis techniques and procedures developed. (12/31/01)

Performance Standards (for 2.1):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Work requests completed by requested due date
- Cost

EXCEEDS:

- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost

Subtask 2.2: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written work request basis (NOR) to determine the mechanical behavior of materials from cryogenic to elevated temperatures, with the majority of tests being conducted at room temperature. The Government will supply the specimens machined from aluminum- and titanium-based alloys and composites, although other materials may be included on a limited basis. Product forms may include, but not be limited to, foils, sheets, plates, rods, forgings, and extrusions. The Contractor shall ensure equipment is operational prior to and after tests. Specific tests and quantities are detailed below:

- Tensile and compression tests to measure strength, modulus, and elongation (up to 800).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to 200).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to 75).
- S-N fatigue tests on notched and un-notched test specimens (up to 120).
- General and stress corrosion tests in salt solutions (up to 50).

Deliverables (for 2.2):

- For each test request, tested specimens (with fracture surfaces intact and preserved) and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of test procedures, calibrations, specimen dimensions, test anomalies, and electronic data files for each test.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (12/31/01)

Performance Standards (for 2.2):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- work requests completed ahead of requested due date

- "rush" work requests designated by the task monitor expedited
- Completed under cost

Subtask 2.3: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written work request basis (NOR). The materials will comprise primarily aluminum, titanium, and nickel-based alloys, although other materials may be included on a limited basis. Product forms may include, but not be restricted to, foils, sheets, plates, rods, forgings and extrusions. Work assignments shall include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to 2000) limited to 36 inches by 12 inches in dimension, but usually on the order of 1 inch by 4 inches in size. The Contractor shall be responsible for ordering chemical supplies; maintaining chemical cleaning baths, monitoring, neutralizing, and coordinating disposal of hazardous materials, and maintaining a catalog of the appropriate materials safety data sheets.

Deliverables (for 2.3):
- For each work request, an informal written and/or oral report of the results to the Requester within 3 working days after completion of the work. The report shall include description of the surface preparation procedures, results, and anomalies.
- Informal written monthly reports that list work requests completed during the reporting period, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of surface preparation activities conducted, standards and procedures used, and any specialized techniques and procedures developed. (12/31/01)

Performance Standards (for 2.3):

MEETS
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)
- Cost

EXCEEDS
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost.

3.	Government Furnished Items: Specialized surface preparation equipment located in Metals Cleaning Laboratory (Building 1229A) including deionized water supply, chemical cleaning and rinse tanks, anodizing equipment, electroplating equipment and supplies, acids, bases, precleaners, neutralizing chemicals, supplies, and related safety equipment. Specialized mechanical test equipment located in the Light Alloy Laboratory (Building 1205) and the High-Temperature Test Laboratory (Building 1205), including cryogenic and elevated temperature chambers, test machines, strain and displacement measurement instrumentation, and System 4000 and Fracture Testing Associates data acquisition systems. Specialized metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEM's, TEM's, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation apparatus and supplies.
4.	Other information needed for performance of task: C1 ***Some travel for conference dissemination of new or improved technologies may be appropriate as these advances occur. The Contractor may also be required to make small purchases of materials as necessary to efficiently perform the task order requirements.*** 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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 1/2/01 Completion date: 12/31/01
7.	NASA Technical Monitor: Keith Bird M/S: 188A Phone: 757-864-3512 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 3 Statement of Work

Task Order Number: 08RDB Revision: 3 Date of Revision: 9/29/03

Title: Support of AirSC Web Sites

1. **Purpose, Objective or Background of Work to be Performed:** (RD03, NAS1-96014)
Listed below for subtasks as appropriate.

For original issued version of SOW, see ETOS file *08RDB.doc*
Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the requirements for the new period of performance around "Control Law" in lieu of "Blended Wing Body Low Speed vehicle" (see [R1]).
Revision 2: Extends the period of performance one year in continuation of NASA's support requirements with new requirements added as Subtask 4 (see [R2] below).
Revision 3: Extends period of performance one year in continuation of NASA's support requirements and deletes Subtasks 1,2, and 4. Task title changed to "Support of AirSC Web Sites" (see [R3] below).

2. **Description of the Work to be Performed:**

Subtask Integration:
Subtask 3 AirSC Branch Web sites

Deliverables:

a) Status reports delivered electronically to the Task Monitor each month. Working days exclude weekends and federal holidays. — monthly

b) Attendance and support of Design Challenge bi-weekly team meetings. — Weekly

Subtask 1 Modeling and Support for [R1]Control Law Design Challenge [R3]***Deleted***
Subtask 2 Support for Design Challenge Web site [R3]***Deleted***

Subtask 3 Dynamics & Control Branch (DCB) and Vehicle Dynamics Branch (VDB) Branch Web sites

Background

DCB & VDB WWW servers have been established to provide our stakeholders access to Branch-related information, including branch research programs, technical reports, draft documents, simulation models and data bases, and administrative information. This subtask would develop and maintain DCB & VDB WWW-sites.

Work to Be Performed This subtask shall include developing and maintaining DCB and VDB WWW-sites on an existing Web server. "Maintaining" shall be understood to mean: (1) adding documents to the server, (2) organizing the total document set in a logical-tree

(1) adding documents to the server, (2) organizing the total document set in a logical-tree using hyperlinks, and (3) installing updated server software. On an infrequent basis, the task will involve shutdown and restart of the Web server software; this is accomplished via the console of the host. Automatic translation programs shall be investigated and implemented a to maximum extent possible.

Information that is to be placed on the Branch Web servers includes:

Branch research program information, researcher technical reports, researcher bibliographies, Branch highlights, draft documents, links to related www-sites, simulation models and data bases, and administrative information.

Deliverables:

a) Documents translated to either Hypertext Mark-up Language (HTML) or Portable Document Format (PDF) from a variety of source documents (including text, Microsoft Word 6.0/97, LaTeX, and PostScript files), generally within 24-72 hours of receipt. HTML version shall be proofread and compared to original source document(s) to insure accuracy.

b) Documented hierarchy on Web server together with up-to-date hypertext-based collection of documentation on Web server. Sufficient explanatory HTML pages of instruction to provide navigation capability throughout the Web structure. (By task completion)

c) Capability for users to submit e-mail address for e-mail list. Capability to e-mail information to e-mail list. List of users who have downloaded documents from the Web server. (By task completion)

d) A record of the total number of documents placed on the server along with their size. A record of the time required to provide translation of documents. (By task completion)

Metrics for Deliverables:

Exceeding performance expectations would be for all documents less than 10 pages to be available within one working day of receipt and larger documents within three working days.

Begin R2 block requirements addition

Subtask 4. DCB Computational Database Maintenance R3***Deleted***

Task Order Number: 08RDB Revision: 3 Date of Revision: 9/29/03

Title: Support of AirSC Web Sites

	End R2 block requirements addition
3.	**Government Furnished Items:** ~~All subtasks:~~ Access to workstation with MATLAB/Simulink license. ~~Subtask 1 only:~~ ~~a) MATLAB/Simulink version of baseline simulation sufficient to support Simulink Design Challenge model implementation.~~ ~~b) Major component subsystem models definition.~~
4.	**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.
5.	**Security clearance required for performance of work:** All individuals working on this task shall comply with program data sensivity and non-disclosure agreements. ~~The R1 Control Law Design Challenge program is NOT classified. The data in R1 the Design Challenge model is often proprietary.~~
6.	**Period of Performance:** Planned start date: 1 January 2001 Completion date: R1,R2 ~~31 December 2002~~ R3 ~~31 December 2003~~ ***31 December 2004***
7.	**NASA Technical Monitor:** Dr. John B Davidson M/S: 132 Phone: 757-864-4010 NASA Competency/Other Technical Coordinator: AirSC/ M/S: 162 Phone: 757-864-9119

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

1. Purpose, Objective or Background of Work to be Performed: ~~(RF06, NAS1-96013)~~

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~~Electronic Systems Branch (~~FIB~~ESB) at NASA Langley Research Center is responsible for acquiring and recording the data for over 1000 parameters on the B-757 ARIES project utilizing a Data Acquisition System (DAS) developed by ~~FIB~~ESB.

The overall objective of this task is to operate, maintain and upgrade the Data Acquisition System (DAS) and validate data acquired by the DAS.

Note: The test and flight support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

2. Description of the Work to be Performed:

Subtask 1

The Contractor shall operate the government provided Data Acquisition System (DAS) on the ARIES B-757. This will include providing an operator for the DAS during all system and environmental ground test and all research flights (NOR) on the ARIES B-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. It is anticipated that approximately 40 local flight research programs and 30 remote site deployments will be required and that the aircraft will be down for approximately 5 months to perform modifications and upgrades to the DAS to support the flight research programs.

1. 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.

2. The Contractor shall modify, integrate, qualify, and validate the DAS as required (NOR) to support changes/upgrades for scheduled research flights to meet FY01 and FY02 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 (~~Shared Common Random Access Memory Network (SCRAMNet) data block software configuration changes, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.

3. The Contractor shall provide Pulse Coded Modulated (PCM) digital data and IRIG-B time to the Data Display and Processing System (DPDS).

4. For each flight test series (NOR), 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.

5. 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. The Contractor shall also provide a calibration database using Microsoft Access and is compatible with the new Veridian Ground Processing Station

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

currently under development by ~~FIB~~ESB.

6. 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 B-757 Project Manager when critical flight schedules conflict with accomplishing these calibrations.

7. 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, the DAS quick look computer, and the Veridian System.
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.

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

3. Government Furnished Items:

Access to the following

1. Use of NASA ground station is available for post flight data processing on a scheduled basis.

Hardware:

1. AATIS (Advanced Airborne Test Instrumentation System) data system with documentation
2. AATIS compatible recording media
3. Assorted collection of Sensors
4. Sensor calibration data
5. Access to Flight Simulation Integration Laboratory (FSIL) 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/B-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.

Task Order Number: 08RFL Revision: ____ Date of Revision:

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Data Acquisition System.

4. <u>Other information needed for performance of task</u>:

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 B-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~~ B-757 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 B-757 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.~~ Building1250) 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

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: December 31, 2001

7. NASA Technical Monitor: F. Keith Harris

M/S: 257 Phone: 757-864-3824

Task Order Number: 09RAC Revision: 13 Date of Revision: 2/22/05

Title: R13 ***SACD*** Analysis and Model Development.

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

The Aviation System Analysis Capability (ASAC) was developed by the Logistics Management Institute (LMI) to support NASA's Office of Aerospace Technology (OAT) technology portfolio investment decisions. ASAC is a tool used to quantify total air-transportation system impacts and socioeconomic impacts of advanced technologies. ASAC consists of a diverse collection of models and databases used by analysts to inform and assist scientist, engineers, other analysts, and program managers of the total transportation and socioeconomic impacts of existing and proposed technology initiatives.

ASAC currently consists of the following models:

- Aircraft/Air Traffic Control (ATC) Functional Analysis Model (FAM) v2.3
- Aircraft Synthesis (ACSYNT) Model v1.8
- Approximate Network Delays (AND) Model v2.4
- Air Cargo Investment Model v1.1
- Air Carrier Cost-Benefit Model (CBM) v2.6
- Air Carrier Investment Model (ACIM) v1.7
- Air Carrier Network Cost Model v1.6
- Air Carrier Operations Model v2.5
- Airport Capacity Model (ACM) v2.1
- Airport Delay Model (ADM) v2.2
- Flight Segment Cost Model (FSCM) – Cost Translator v1.5
- FSCM – Mission Generator v1.4
- Noise Impact Model (NIM) v3.1
- Regional and Commuter Air Carrier Investment Model v1.3
- System Safety Tolerance Analysis Model v2.7
- Flight Optimization System (FLOPS) Model v1.8

Two general types of analyses are performed using ASAC. Macro analyses are used for high-level decision making and resource allocation. Bottom-up analyses are used for detailed decision-making (e.g., program down-selects). The NASA Inter-center Systems Analysis Team (ISAT) is responsible for providing OAT with this type of decision support. ISAT is a Langley led effort and the task described herein will utilize ASAC analysis capability at Langley and develop ASAC analysis expertise at Langley. After developing the capability, tasks for adding specific ASAC models will follow.

R2 Framework CT was developed by Teamvision, Inc. under AGATE Program and is an integration framework linking ASAC objects and is capable of supporting multi-variable sensitivity analysis and 3-D display of solution space analysis outputs.

Revision 1: Extended the FY01 schedule, performance standards, and the completion date one month. (For details see file 09RAC01.doc on electronic task order system, ETOS.)

Revision 2: Extends the period of performance approximately one year in continuation of NASA's support requirements with a redefinition of the work required (see [R2] above and below).

Update 1: Adds clarification to existing travel requirements in Section 4 (see [U1] below).

Revision 3: 6/12/02: Increases anticipated travel requirements from 4 to 6 trips, 6/27/02: adds requirements as new Task B and extends completion date one month (see [R3] below).

Revision 4: Adds new programming support requirements as Task C (see [R4] below).

Revision 5: Extends the period of performance one year in continuation of NASA's support with redefined requirements in (sub)Task D (including roll-in of follow-on work previously performed under Task Order 28RAC) for the new period of performance (see [R5] below).

Revision 6: Adds new requirements as (sub)Task D.7 (see [R6] below)

Revision 7: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support, with requirements added as (sub)Tasks E.1 through E.3 for the new period of performance (see [R7] below).

Revision 8: Adds new requirements as (sub)Tasks E.4 and E.5 with associated deliverables and schedule and updates (sub)Task E performance standards (see [R8] below).

Revision 9: Adds requirements to enhance Virginia Tech Decision Support Transportation model to calculate demand for range of radical vehicle concepts and technologies developed in ASCAC as (sub)Task F (see [R9] below).

Revision 10: Deletes (sub)Tasks E.3 and E.4 and their associated deliverables and adjusts some details of (sub) Task E.2 (see [R10] below).

Revision 11: Adds requirements to enhance the Transportation Systems Model in (sub)Task F to include the effects of 'Agent Based Modeling' and extends the deliverables schedule (see [R11] below).

Revision 12: Extends the period of performance 12 months in continuation of NASA's support with requirements added as (sub)Tasks G and H for the new period of performance (see [R12] below)

Revision 13: Updates title. Adds JPDO Evaluation & Analysis Directorate systems studies with the national Transportation Systems Analysis Model and includes enhancements to compute flight schedules from demand for travel (see [R13] above and below).

2. **<u>Description of the Work to be Performed</u>:**

Note: Relocating the databases and models to Langley-based servers is not required under this task. Although Langley has the current executable and source code for the LMI software, there are no provisions in the current contract for LMI to provide the actual updated software codes to the government; therefore, a requirement for version control at Langley is not anticipated. LMI thoroughly documents all changes to the database and models as developed as they are developed.

Begin [R2] block

<u>Task A</u>: The Contractor shall perform top-down and also bottom-up analyses that use the ASAC models and databases and Framework CT to provide the following results:

1. Impact assessments of NASA technologies on the performance of the air transportation system as measured by delay, number of operations, and revenue passenger miles. The projection years shall be 2007 and 2022, and the projections shall utilize the Terminal Area Forecast-based unconstrained business case, the Economically constrained business case, demographic projections, and transportation mode preference criteria.
2. Multi-variable sensitivity analyses that characterize tradeoffs of safety, capacity, and economic/business technologies, operations, and concepts.
3. In support of OATIP, top-down analysis of the air transportation system that defines and quantifies performance gaps in the ability of existing technologies, operations concepts, and strategies to satisfy future air transportation demand.

Deliverables:

Task A:

1. Sensitivity and rollup assessment of impacts of NASA technologies on Capacity.
2. 3-D 'carpet plots' of air transportation solution space relative to safety, capacity, and economics/business.
3. Technology and operations 'area' requirements which, if implemented, could lead to the ability of a future air transportation system to satisfy the demand for air travel.

Schedule:

Task A:

1. March 30, 2002
2. July 30, 2002
3. November 30, 2002

Performance Metrics: The following will be used to determine the quality of Contractor task performance, relative to the task requirements:

Contractor progress reported monthly, tracked against the scheduled time allotted will be used to monitor the Contractor's performance.

Performance Standards: The following performance standards will apply:

Meets performance defined by Task A, subtask 1, 2, and 3 delivery by scheduled completion date.

Exceeds performance defined by:

1) Task A, subtask 1: Safety, capacity, and economic/business solution space optimized for safety, and for capacity, and for economic/business.

2) Task A, subtask 2: Technology and operations 'area' requirements are quantified.

End R2 block

Begin R3 block addition

Task B:

1. The Contractor shall use the Systems Analysis Branch air transportation system engineering and analysis (SAB ATS SE&A) models and simulations and methodology to conduct analyses of the solution space of minimum aircraft separation possible based on communication, navigation, surveillance and datalink hardware/software performance and dispersions, movable object physical limitations, and human performance, independent of current FAA requirements.

2. Execute trajectory simulation to conduct trade studies of alternative technologies and procedures for the operation of small aircraft at untowered airports.

Deliverables:

Task B.1. Probability density distribution and simulation and model output of minimum aircraft separation as a function of input variables described in Task B.1.

Task B.2. Simulation and model output of small aircraft trajectories, separations, and conflicts as a function of input variables described in Task B.2.

Schedule:

Task B.1. December 30, 2002

Task B.2. December 30, 2002

Performance Standards: The following performance standards will apply:

Meets performance defined by: Tasks B.1. and B.2. delivery by scheduled completion date.

Exceeds performance defined by: as a result of analyses conducted in Task B.1, defines and develops new variable correlations, input/output relationships, and/or output correlations of significant sensitivity and/or statistical significance that may be analyzed in future analyses.

End R3 block addition

Begin R4 block addition

Task C: The Contractor shall provide computer and software programming support to expand the existing analytical and simulation capability and provide higher fidelity analyses in performing the following requirements:

1. Develop software to integrate input data files directly with SAB models and simulations.

2. Develop software that integrates and automates utilization of submodules of the SAB models.

3. Installing and integrating utility programs.

Deliverables:

SAB models and simulation software lines of code.

Schedule:

December 30, 2002

Performance Standards: The following performance standards will apply:

Meets performance defined by: Meets performance defined by Task C with delivery by scheduled completion date.

Exceeds performance defined by: Obvious computational efficiencies and improvements.
End R4 block addition
Begin R5 block requirements addition/redefinition
Task D: The Contractor shall provide computer and software programming support to expand the existing analytical and simulation capability and provide higher fidelity analyses in performing the following requirements:

1. Develop demographically-based air transportation alternative route structures. In FY02, SAB conducted an analysis of potential market and demand for various small aircraft vehicles. The demand was based on family income and consumer price for multiple small aircraft transportation business models and personal utilization and presented the potential diversion of travelers from automobiles and air carrier operations. The FY03 analysis will use national demographic data and models (at the county level) to project probable geographic locations for small aircraft transportation basing that corresponds to the potential economically based market. Probability

densities will be calculated, using a gravity model, for alternative small aircraft transportation air route structures (origin/destination, number of flights, stage length, time of day, waypoints) based on the economic demand and demographic calculations.

2. Conduct simulation and analysis of SATS operations in the enroute environment. Simulation of the enroute environment will be integrated with High Volume Operations (HVO) environment simulation to develop contiguous integrated operations and flight profiles from the local HVO airport environment, through local-to-enroute transition, and into operations within enroute airspace. Operations and environment will include airspace configurations, mixed equipage operations, flightpaths, altitude minima, holding patterns, and transition methods. Analyses will include airspace capacities and densities, conflicts, and the 'ripple effect' impact of HVO on transition and enroute operations and vice versa.

3. Conduct simulation and analysis of SATS Low Level Minimums (LLM) operations. Simulation and analysis of approach procedures, flight paths, and navigation systems performance in a low level minimum environment. Analyses will support the development of minimum ceiling and visibility requirements and corresponding flight deck technology requirements. LLM environment will be integrated with HVO environment to analyze LLM operations within the HVO environment.

4. Conduct simulation and analysis of Wake Vortex Avoidance System (WakeVAS) operations concepts. Simulation and analysis of WakeVAS operational characteristics and technologies that will include, but is not limited to: geographic and meteorological conditions; airport and local airspace operations and runway configurations; technology accuracy and limitations; aircraft-type mix and scheduling; interfacing NAS parameters and operations.

5. Integrated operations development and analysis. Significant changes are occurring in the business and operations of major air carriers that may provide opportunities for new entrants into air transportation. New operational and vehicle concepts being developed by NASA may be of potential benefit to these new entrants. This subtask shall build on the results of subtask (a). Personal air vehicles, runway independent aircraft, and unpiloted air vehicles shall be introduced into the fleet mix. Simulations of traffic flow and air traffic management scenarios corresponding to the expanded fleet mix and origin and destination pairs shall be conducted. Analyses shall be conducted to determine local and national system-level economic, capacity, and air traffic flow impacts.

6. Conduct simulations of the traffic flow and air traffic management scenarios developed in (sub)Task D.1 (above) and analyses that extrapolate the simulation results to the total national airspace system. Simulation results shall compare airport capacity and volume density relative to each scenario and to a baseline scenario that corresponds to current National Airspace System operations. Simulation output data sets/files will be used as overall evaluation result outputs and also as input files to analysis algorithms to assess national system-level impacts (economic, delay, throughput) of the scenarios. The analyses shall estimate aircraft and volume density parameters for notional and actual airspace sectors that are consistent with the implementation of the advanced scenarios. Analyses output data sets/files shall describe, at national system-level, the impacts of the advanced scenarios on the air transportation system including number of operations, enplanements, delays, and economics.

Begin R6 block addition

7. The Contractor shall research and collect data, develop simulation inputs, and conduct analyses and examination of communication, navigation, and surveillance (CNS) variations among current and proposed ground-based, space-based and flight deck-based CNS systems. The results of this effort will quantify the impacts of CNS accuracy and error rates on the traffic flow, operations and air traffic management strategies currently employed in the total national airspace system or on potential future strategies that have been proposed. Simulation results shall compare system capacities, volume densities, conflicts, and the relationship of CNS systems performance to each of the aforementioned, relative to each stratagem and to a baseline scenario that corresponds to current National Airspace System operations. Simulation output data sets/files will be used as overall evaluation result outputs and also as input files to further analyses to assess national system-level impacts (economic, delay, throughput) of the scenarios.

End R6 block addition

Deliverables:

Task D.1. Probability densities for transportation air route structures (origin/destination, number of flights, stage length, time of day, waypoints) based on the economic demand and demographic calculations.

Task D.2. Airspace capacities, densities, conflicts, and the ‘ripple effect’ impact of HVO on transition and enroute operations and vice versa.

Task D.3. Airspace capacities, densities, conflicts, and the ‘ripple effect’ impact of LLM on integrated HVO and enroute operations.

Task D.4. Airspace capacities, densities, conflicts, and the 'ripple effect' impact of WakeVAS operational concepts and technologies.

Task D.5. Air route structures for major air carriers, small aircraft, personal air vehicles, runway independent aircraft, and unpiloted air vehicles; local and national level economic impacts; airspace capacities, densities, and conflicts.

Task D.6. Air traffic flow simulations and national-level capacity analyses.

R6 Task D.7. CNS-based air traffic simulations and analyses reports defining simulation methodologies, metrics and finding results of impact assessments on the NAS.

Schedule:

Task D.1. April 30, 2003
Task D.2. September 30, 2003
Task D.3. September 30, 2003
Task D.4. December 31, 2003
Task D.5. December 31, 2003
Task D.6. December 31, 2003
R6 Task D.7. December 31, 2003

Performance Standards: The following performance standards will apply:

Meets performance defined by: Tasks D.1 through D.7. delivery by scheduled completion date.

Exceeds performance defined by: Air transportation solution spaces defined and optimized for capacity and economic/business; define and develop new variable correlations, input/output relationships, and/or output correlations of significant sensitivity and/or statistical significance that may be analyzed in future analyses.

End R5 block requirements addition/redefinition

Begin R7 block addition

Task E: The Contractor shall provide computer and software programming support to expand the existing analytical and simulation capability and provide higher fidelity analyses in performing the following requirements:

E.1 Conduct simulation and analysis of Virtual Airspace Modeling and Simulation (VAMS) Project Wake Vortex Avoidance System (WakeVAS) operations concepts. Simulation and analysis of WakeVAS operational characteristics and technologies that will include, but is not limited to: geographic and meteorological conditions; airport and local airspace operations and runway configurations; technology accuracy and limitations; aircraft-type mix and scheduling; interfacing NAS parameters and operations.

E.2 Conduct simulation and analysis to evaluate the impacts, concepts, procedures and technologies of a small aircraft transportation system (SATS) using NASA GFI run-time simulators. Simulation and analysis shall be conducted in conjunction and cooperation with the FAATC conducted Human-in-the-Loop (HITL) simulations that will include ATC operators and pilots. These analyses and evaluations are designed to discern and quantify the potential influences of the SATS system to the NAS operations R10~~and Mobility~~ on a local, regional and national level. The simulations will provide insight into Single Pilot Performance (SPP), High Volume Operations (HVO), and Low Landing Minimums (LLM) concepts, procedures, software, and technologies as a wholly integrated operation. Through the use of HITL and run-time/non-HITL simulations, the accuracy of NASA-sponsored simulations will be verified through comparative analysis of the results of the FAATC and NASA simulations.

E.3. R10Deleted

Begin R8 block addition

E.4. R10Deleted.

E.5. Conduct post-process data correlation and statistical analysis of existing R10~~WVAS, SATS, and~~ air transportation system simulations and analyses. Collect and correlate simulation and analysis input data sets; collect and correlate the corresponding output data and results; use statistical methods and tools (e.g., sensitivity, uncertainty, probabilistic) to determine correlations (input-to-output, output-to-output) that have significant sensitivity and/or statistical significance; and, develop complex, multi-variable data/information displays and presentations of the correlated data.

End R8 block addition

__Deliverables__:

Task E.1. Airspace capacities, densities, conflicts, economics, and the 'ripple effect' impact of WakeVAS operational concepts and technologies.

Task E.2.1. Probability densities for transportation air route structures (origin/destination, number of flights, stage length, time of day, waypoints) based on the economic demand and demographic calculations.

Task E.2.2. Airspace capacities, densities, conflicts, R10delays, and extrapolated controller workload for HVO, LLM, SPP, and R10SATS operations concepts in the National Airspace System.

Task E.3. R10Deleted
Begin R8 block addition
Task E.4. R10Deleted

Task E.5. Statistical analysis and presentation of the correlation of inputs and outputs of R10~~WVAS, SATS, and~~ existing air transportation system simulations and analyses.
End R8 block addition

Schedule:

Task E.1. November 30, 2004
Task E.2.1 R10~~May~~ September 31, 2004
Task E.2.2. R10~~December~~ November 15, 2004
Task E.3. R10Deleted
Begin R8 block addition
Task E.4. R10Deleted
Task E.5. December 31, 2004
End R8 block addition

Performance Standards: The following performance standards will apply:

Meets performance defined by: Tasks E.1 through E.5. delivery by scheduled completion date.

Exceeds performance defined by: Air transportation solution spaces defined and optimized for capacity and economic/business; define and develop new variable correlations and input/output relationships, R8~~and/or output correlations of significant sensitivity and/or statistical significance~~ that may be analyzed in future analyses.
End R7 block addition
Begin R9 block addition

Task F: NASA currently has no accurate models to determine the demand for and likely adaptation of technologies developed with research funding applied to vehicles used in the national transportation system and to project the benefits of those technologies to the agency and national goal levels. Many research programs invest heavily in vehicle technology enhancements without ever knowing if the demand for and cost benefits of the technology were of sufficient levels to drive the transportation industry to adopt it. However, the funding for many research programs in aeronautics does hinge upon the eventual adoption and commercialization in the marketplace. To aid in program planning and advocacy, a tool is needed to be able to estimate the type of demand there will be for a technology given the associated costs and prices, so that the taxpayers are investing funds for research in the right places with a high probability that improved existing and/or new applications will be adopted for the benefit of society.

The Virginia Tech Decision Support Model (VT-DSM) developed for the SATS program has achieved much of the functionality to make demand forecast analyses for vehicles in the transportation system. However, since it was developed exclusively as a SATS analysis tool it can currently only analyze a transportation system with automobiles, the current commercial air system and projected SATS airplane vehicles. The *Contractor shall enhance* the MatLab based VA Tech DSM to model the radical vehicles and technologies that are examined in the Systems Anaysis Branch. By modeling these new concepts cost/benefit assessments can be conducted to insure that performance gains offered at a given price will be a viable economic concept and that there is payback to the American taxpayer for investment in research dollars. The *Contractor shall install* the Virginia Tech model on SAB computers *and shall modify it* to meet the program planning and advocacy needs of NASA's aeronautics program. In cooperation with Virginia Tech, the transportation mode choice modeling *shall be generalized* so that any transportation mode can be quickly analyzed with respect to the baseline projections. Macro economic models *shall be combined* with the base demand model so that changes in national economic and/or societal trends or changes in the real cost of travel with respect to GDP can be captured. Graphical user interfaces *shall be developed* to aid NASA program analyst in the comprehensive modeling of the national transportation system and the impact of NASA vehicle and technology programs.

Begin 11 block addition
The transportation system model currently utilizes a 'logit' model formulation to make transportation mode choice decisions. The logit model has been used for decades to model consumer choice traits in transportation system modeling. However, the logit model has limitations in the degrees of freedom that can be incorporated and calibrated. Therefore, new theory suggests that agent based modeling can better represent the widely varying choices of consumers in the market place. The agent based modeling technique, looks at an agent as an individual with 'free choice' in the system. The agent can be programmed to have many alternatives for choices. Then each choice is give an probability distribution for making these choices. In the model, then each agent makes a series of choices from the probability distribution

and acts upon that choice in the transportation model. The agent based modeling technique also has the strength of being able to model a consumers choices based upon a series of choices chronologically, with each choice having a dependence on its previous choices. Therefore with many agents in the system, this technique can model the actions of a population of consumers in the transportation marketplace. The modeling will also greatly strengthen the projections of how travelers will react to and the resulting benefits of goals and/or programs as defined by the AeronauticsEnterprise.

In the current work the agent shall be programmed to include, but not be limited to the following properties (characteristics):

- Levels of household income (brackets from 25K to 250K and above)
- Life in households of varying size (~1 to 6)
- Households of various education levels
- Location of residence MSA or non-MSA
- Generation group identity
- Personal value of time that varies for personal travel and for business travel
- Different party sizes for the trip
- Different trip durations
  - day
  - short (1 to 2 nights)
  - medium (3 to 6 nights)
  - long (7+ nights)
- Availability and need for personal automobile
  - on route
  - at destination
- Pilots license (yes or no)

End R11 block addition

R13 ***(Begin requirements previously part of Task H:)***
Continue system studies, analysis, algorithm validation and data comparison with the Virginia Tech DSM micro-model to ensure that the results are defendable and correlate with all known databases such as the 1995 ATS data, Census data, 2001 National Household Transportation Survey, Travel Industry Association of America data.

Since errors in the decision support models were fixed through FY '04, update and refine SATS air taxi operations cost projections for any potential SATS aircraft based upon refined system studies of average passenger loading, deadheading and the latest projections of fixed and operating costs. Generate up-dated demand numbers based on refined cost projections and alternate pricing model information as gathered for potential air taxi operators.

Conduct a system study for the demand and cost of utilizing current technology and proposed new technology design turbo-props and piston aircraft for air-taxi operations. FAA projections indicate severe sector overloading in the near future with or without SATS, but a large fleet of air taxi VLJ's could compound the overloading inducing delays on all air traffic. At the ranges associated with VLJ air taxi operations an aircraft with almost the same cruise speed but lower operating altitude may be a better fit for many routes. This study will utilize the RTI MCATS software to model a networked air-taxi system to compute average air-taxi flight costs, average aircraft passenger loadings and percentage of flights that were flown as deadheads. Then based upon the cost parameters and the airplane performance, a national demand study will be conducted to compare the market for a twin engine turboprop and piston aircraft to compete as a SATS aircraft in an air-taxi operation. In addition, the effect of limiting the altitude of VLJ's for short/medium range flights will also be studied as an option to lessen the effect on enroute air traffic flow and control. The demand projections will be computed with the Integrated Mode Choice, Small Aircraft Demand and Airport Operations Model and compared with demand projections from the Va Tech decision support model.

Make enhancements to the user-friendly GUI programming for the bottom-up DSM macro model that has been validated by the group. The goal is to develop a model that a wide range of users, such as a potential air taxi operators or NASA systems analysts, can generate valid results within the boundaries of the program. This will allow technical, but inexperienced users, to conduct demand forecasts nationally or regionally for the potential of various aircraft that could be used for SATS operations. This effort will entail the enhancements of displays that allow the user to generate all needed inputs from the interface, as well as program graphical output displays to present significant results. These input and displays will be used to demonstrate the power of the model to predict demand for the various stakeholders at the demo in Danville.

All key SATS TSAA messages are summarized, understood, and explained for the Danville demonstration and SATS closeout. It will be the responsibility to review all TSAA work for consistency and validity to ensure that analysis results are documented and of value for future work and/or studies. These messages will include, but not be limited to:

- SATS business case and market assessment
- Impact of SATS operating capabilities
- Impact of SATS to the environment
- Impact of SATS to mobility of the nation
- Impact of SATS to the NAS

Prepare a series of final closeout reports that integrate, summarize, and provide reference links to all TSAA SATS Product Data. The reports will include but are not limited to:

1. Final Integrated SATS Business Case & Market Assessment Report
2. Final Integrated SATS Enroute Analysis and NAS Impact Report
3. Final Integrated Impact of SATS Operating Capabilities Report
4. Final Integrated SATS Mobility Impact Report
5. Final Integrated SATS Gap Analysis Report
6. Final Integrated Report on Suite of Transportation Analytical Modeling Tools

For the SATS Danville demonstration, update analysis to reflect latest data from both aircraft manufactures and potential air taxi operators. Check VLJ range payload numbers with SAB's aircraft synthesis program (potential operators have questioned the manufactures published data which is currently being used). Prepare posters, displays, and simulations for the demonstration.

1. Provide simulations of NAS forecasted traffic highlighting sector activities and ATC workload
   Technical Report – SATS Simulation Analysis of the HVO & ERO Concepts
2. Looped ppt slideshows and posters of SATS future impacts to the NAS.
   Technical Report – NAS Impact Assessment Report including SATS Operations
   Technical Report- Controller Performance Report for SATS Operations
3. Presentation and demonstration for the top down Program - Integrated Mode Choice, Small Aircraft Demand and Airport Operations Model
   Technical Report – SATS Market Sensitivity Analysis
4. Looped ppt slideshow and posters for mobility and technology gaps
   Technical Report – Final SATS Assessment Report
   Final SATS Improved Mobility Report
   Final SATS Technology Gap Report

R13 ***(End requirements previously part of Task H:)***

Deliverables:

Task F:

1. Enhanced MatLab code that includes modules to model performance characteristics radical new transportation vehicle concepts.
2. Enhanced MatLab code that includes modules to model cost characteristics radical new transportation vehicle concepts.
3. Capability to add regional economic and/or demographics changes to the national database to compute the demand for technologies in a region and to modify the national data bases to account for national changes.
4. Capability to add virtual airports to the model to assess the impacts of technology that do not need to use existing airport infrastructure.

5. Develop a user-friendly graphical user interface (GUI) to allow a wide range of researchers, technologists, businessmen and economists to easily run the basic demand forecasting code.

Begin R11 block addition

6. Agent based algorithm modeling consumer trip choices to replace the logit model mode choice algorithm on the transportations systems code

End R11 block addition

R13 ***(Begin deliverables previously part of Task H)***

7. Monthly progress reports to NASA and NCAM.
8. Reports, charts & simulations including results of all systems and cost studies conducted
9. Reports, charts and code on all algorithm enhancement and validation
10. Reports, charts and code of all GUI enhancements
11. Refined charts & simulations of passenger demand numbers form the turboprop studies and latest cost data.
12. Final close-out reports of complete TSAA effort including key values and benefits & gaps, Danville demo support and all lessons learned from the TSAA model development and studies.

R13 ***(End deliverables previously part of Task H)***

*****Begin 13 block Replacement for Task G*****

Task G:

1. Demand will be projected for scheduled commercial air service in 2014 and 2025 based on county level demographics using the Transportation Systems Analysis Model (TSAM). All long distance trips will be modeled as a function of household income and demand will be projected for scheduled air service as the travel mode choice based on travel costs and total trip time. Two sets of demand projections will be performed- A. Demand for scheduled air for 2014 and 2015 at 2005 tickets prices and B. Demand for scheduled air for 2014 and 2025 at a 13% and 25% respectively, reduction in costs. The exact metric for cost reduction (ex, DOC, required yield, ticket price, etc) will need IPT input.

Project future unconstrained schedules based on demands from A and B. The methodology used will be SAB's Future Growth and Schedule Model (FGSM) . Demand from TSAM input into FGSM will be used to modify the future schedules to reflect new direct flight that demand growth will enable and additional demand will be split between adding flights and/or larger aircraft using a flight frequency/aircraft passenger capacity algorithm. Potential to shed flights from hubs to secondary airports in a region can be determined as required.

2. Work with Seagull to further refine flight shedding data generated by Seagull with their Future Flight Demand Generator Tool. Use TSAM to determine to changes in mode choice and, thus, passenger demand when flights are shed to outlying airports. There is the potential to either gain or loose passengers that can be calculated due to TSAM's origin and destination data for airport catchments area.

3 SATS market demand and operations have been analyzed in support of the SATS Project Office. The output of these analyses can be modified as required to generate metrics as required by the JPDO. SATS demand analysis project as many as 27% and 50% increases over scheduled air fights in the 2010 and 2022 time periods.

4. New Type Vehicle: A new vehicle for analysis is to be chosen by the EAO Vehicle Analysis
Subgroup from vehicles under study by NASA's Aerospace Vehicle Systems Program. Vehicle performance, costs and/or required yield, and any infrastructure enhancements will be modeled in TSAM and the demand for the new vehicle will be evaluated. A schedule for the new vehicle be generated from the demand and the effect on the schedule of scheduled commercial service will be evaluated, as well as the overall effect on ATM capacity.

Deliverables Task G:

1. Results of studies of the projected demand for commercial air in 2014 and 2025, including flight schedules to be input into air space simulators.
2. Results of studies to show the benefits and practicality of shedding commercial air flights to alternate airports in a metropolitan area to help alleviate runway congestion.
3. Tailor results of SATS studies to JPDO metrics to provide information on the affect of SATS in the airspace system.
4. Conduct systems studies to show the demand for a new technology ESTOL vehicle if incorporated in the commercial air market with new capabilities and also estimate the need and cost for new infrastructure to obtain benefits of the new technology.

*****End 13 block Replacement for Task G*****

<u>Schedule</u>:

<u>Task F</u>:

1.) R11 ~~September 30, 2004~~ December 31, 2004
2.) R11 ~~September 30, 2004~~ December 31, 2004
3.) R11 ~~September 30, 2004~~ December 31, 2004
4.) R11 ~~September 30, 2004~~ December 31, 2004

5.) R11 ~~September 30, 2004~~ December 31, 2004

6.) R11 December 31, 2004

7-12.) R12 September 30th, 2005

Task G:

R13 ***December 31, 2005***

Task G. December 31, 2005

Performance Metrics: The following will be used to determine the quality of Contractor task performance, relative to the task requirements:

Contractor progress reported monthly, tracked against the scheduled time allotted will be used to monitor the Contractor's performance.

Performance Standards: The following performance standards will apply:

Meets performance defined by Task ***G,*** subtask 1 through ***4*** delivery by scheduled completion date.

Exceeds performance defined by:

Task ***F***, Run some example cases with new vehicles concepts already conceptualized within the Systems Analysis Branch.

3. Government Furnished Items: The following will be provided by NASA to the Contractor:

A. Access to existing specialized analysis tools required to perform these tasks
B. Access to existing models required to perform these tasks
C. Access to the existing databases required to perform these tasks
D. List of applicable NASA technologies for assessment.

4. Other information needed for performance of task:

It is anticipated that the Contractor will need to attend U1 ~~some~~ R3 ~~four (4)~~ six (6) technical interchange as coordinated with the Technical Monitor.

5. Security clearance required for performance of work:

Access to the databases and models maintained by the Contractor shall be restricted to parties approved by ISAT.

6. Period of Performance:

Planned start date:	R2 ~~2/12/01~~	Completion date:	R1 ~~8/31/01~~
	R5 ~~10/01/01~~		R2 ~~9/30/01~~
	R7 ~~1/1/03~~		R3 ~~11/30/02~~

	R12 ~~1/1/04~~ 1/1/05	R5 ~~12/30/02~~ R7 ~~12/31/03~~ R12 ~~12/31/04~~ 12/31/05
7.	**NASA Technical Monitor**: Mr. Robert E. Yackovetsky M/S: 348 Phone: 757-864-3844 NASA Directorate/Other Technical Coordinator: TBD M/S: Phone:	

Task Order Number: 09RBL Revision: ____ Date of Revision:_ 8/18/00

Title: Experimental Hardware Development and Process Improvement

1. **<u>Purpose, Objective or Background of Work to be Performed</u>**: (09RBL, NAS1-00135)

The Models Systems Branch (MSB) develops model systems and technology for a wide variety of experimental hardware research needs used in LaRC aerospace testing facilities and selected flight research experiments off center. These model system structures are constructed using composites and/or metallic aerospace materials. The model system configurations typically involve complex geometry, extensive instrumentation, high dimensional precision and stringent structural loading performance. The MSB team develops a concept design by documenting the specifications and performance requirements for the research hardware. The MSB team consults with the research customer and the fabrication activities throughout the detail design to ensure that the model systems meets the research needs and takes advantage of efficient fabrication techniques. If insufficient specification or performance is not defined, the MSB team executes feasibility studies and/or sensitivity analyses to provide a basis upon which the research requirements can be defined more explicitly. The design may involve new technology that is immature and necessitate risk reduction strategies such as; proof-of-concept development, material testing/characterizations and structural verification tests. The MSB team uses Pro/Engineer computer aided engineering software to develop and document the model system. In addition, The MSB team uses Microsoft Office software tools to develop, document and share the design development with the research requestor and the fabrication activity.

Note: The model and project support in this task is driven by its research nature and is indefinite delivery and indefinite quantity (IDIQ). As each specific model and project requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask.

Revision 1: Extends deliverable due dates and the completion date to reflect NASA's need for continued support (see [R1] in SOW file *09RBL01.doc* on the electronic task order system [ETOS]).

Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by updating Subtasks 1 and 2 schedule and adding new Subtask 3 and noting travel requirements (see [R2] below).

2. **<u>Description of the Work to be Performed</u>:**

Subtask 1:The Contractor shall perform the following tasks as input for the Integrated Models Product Cycle Team (IMPCT) under the Wind Tunnel Enterprise (WTE):

- Develop geometry and lofts defining model system configuration.
- Generate input for the IMMPCT planning and process improvement functions that include: work breakdown structure, time estimates, subtask schedule and capturing metrics on the design cycle time.
- Execute detail design including documentation in compliance with our in-house ISO

9001 processes LAPG1710.15 and CP-508. They can be found on the LaRC LMS website.

It is anticipated that an average of 4 model tasks will be defined per year not to exceed 6 per year.

Deliverables:

- Detail design drawings, CAD geometry definitions and fabrication liaison on force and moment metal models.
- Development of Cycle time process improvement metrics including work breakdown structures, time estimates and design schedule to a contracted scheduling planning activity.

Schedule of Deliverables:

- Work breakdown structures, time estimates and schedule are due 3 weeks after model task definition has been provided.
- Conceptual design, CAD geometry definition, detail design shall be delivered as defined by the model task schedule.
- Cycle time process improvement metrics are due [R2]***December 31 2002***.

Metrics for Deliverables:

Minimum performance

Detail design documentation shall be compliant with ISO9001 processes LAPG1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity.

Exceeding minimum performance

Contractor would exceed the minimum performance with suggestions of improvements to models design process that improve (reduce) the cycle time. Perform work in a more rapid manner than the original schedule and time estimate (at least one week earlier than specified date of completion).

Subtask 2:

- Develop and maintain design and fabrication schedules of model systems using Critical Chain Project Management.
- Integrate various model systems schedules supplying resource loading.
- Provide training on Critical Chain Project Management to personnel who have been assigned to Integrated Product Teams designing and fabricating models systems.

It is anticipated that an average of 1 project task will be required per month not to exceed 3 per month.

Deliverables:

- Project schedules and what if analyses scheduling scenarios for projects to regain schedule slippage or to adjust priorities.

- Supply schedules to weekly Engineering and Fabrication Models Meeting.
- Recommendations for process improvements to engineering and fabrication functions.

Schedule of Deliverables:

- Project Schedules to be activated and delivered within 3 weeks of task kick-off meeting, Project update status and task list given weekly.
- Report on process improvements for design and fabrication of model systems by R2 ***December 31, 2002***.

Metrics for Deliverables:

Minimum Performance:

Submits all deliverables on time with minimal errors. Consistently maintains schedule accuracy to within +/- two working days on each project. Recommends schedule-related improvements to design and fabrication processes.

Exceeding Minimum Performance:

Submits all deliverables on time with no errors. Consistently maintains schedule accuracy to within +/- one working day at each branch. Recommends new managerial techniques or processes that increase any branch's operational efficiency. Produces easy-to-use examples of schedule-related products or techniques that permit personnel to quickly identify potential cycle time reductions. Documented reductions in the model development cycle of 25% or more, which can be attributed to successful implementation and use of CCPM.

*****Begin R2 block*****

Subtask 3:

Force balances are structural instruments that measure the 6 components of aerodynamic loads on wind tunnel models during testing. In that capacity balances designs are optimized for structural strength, minimization of interactions between the six components of measure and increased sensitivity to increase accuracy of the force measurement. Because of these opposing design constraints the balance is a highly stressed structural component. Due to these high stresses, desire to increase the aerodynamic limits of wind tunnel testing and to ensure no structural failure of wind tunnel model systems, a more thorough analysis is required of each balance that will be tested in mandatory facilities under LaPG 1710.15. In LaPG 1710.15 balance requirements exist that require finite element models, fatigue and fracture analysis to be performed on balances that are highly stressed and don't have the appropriate factor of safety.

- Develop finite element models for structural analysis of force balances
- Perform structural analysis of balances.
- Analyze overloads that may be requested by aerodynamic testing organization
- Perform Fatigue and Fracture Analysis as determined by LaPG 1710.15

Deliverables:

- Finite element models of balances scheduled for use in aerodynamic tests.
- Structural analysis of each balance and fatigue and fracture analysis when required.

	• Recommendations on improvements to balance designs to increase aerodynamic load capacity, structural integrity and increased accuracy **Schedule of Deliverables:** • Finite element models, structural analysis, fatigue and fracture analysis of balances delivered as determined by requirements and schedule. • Recommendations on improvements to balance designs to increase aerodynamic load capacity, ensure structural integrity and increased accuracy by December 31, 2002 **Metrics for Deliverables:** **Minimum performance** Detail analysis documentation shall be compliant with ISO9001 processes LAPG1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. **Exceeding minimum performance** Contractor would exceed the minimum performance with suggestions of improvements to balance design to increase aerodynamic load capacity, ensure structural integrity and increased accuracy. Perform work in a more rapid manner than the original schedule and time estimate (at least one week earlier than specified date of completion). *****End R2 block*****
3.	**Government Furnished Items:** Mechanical design software Pro/EngineerOffice space R2***Structural and Fracture analysis software*** CAD/CAM/CAE Workstation Prochain Scheduling Software Selected training in process improvement on an as needed basis.
4.	**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. R2 ***Travel anticipated:*** ***1. One week, one person, Palmdale, CA, 1st qtr CY02*** ***2. Two days, one person, Fort Worth, TX, 3rd qtr CY02***
5.	**Security clearance required for performance of work:** Secret Clearance required for subtask1.
6.	**Period of Performance:** Planned start date: 1/01/01 Completion date: R2***12/31/02***

7.	**NASA Technical Monitor:** Drew J. Hope M/S: *222A* Phone: 757-864-*7278* NASA Competency/Other Technical Coordinator: Bob Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 09RCE Revision: 1 Date of Revision: 5/31/01
Title: **Processing of Advanced Metallic Materials**

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

The purpose of this task is to develop and optimize advanced processing techniques for fabricating structures and subelements using advanced metallic materials for aerospace applications. R1 ~~In addition, coatings for protection of metallic materials at high temperatures will be developed.~~

Revision 1: The purpose of this revision is to expand the materials processing activity to include post-processing of the material systems under Subtask 2.1 and to delete the above reference to coatings activity (see R1 above and below).

2. Description of the Work to be Performed:
Note: The required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)
Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1: Materials Processing

The Contractor shall, on a written work request basis (NOR), subject aluminum, titanium, Ti-PMC (polymer matrix composites) hybrid laminate, metal matrix composites, metallic foams, and metallic honeycomb core sandwich specimens to thermomechanical treatments and thermal exposures (isothermal and cyclic). The government will provide all test materials and specimens in the required conditions.

The Contractor shall conduct thermal cycling exposures of selected materials in an air environment in the temperature range from cryogenic temperatures (as low as liquid helium) to 2000°F (up to 30 specimen sets). The government will provide the load-temperature-time profiles for the tests. The Contractor shall conduct high-temperature isothermal exposures on specimens for times up to 100 hours and temperatures up to 2000°F (up to 30 specimen sets). The Contractor shall be responsible for inserting the specimens in appropriate furnaces, cataloging and tracking the specimens throughout the exposures, and removing the specimens from the furnaces at the appropriate times. The Contractor shall process specimens with pressure/load/temperature profiles using hot isostatic press equipment or vacuum hot press equipment (up to 20 runs total). The

Task Order Number: 09RCE Revision: 1 Date of Revision: 5/31/01
Title: **Processing of Advanced Metallic Materials**

Contractor shall deposit coatings of thermal-sprayed aluminum and titanium onto government-supplied substrates using plasma spray equipment (up to 25 runs). **Begin [R1] block** ***Plasma spray processing may include Ni-Ti based shape memory alloys and metal matrix composites. The contractor shall develop and optimize the pre-processing of the raw materials and post-processing of the plasma-sprayed materials to achieve optimum properties of the end product. Pre-processing may include ball-milling of powders to produce nano-grain size in the raw material as well as the final product. Post-processing may include vacuum hot pressing, vacuum heat treatment, and hot isostatic pressing. Up to 30 pre-processing/plasma-spray/post-processing combinations shall be conducted.*** **End [R1] block** The Contractor shall conduct up to 30 uniaxial superplastic forming (SPF) processing runs and up to 10 biaxial SPF processing runs. The Contractor shall utilize friction stir welding, resistance welding and/or adhesive bonding to fabricate up to 100 joint coupons and up to 10 demonstration panels. The Contractor shall ensure equipment is operational prior to and after processing runs and conduct periodic maintenance to ensure equipment operability. The Contractor shall conduct processing experiments for fabrication of metallic foams.

Deliverables (for 2.1):
- For each work request, processed specimens and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of processing procedures, calibrations, specimen dimensions, anomalies, and electronic data files for each processing run.
- Informal written monthly reports that list work requests completed during the reporting period, total cost associated with each work request, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (12/31/01)

Performance Standards (for 2.1):

MEETS:
- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:
- work requests completed ahead of requested due date

	• "rush" work requests designated by the task monitor expedited • Completion under cost • [R1] ***New state-of-the-art in materials processing defined.***
3.	Government Furnished Items: Specialized materials processing equipment located in the Light Alloy Laboratory (Building 1205), including the vacuum hot press, hot isostatic press, plasma spray apparatus, and various ovens and furnaces. Specialized materials processing equipment located in the Structures and Materials Laboratory (Building 1148) including superplastic forming facilities and resistance welding equipment.
4.	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. [R1] ***Some short term travel and training may be necessary.***
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 1/2/01 Completion date: 12/31/01
7.	NASA Technical Monitor: Dr. Stephen Hales M/S: 188A Phone: 757-864-3128 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 09RDB Revision: 6 Date of Revision: 11/19/04

Title: Support of Turbulence Mitigation for Aviation Safety Program [R1] and Simulation Programming Support for Advanced Concepts Vehicles

1. **Purpose, Objective or Background of Work to be Performed: (RD05, NAS1-96014)**
Listed below for subtasks as appropriate.

Revision 1: Changes Title, adds Subtask 4, and makes some minor word changes for clarification and out of PBC concerns. (See [R1])
Revision 2: Extends the period of performance nine months in continuation of NASA's support requirements and redefines the schedule to reflect GFI dependency (see [R2] below).
Revision 3: Extends the period of performance three months in continuation of NASA's support requirements (see [R3] below).
Revision 4: Extends the period of performance one year in continuation of NASA's support with some requirements updates in Subtask 4 for the new period of performance (see [R4] below).
Revision 5: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R5] below, section 6).
Revision 6: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R6] below, section 6).

2. **Description of the Work to be Performed:**

Subtask Integration:

Subtask 1	Feasibility and Requirements Definition Study for Transport-Aircraft Turbulence-Tolerant Flight Control Systems.
Subtask 2	Simulation Development for Turbulence Mitigation Research
Subtask 3	Modeling and Simulation for Aeroelastic Semispan Model (ASM)
[R1]Subtask 4	Mathematical Modeling in Software for Advanced Concept Vehicle models

Deliverables [R1] *:*

a) Status reports delivered electronically to the Task Monitor. — Monthly

b) Attendance and support of team meetings as [R1]required to perform the Task Order — [R1]Variable

Subtask 1 Feasibility and Requirements Definition Study for Transport-Aircraft Turbulence-Tolerant Flight Control Systems

Task Order Number: 09RDB Revision: 6 Date of Revision: 11/19/04

Title: Support of Turbulence Mitigation for Aviation Safety Program R1 and Simulation Programming Support for Advanced Concepts Vehicles

Background

In the context of commercial-aircraft operations, encounters with hazardous atmospheric turbulence are a significant safety issue. Despite the expected development of improved strategic and tactical turbulence warning products, it is anticipated that aircraft will still penetrate either known or unknown areas of hazardous turbulence. It then becomes desirable to provide some measure of automatic control to the aircraft to enable the reduction of gust-induced cabin accelerations without compromising the structural integrity or flying qualities of the aircraft R1 through Turbulence Mitigation Control Systems (TCMS). Prior to making the commitment for full-scale flight demonstration of such systems, a "requirements" study is needed to assess the inherent capability of current commercial-transport aircraft configurations to optimally use such a system for its intended function.
It is desirable to assess the current capabilities of typical transport flight control modes, aerodynamic control power, sensor performance limitations, etc., to adequately offset gust-induced cabin accelerations to "safe" levels. This assessment could involve a mix of analysis, unpiloted simulation, and piloted simulation and produce definitions of practical modifications that could be implemented to provide this capability, where warranted (e.g., enhanced flap system capability, or a better sensor, etc.). Finally, the assessment should result in defining certification issues and recommending methodologies to address these issues.

The Contractor shall perform the following requirements:

- Assess the current performance capability of flight control surfaces, sensors, and control laws, for offsetting gust-induced accelerations to safe levels in the cabins of typical transport aircraft.
- Define non-hazardous gust-induced acceleration levels; these will be used as targets for defining the system requirements for acceptable gust alleviation (i.e., how much gust-induced acceleration needs to be alleviated to make the system a "safety device"?). Sources could include FARs, DOT passenger train/bus/subway regulations, etc., and results of FDR data analysis from actual turbulence-encounter accidents
- Assess achievable capabilities with both minimal and substantial hardware and sensor retrofits, for offsetting gust-induced accelerations in the cabins of typical transport aircraft.
- Define system requirements to achieve the capabilities. Include actuation requirements, structural and aeroelasticity considerations, and required sensor performance, particularly incremental benefits of "look-ahead" capability.
- Identify certification issues associated with implementing ride-smoothing control

laws, both as retrofits and within the context of new designs.

- Support outyear objectives demonstrating a ride-smoothing control system aboard a NASA research aircraft by focusing some attention on likely candidate platforms.

Deliverables

a) Informal summary report documenting findings from analysis and simulations of current-system capability assessment -- Due [R2] ~~6/30/01~~ GFI, (a) + 3 mo.
b) Informal summary report documenting findings and recommendations from the non-hazardous gust-induced acceleration levels definition -- Due [R2] ~~6/30/01~~ GFI, (b) + 3 mo:
c) Summary report documenting recommendations, including previous informal summary reports, from the assessment and definition of achievable gust-induced acceleration-reduction capability. -- This documentation shall address the requirements for (a) a system with minimal hardware/system retrofits, and (b) a system with hardware retrofits, as needed. Due [R2] ~~9/30/01~~ GFI, (a) + 6 mo.
d) Informal summary report describing initial efforts and results at assessing certification issues for ride-smoothing control systems -- Due [R2] ~~9/30/01~~ GFI, (b) + 6 mo.

Standards and Metrics:

a) *Quality of innovation, technical execution, and documentation.* Consideration will be given to the thoroughness with which the requirements are addressed. The types of aircraft assessed, the types of systems considered, and the number and type of certification criteria considered will be used to assess the quality of the technical work. The quality of technical work is the predominant metric and shall determine the distinction between "meets", and "exceeds" performance expectations.
b) *Timeliness in meeting the deliverables schedule.* Meeting all deliverables on time is to be considered consistent with "exceeds" performance expectations. Meeting all deliverables with no more than two being only 1 month late is to be considered consistent with "meets" performance.

Subtask 2 Simulation Development for Turbulence Mitigation Research

Background

An aeroelastic batch simulation capability is essential for turbulemce mitigation research to properly assess the mean body/elastic/control coupled dynamic response of the vehicle under study. The associated mean body and control degrees of freedom database for such a simulation may contain nonlinear aerodynamic tables as well as quasi-static aeroelastic increments.

Requirements

This subtask provides support for maintaining an existing aeroelastic batch simulation capability and upgrading it for turbulence mitigation studies with enhancements resulting from the ASM effort (see Subtask 3).

Deliverables

Begin R1 block

a) Upgraded B737 Simulink simulation including rigid body gust penetration effects — R2 ~~6/01/01~~ GFI, 1(a) + 3 mo

b) Simulation modeling of discrete gusts comparable to those associated with passenger and crew in-flight injuries — R2 ~~6/01/01~~ GFI, 1(b) + 3 mo

c) Incorporation of candidate TMCS control law into B737 Simulink simulation — R2 ~~9/01/01~~ GFI, 1(a) + 6 mo

End R1 block

Potential Future Deliverables(contingent on continued funding):

a) Documented addition to the simulation preprocessor to generate p-transform data. — R2 ~~10/01~~TBD

b) Streamlined process for incorporating a new aircraft's database into the simulation to allow efficient assessment of a variety of aircraft. — R2 ~~12/01~~TBD

Standards and Metrics:

a) *Quality of innovation, technical execution, and documentation.* Consideration will be given to the thoroughness with which the additional capabilities are incorporated into the simulation including the demonstrated accuracy of the added capabilities and the readability/effectiveness of the supporting documentation. The quality of technical work is the predominant metric and shall determine the distinction between "meets", and "exceeds" performance expectations.

b) *Timeliness in meeting the deliverables schedule.* Meeting all deliverables on time is to be considered consistent with "exceeds" performance expectations. Meeting all deliverables with no more than two being only 1 month late is to be considered consistent with "meets" performance.

Subtask 3 Support for Turbulence Mitigation Aspects of the ASM Test Program

Background

The ASM wind tunnel test program requires mitigation of dynamic response due to tunnel turbulence in both elastic and pseudo rigid body degrees of freedom. Utilization of sensors that provide advance knowledge of the oncoming turbulence is expected to be critical. The technology developed in support of the ASM program will be directly applicable to the Safety Program turbulence mitigation effort.

Requirements

Mathematical Models

Generate the data required to model the dynamic response of the ASM test article in a turbulent environment over the anticipated test envelope for nominal and alternate model characteristics. Include the following detailed requirements:

1. Replace the "as designed" structural representations with "as built and ground vibration tested" representations to include the engines/nacelles with the various selections of mass distribution and stiffness (one being the flutter stopper near zero stiffness for the outboard engine attachment). Also include all previously planned variations in the fuselage coupling springs.
2. Generate modal matrices for the structural models in 1 above, the output equations for all sensors on the model for each modal set, and generalized aerodynamic forces over the Mach number and reduced frequency ranges of interest in the test media. Include sensors to generate generalized forces per unit actuator hinge moment and summation of forces outputs.
3. Modify aerodynamics as appropriate using any available CFD or experimental data.
4. Develop rational function approximations (RFA's) for the generalized aerodynamic force elements paying particular attention to the gust and ride control vane columns. Further generalization of the MATLAB RFA code is likely to be required to allow more general selection of equality constraints. Allow column dependent and minimum state RFA's.

5. Develop actuator model to support inclusion of the hinge moment equations. This involves analysis of actuator test data to obtain dynamic impedance characteristics, performance under load, sensitivity to inertia and hydraulic pressure variations, and assessment of performance enhancement from compensated position and differential pressure feedback.
6. Characterize tunnel turbulence in the media to be employed and over the Mach number range of interest.
7. Develop p-transform data generation capability and apply to ASM.

Simulation

Develop a MATLAB/Simulink simulation of the ASM model that predicts dynamic response to turbulence, admits digital control laws and provides continuous linear open loop state space models about trimmed conditions for use in control law design. Include the following detailed requirements:

1. Provide a capability for trimming the model to desired conditions such as maximizing minimum margin to impingement of the flexible fuselage beam into the rigid fuselage fairing. The design variables will include the control surfaces and the turntable angle.
2. Refine existing ability to "fly" the simulation from point to point, as the model will be tested, in a turbulent environment.
3. Refine the ability to simulate the quantization and digital aspects of the digital controller and provide the capability for interpolation for controller parameters with Mach and dynamic pressure.
4. Provide the option for outputs from all available sensors on the model.
5. Accommodate inclusion of the available antialiasing filters, sample rates, and controller definitions present in the digital controller.
6. Incorporate capability for including hinge moment equations and finite stiffness of the control surface and backup structure.
7. Provide capability to generate continuous linear state space models of the open loop system for nominal and alternate choices of variable parameters at flight conditions of interest.
8. Incorporate summation of forces and residualized displacement output options.

Maintain and modify software as required to efficiently compute trim conditions, linear models, and nonlinear simulation responses of the model.

Deliverables:

a) Model data for nominal and alternate "as built" ASM configurations sufficient to generate a batch simulation of the ASM test. GFI,(b)+2 months

b) Trim shots, static checks, linear models as requested by customer. ongoing

c) Engineering users manual for Simulink simulation including, but not limited to, check cases, example time histories, example trim cases, high level block diagrams. GFI,(b)+4 months

Metrics:

a) *Quality of innovation, technical execution, and documentation*. The quality of technical work is the predominant standard and shall determine the distinction between "meets", and "exceeds" performance expectations. Consideration will be given to the thoroughness with which the mathematical model and simulation are developed including the degree to which each of the requirements are addressed. A rating of "exceeds" will be reserved for accomplishing a large majority of the requirements and making significant progress on the remaining requirements. A rating of "meets" will require accomplishing most of the requirements while making significant progress on a majority of those remaining.

b) *Timeliness in meeting the deliverables schedule.* Meeting all deliverables on time is to be considered consistent with "exceeds" performance expectations. Meeting all deliverables with no more than two being only 1 month late is to be considered consistent with "meets" performance.

Start of [R1]Block

Subtask 4 Mathematical Modeling in Software for Advanced Concept Vehicle models

Background

This subtask provides for the mathematical modeling in software of futuristic Advanced Concept Vehicles. The models are typically developed in Mathworks Matlab and/or Simulink, but also utilize FORTRAN and C/C++ software components. A mathematical description of the aerodynamics, propulsion, inertia, and subsystems of the vehicle is provided as GFI; the task involves realizing these components as an integrated model suitable for batch and interactive control law design and analysis.

Requirements

Develop the software, [R4]~~comparison with checkcases~~, trim solution and linear model generation and comparisons, software configuration control, debugging, software release packaging, and checkcase generation on government-provided UNIX workstations and software licenses. Use of Gnu software tools (including gdb and Make) and CVS configuration management tools are required as well as Fortran, C, C++, Matlab M-scripts, Simulink, and TLC tools. (Knowledge of OpenGL graphics language would be helpful.)

Deliverables:

(a) Major and minor internal releases of software models (one week after receipt).
[R4]~~(b) Checkcase matching documentation as required (one week after receipt).~~
(b) Linear models and trim shots as requested by customer (one week after receipt).
(c) Control system unit-test checkcases (2 weeks after receipt of control laws).
(d) Monthly progress reports.

Performance Evaluation Criteria:

a.) Quality of innovation, technical execution, and documentation. Consideration will be given to the thoroughness with which the requirements are addressed. The quality of the technical work is the predominant metric and will determine the distinction between "meets" and "exceeds" performance expectations.
b.) Timeliness in meeting deliverables schedule. Meeting all deliverables on time is to be considered consistent with "exceeds" performance expectations. Meeting all deliverables with no more than two being only one month late is to be considered consistent with "meets" performance. Each early deliverable shall offset any late deliverable by an equal amount of time.

End of [R1]Block

3. **Government Furnished Items:**

All subtasks: Access to AirSC computer resources.

Subtask 1:

Task Order Number: 09RDB Revision: 6 Date of Revision: 11/19/04

Title: Support of Turbulence Mitigation for Aviation Safety Program [R1] and Simulation Programming Support for Advanced Concepts Vehicles

	a) Access to NASA B-757 simulation databases, code, and facility; available linear models as generated previously; and the aircraft hardware as needed. b) Access to turbulence-related accident data (e.g., flight data recorder) as available to other NASA researchers. Subtask 2: Existing Batch MATLAB/Simulink Simulation with Preprocessor and NASTRAN Inputs for TCA Aeroelasic Models Subtask 3: a) Model data and simulation code developed on previous contracts and by NASA personnel. b) Specification of the "as built" structural model including GVT test results [R1]Subtask 4: Mathematical description of the aerodynamics, propulsion, inertia, and subsystems of the vehicle.
4.	**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.
5.	**Security clearance required for performance of work:** This task is unclassified. Adherence to restrictions and control on company proprietary data is required for parts of some subtasks.
6.	**Period of Performance:** Planned start date: 1 January 2001 Completion date: [R2] ~~31 December 2001~~ [R3] ~~30 September 2002~~ [R4] ~~31 December 2002~~ [R5] ~~31 December 2003~~ [R6] ~~31 December 2004~~ ***31 December 2005***
7.	**NASA Technical Monitor:** James G. Batterson M/S: 149 Phone: 757-864-4059 **NASA Competency Coordinator:** AirSC/ M/S: Phone: 757-864-

Task Order Number: 09RFL Revision: 4 Date of Revision: 1/22/2005
Title: Aerospace Data Acquisition and Processing Station (ADAPS) Support for Langley's Research Aircraft

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

The Aerospace Data Acquisition and Processing Station (ADAPS) in the Electronic Systems Branch (ESB) at NASA Langley Research Center is responsible for displaying, archiving, and processing flight data for Langley's Research Aircraft Fleet. The current fleet consists of a Boeing 757 and three General Aviation Aircraft.

The overall objective of this task is to archive, retrieve, process and display the data recorded by Langley's Research Aircraft and maintain the data processing equipment in ADAPS.

Note: The data processing support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

Revision 2: Extends the period of performance one year in continuation of NASA's support requirements with context and title broadened to include all Langley research aircraft. (Significant Revision 2 changes are indicated in Bold Italic font.)
For details of issued original, Revision 1, Revision 2 SOWs, see ETOS files *09RFL.doc*, *09RFL01.doc*, and *09RFL02.doc*, respectively.
Revision 3: Increases the scope of Item 5 on Sub-Task 1 and makes other scope clarifications/revisions (see R3 below).

Change 1: extends the period of performance for two months (through 28 February 2005) in continuation of NASA's support requirements with no change in detailed requirements for the new period of performance (see R3.1 below, Sect. 6).

Revision 4: Deletes the Web Based Retrieval in Subtask1.1, all of Subtask 1.5, deliverables 5 and 10, performance standard 7 under "meets and performance standard 4 under "Exceeds", and extends period of performance ten months to December 31, 2005 (see R4 below).

2. Description of the Work to be Performed:

Subtask 1

1. The Contractor shall archive and process data from research flights and ground tests using the Aerospace Data Acquisition and Processing Station (ADAPS) (NOR). Standard data products produced by the Contractor in ADAPS shall include run summaries, Comma Separated Value (.csv) files and displays of processed DAS data. Run summaries of flight data shall be provided to the DAS Instrumentation Engineer

Run summaries of flight data shall be provided to the DAS Instrumentation Engineer within 2 working hours after receiving the request. The Technical Monitor (TM) shall be notified immediately of any ADAPS failures that would delay the processing and delivery of the data. NASA will also provide ADAPS a database for processing the DAS data. The Contractor shall verify the database is compatible with the ADAPS processing system. Data shall be archived, retrieved and processed using the NASA Omega/NT Real Time Processing system in ADAPS R4~~and the Web Based Retrieval System~~. This data shall be provided to researchers upon request. It is anticipated that a total of 100 research flights will be processed by ADAPS during estimated period of performance of this contract.

2. The Contractor shall maintain ADAPS in an operational mode. This will include analysis and repair of any anomalies that will prevent ADAPS from archiving, retrieving, processing and displaying data. The Contractor may schedule ADAPS equipment repair and calibration through NASA funded services and facilities. The Contractor shall notify the Technical Monitor (TM) of any ADAPS 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 ADAPS drawings and hardware. The Contractor shall maintain configuration management for all of the ADAPS drawings, hardware and software.

3. The Contractor shall make backups of all ADAPS system hard drives, RAIDS and associated databases to minimize system down time in the event of a system failure.

4. The Contractor shall be compliant with NASA-LaRC ISO 9001 requirements as applicable to this task.

5. R4***Deleted***

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 flight data.
3. Run summaries and Comma Separated Value files of processed DAS data
4. Monthly written status reports.
5. R4***Deleted***
6. Notification of any ADAPS failures that would delay the processing and delivery R3of

requested data.
7. ADAPS data logs identifying dates, times, flight number, and processed database.
8. ADAPS configuration control documents.
9. R3 A backup of ADAPS system hard drives, RAIDS and associated databases.
10. R4 ***Deleted***
11. ADAPS System Drawings

Performance Standards and Evaluation Criteria

Meets:

1. B-757 flight data are uploaded to ADAPS RAIDs and available for processing within 6 working hours after data is delivered to ADAPS and within one working hour after data is delivered from the General Aviation Aircraft.
2. Run summaries of flight data provided to the to the DAS Instrumentation Engineer within 2 working hours after receiving request.
3. Standard data products (Run Summaries and Comma Separated Value files) of NASA approved DAS data are provided to the experimenter within 4 hours after receiving request.
4. Monthly written status reports.
5. A backup of ADAPS system hard drives, RAIDS, and associated databases are made following any configuration changes to the system or at 1-month intervals, which ever comes first.
6. Notification of ADAPS failures within 8 working hours.
7. R4 ***Deleted***
8. 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.
9. All procedures, drawings software and hardware are under configuration control, as determined by review and random checks by the TM against actual hardware, procedures and drawings.
10. All calibrated ground support equipment supporting ADAPS conforms to LMS-CP-506

Exceeds:

1. B-757 flight data are uploaded to ADAPS RAIDs and available for processing within 4 working hours after data is delivered to ADAPS and within 30 minutes after data is delivered from the General Aviation Aircraft.
2. Run summaries of flight data provided to the to the DAS Instrumentation Engineer within 1 working hour after receiving request.
3. Standard data products (Run Summaries and Comma Separated Value files) of NASA approved DAS data are provided to the experimenter within 2 hours after receiving request.

	4. R4 ***Deleted*** 5. Contractor suggested improvements are accepted (government reviewed and approved) to modify operating procedures or upgrade equipment to decreased turnaround time of processed data.
3.	Government Furnished Items: 1. DAS data on removable storage media. 2. DAS database to process ADAPS data 3. Schedules 4. ADAPS Facility 5. Omega/NT Real Time Processing System 6. Time Code Receivers/Generators 7. Optical recorders, Magnetic tape recorders (DLTs), CD recorders, Removable Hard Drives 8. Network Systems 9. Archiving media 10. Printers and plotters 11. RAID Systems
4.	**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.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: / Completion date: At issuance: January 2, 2001 — December 31, 2001 Revision 1: January 2, 2002 — December 31, 2002 Revision 2: January 2, 2003 — December 31, 2003 Revision 3: January 1, 2004 — R3.1 ~~December 31, 2004~~ R4 ~~February 28,2005~~

	Task Order Number: 09RFL Revision: 4 Date of Revision: 1/22/2005 Title: Aerospace Data Acquisition and Processing Station (ADAPS) Support for Langley's Research Aircraft

	Revision 4: ***February 28, 2005*** ***December 31, 2005***
7.	**NASA Technical Monitor:** F. Keith Harris M/S: 257 Phone: 757-864-3824

Task Order Number: 10RAA Revision: ____ Date of Revision:

Title: Advanced Space Transportation Systems Subsystem Technology Development

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

The NASA Langley Research Center Vehicle Analysis Branch (VAB) develops and applies computer-aided tools in the systems analysis of advanced space transportation concepts. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, and operations. Contract support is needed, primarily:
(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems, and
(b) to perform analyses in selected disciplinary areas.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems.

Currently, the primary computational platforms are Silicon Graphics (SGI) workstations. Sun workstations, Apple Macintosh, and IBM PC or clones also host a few engineering codes critical to the systems analysis work.

2. Description of the Work to be Performed:

1.0 Launch Vehicle Subsystems Technology Definition

Provide subsystems definition for a range of launch vehicle concepts to support assessments and trade studies. Activities include subsystem/component selection and technology identification, sizing and internal packaging analysis, center-of-gravity analysis, and description of subsystem designs at a conceptual level. Scope should encompass all major required subsystems, including avionics, power/electrical, controls actuation, landing gear, and air conditioning/environmental systems.

1.1 Small Payload-Class Reusable Booster
Provide subsystems definition for an experimental reusable booster concept.

Deliverables: Informal status reports summarizing interim results by 4/1/01 and 7/1/01. An informal written report summarizing: the study objectives, the vehicle configuration and assumptions, the study results, references and data sources, and methodology for estimates by 10/1/01.

Metric: Thoroughness of the effort as measured by inclusion of all requirements described above and thoroughness of reference sources and comparative data.

Task Order Number: 10RAA Revision: ____ Date of Revision:

Title: Advanced Space Transportation Systems Subsystem Technology Development

2.0 Weight Estimation Tool Transfer to VAB Customers

The Contractor shall provide for the transfer of VAB weight estimation tools and documentation to customers upon request and shall respond to customer inquiries concerning installation and operation of the tools on the customer's computer. The Contractor shall maintain a current list of customer contact points to whom tools have been transferred and shall provide a quarterly update to current users appraising them of the current version of the weight estimation tools and any significant changes in these tools. The Contractor shall provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically, such requests are received once every two to four weeks.

Deliverables
1. Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. (monthly)
2. Delivery of software and documentation to customers. (on request)
3. Updates to current users. (quarterly)

Metric: Effectiveness of transfers measured by use of transfer method acceptable to customer and by successful customer reproduction of output from sample cases which have been run on VAB computers. Timeliness of transfers measured by documentation being sent out within 2 days of receiving the request and completion of the transfer of the tools within one week, unless otherwise specified.

3. Government Furnished Items:

1) Access to SGI workstations, IBM PC, and Macintosh computers.
2) Vehicle definition and mission description to be used as reference for subsystem technology definition tasks.
3) Access to the LaRC technical library and, on request, points of contact for any specific topic at other Centers and in industry.

4. 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.

Exceeding Minimum Performance

The "metrics" included in the task descriptions describe minimum acceptable performance. To exceed minimum performance, the Contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

5. Security clearance required for performance of work:

None.

6. Period of Performance:

Planned start date: 1/1/01 Completion date: 12/31/01

7. NASA Technical Monitor: Roger A. Lepsch, Jr.
M/S: 365 Phone: 757-864-4520

NASA Competency/Other Technical Coordinator
M/S: Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

	Task Order Number: 10RBH Revision: 6 Date of Revision: 1/18/05 Title: Vehicle Aerodynamics Screening and Analysis

1.	**Purpose, Objective or Background of Work to be Performed:** (DG03, NAS1-96014) The NASA Langley Research Center Aerothermodynamics Branch (AB) provides experimental and computational data and analysis to define the aerothermodynamic performance of Space Transportation Systems (STS) and Planetary Entry (PE) vehicles across the speed range. The general purpose of this task is to provide quick turn-around grid/flowfield analysis to meet aerothermodynamic analysis requirements of the AB across the speed range. The expected outcome of this task is quick turn-around for aerodynamic analysis of parametric configuration changes for [R2]STS and PE vehicles. Revision 1: For NASA's continuing support requirements, the UNLATCH completion date is extended to 12/31/01. Also omitted overall task start and completion dates are added and the change in Technical Monitor is documented. (See [R1] details in ETOS file *10RBH01.doc*.) Revision 2: Extends the period of performance one year in continuation of NASA's support requirements, annotates completed requirements, and redefines the requirements for the new period of performance (see [R2] above and below). Revision 3: Extends the period of performance one year in continuation of NASA's support requirement, annotates completed requirements, redefines the requirements for the new period of performance, and documents the Technical Monitor change that was effective July 19, 2002 (see [R3] below). Revision 4: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support requirements, annotates completed/discontinued requirements, and redefines the requirements for the new period of performance (see [R4] below). Revision 5: Extends deliverable dates for Subtasks 1, 8, and 15-17 to December 31, 2004 in continuation of NASA's support requirements and annotates completed/discontinued requirements in Subtasks 11, 13, and 14 (see [R5] below). Change 1: Contractor-initiated change extends the period of performance 2 months to February 28, 2005 (see [R5.1] below, Section 6). Revision 6: Extends deliverable dates for 1, 8, and 15-17 and overall period of performance ten months to December 31, 2005 in continuation of NASA's support requirements and adds *LAURA code* to GFI (see [R6] below).
2.	**Description of the Work to be Performed:** A. Analyses and Analysis Enhancements. The Contractor shall provide quick turn-around, across the speed range aerodynamic analysis for STS and PE vehicles using the FELISA unstructured grid/flow solver software and modify/develop, evaluate, and implement software designed to enhance the aerodynamic analysis process.

Historically, on an annual basis, aerodynamic analyses of approximately 50 different configurations of X-33/ X-34/Shuttle Orbiter class vehicles have been required. For each configuration, the grid generation required 2 to 3 days and an additional 3 to 4 days to obtain and post process the results. While current plans do not require any X-33 or X-34 configurations to be analyzed, it is anticipated that new R2STS programs and new planetary initiatives will generate requirements similar in quantity and complexity, for aerodynamic screening and analysis.

B. Analysis Tools Development. The Contractor shall assist in the development of flow field analysis tools for R2STS and PE entry vehicles through the following activities:

1. The Contractor shall assist in evaluating the code UNLATCH, an axisymmetric analogue heating code based on inviscid flow solutions on unstructured grids;

2. R2Completed.
3. The Contractor shall develop software modules that define the thermodynamics, transport properties and gas kinetics for the gas constituents associated with R2Earth, other planets and moons of interest for planetary exploration.

Deliverables and Schedule: The Contractor shall deliver in an informal written report for each configuration, the computed aerodynamics and comparisons with any experimental/computational data for the configurations discussed below.

1. Support for the UNLATCH software evaluation will be limited to providing 3-6 flowfield solutions for freestream conditions and configurations selected by the government. This work should be completed by R5R3~~10/01/03~~ R6~~12/31/04~~ ***12/31/05***.

2. R2Completed.
3. R2Completed.
4. R2Completed.

Begin R2 block of new requirements
5. R3Completed.
6. R3Completed.
7. R3Discontinued.
End R2 block of new requirements

Begin R3 block of new requirements
8. The Contractor shall validate previous implementation of 11-species non-equilibrium air chemistry model in the FELISA code by comparison with LAURA inviscid results. This validation effort should be completed by R4~~02/01/03~~ R5~~9/30/04~~ R6~~12/31/04~~ ***12/31/05.***

9. [R4]Completed.

10. [R4]Discontinued.

11. [R5]Discontinued

12. [R4]Discontinued.
End [R3] block of new requirements

Begin [R4] block of new requirements
13. [R5]Completed

14. [R5]Discontinued

15. The Contractor shall provide 6 to 10 FELISA solutions for a planetary configuration to be determined. The task will require definition of aerodynamic coefficients with results obtained and reported by [R5]~~9/30/04~~ [R6]~~12/31/04~~ ***12/31/05***.

16. The Contractor shall provide initial and on-going assessment of the HEFSS unstructured code, provide user recommendations to the HEFSS team for improvements in the code, and make comparisons between HEFSS and FELISA in usability, accuracy and efficiency on planetary and space access configurations agreed upon between the Contractor and the Government. This task is to be completed by [R5]~~09/30/04~~ [R6]~~12/31/04~~ ***12/31/05.***

17. The Contractor shall develop an improved versioning system for the LAURA viscous solver code and provide support for investigation of bugs and analysis enhancements. This task is to be completed by [R5]~~09/30/04~~ [R6]~~12/31/04~~ ***12/31/05.***
End [R4] block of new requirements

Standard: The Contractor shall complete the aerodynamic analysis of each configuration in less than 1 week after receiving the configuration geometry.

The above standard describes a minimum acceptable performance. To exceed minimum performance the Contractor can, for example:

1) Identify and implement procedures that produce a measurable decrease in human and/or computer resources required to do the aerodynamic analysis,
2) Create and implement software that produces a measurable decrease in human and/or computer resources required to do the aerodynamic analysis.

	3) Deliver additional atmospheric chemistry modules.
3.	**Government Furnished Items:** The Government will provide the FELISA, GRIDEX, UNLATCH R4,HEFSS, and R6***LAURA*** – including documentation and test cases - software as well as Silicon Graphic hardware for both grid generation and flow analysis. In addition, the Government will provide time on mainframe R3and cluster computers on an as needed basis, vehicle configuration geometries, R3and trajectory flowfield conditions.
4.	**Other information needed for performance of task:** The Contractor should be aware that the AB does analysis for industry proprietary programs. All information concerning such programs must be handled with confidentiality and all deliverables, as defined in the above section 3, are the sole property of the customer.
5.	**Security clearance required for performance of work:** A secret level of security clearance is required for this task.
6.	**Period of Performance:** Planned start date: R2~~01/02/01~~ R3~~01/02/02~~ R4~~01/02/03~~ R6~~01/02/04~~ ***02/28/05*** Completion date: R2~~12/31/01~~ R3~~12/31/02~~ R4~~12/31/03~~ R5.1~~12/31/04~~ R6~~2/28/05~~ ***12/31/05***
7.	**NASA Technical Monitor:** R3Ron Merski M/S: 408A Phone: 757-864-7539 NASA Competency/Other Technical Coordinator Robert Hedgepeth M/S: *285* Phone: 757-864-*8265*

Task Order Number: 10RCG Revision: 7 Date of Revision: 3/03/05

Title: [R1]Structural Analysis and Design of Lightweight Antenna Platforms

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

The purpose of this task is to characterize the [R1]static and dynamic distortion of tensioned membranes [R1] structures and to analytically develop dynamically scaled models of such structures for laboratory testing. This work is performed in support of NASA Earth Science and Space Science Enterprise objectives for lightweight, deployable space platform development.

Change 1: Schedule, exceeds MA, and Completion date are changed to agree with Change 1 of Contractor's Task Plan dated 4/30/2001 – due to not receiving GFI in time (see [C1] below).

Revision 1: Reactivates the Task Order with 1) updated title and Task#1 noted as completed, 2) work extended to include analysis support for the development of a scaled model lightweight antenna to be used for structural dynamics and control testing in the laboratory (new Task#2), and 3) completion date changed to 12/31/02. (see [R1] above and below).

Revision 2: 1) Extends task completion date to 9/30/03 and 2) Redefines requirements due to changes in availability and quality of existing models.

Revision 3: Extends task completion date to 12/31/03 for completion of mechanical design and structural analysis requirements (see [R3] above and below).

Change 1: In response to a Contractor-initiated change that reduces staffing to support higher priority NASA work and adjusts for an award fee accounting error, the period of performance and schedule is extended seven months to July 31, 2004 (see [R3.1] below).

Revision 4: Reinstates requirements for staffing and extends completion date to 12/31/04 for completion of revised mechanical design and structural analysis requirements that include a second application focus (see [R4] below).

Revision 5: Removes engineering design requirement in subtask 2.0 and documents change in technical monitor (see [R5] below).

Revision 6: Extends the period of performance 9 months to September 30, 2005, in continuation of NASA's support with no changes to detailed requirements for the new period of performance. It is anticipated that the required analyses will decrease to about 30 to 40% of those for the previous year beginning in March '05 (see [R6] below, Section 6)

Revision 7: Extends the period of performance 3 months to 12/31/05 in continuation of NASA's support with reduced requirements, and documents a change in Technical Monitor (see [R7] below).

2. **Description of the Work to be Performed**:

The Contractor shall perform the following:

Task:[R1](Completed)

~~1. Characterize the optical distortion of a tensioned, membrane-like fresnel lens due to structural dynamic excitation~~

~~1.1 Define optical models of the silicon membrane lens (based on the geometry provided) in the following (4) distorted configurations: nominal (no distortion of the lens), first~~

~~vibrational mode and amplitude, second vibrational mode and amplitude, and third vibrational mode and amplitude.~~

~~1.2 For the nominal optical configuration, perform ray trace analysis over 0.36 to 1.8 microns of solar spectrum as a function of incidence angle from -10 to +10 degrees.~~

~~1.3 For each of the other optical configurations, perform ray trace analysis over 0.36 to 1.8 microns of solar spectrum as a function of incidence angle from -10 to +10 degrees.~~

~~1.4 Analyze the % Total Power Loss for each configuration at each incidence angle based on the ray trace results and the given solar array geometry.~~

~~1.5 Analyze the % Cell Fill for each configuration at each incidence angle based on the ray trace results and the given solar array geometry.~~

Begin R1 block addition

2.0 Perform structural analysis R5~~and engineering design~~ to support the development of a dynamically-scaled lightweight antenna R2test article for dynamics and control research .

Begin R2 block requirements redefinition

2.1 Perform dynamic analysis on full scale finite element model (FEM) including:

2.1.1 Verify design parameters and structural performance of a full-scale Finite Element Models (FEM) and determine suitability of model for use. (completed)

2.2 Evaluate, define and analyze structural models of a lightweight antenna.

2.2.1 Formulate a set of static and dynamic structural FEM's for a lightweight antenna based on upper level specifications provided by the government. The models shall have increasing levels of fidelity from concept level to laboratory test hardware level.

2.2.2 Support engineering design trade studies to establish hardware design and control system specifications for a laboratory test article

2.2.3 Define, incorporate and/or validate FEM models of system hardware sub-components provided by government or external partners.

2.2.4 Define full-scale antenna model based on government specifications and compare structural performance to reduced-scale model.

Begin R7 block deletion

~~2.2.5 Provide structural analysis results required to define system models for control system simulations~~

~~2.2.6 Provide solid body models of antenna models in Pro-Engineer~~

~~2.2.7 Create VRML model for control system simulations~~

End R7 block deletion

** Begin R4 block addition **

2.2.8 Contribute to the government development of a modal test plan to ensure feasibility and availability of sufficient and suitable data for analytical model validation.

2.2.9 Perform modal test validation and model update of FEM based on test data provided by government or external partners.

** End R4 block addition **

End R2 block requirements redefinition

End R1 block addition
** Begin R4 block addition**
Begin R7block deletion
~~3.0Perform structural analysis to support the development of a hybrid inflatable antenna for structural dynamics research.~~
~~3.1 Define static and dynamic structural models of fully deployed test model via Finite Element Modeling (FEM) based on specifications provided by the government and external partners.~~
~~3.1.1 Define and analyze structural models of a hybrid inflatable antenna.~~
~~3.1.2 Formulate a set of static and dynamic structural FEM's for a lightweight antenna based on upper level specifications provided by the government and external partners. The models shall have increasing levels of fidelity from concept level to laboratory test hardware level.~~
~~3.1.3 Support engineering design trade studies to establish hardware design specifications for a laboratory test article with government and external partners.~~
~~3.2 Define, incorporate and/or validate FEM models of system hardware sub-components provided by government or external partners.~~
~~3.2.1 Contribute to the government development of a modal test plan to ensure feasibility and availability of sufficient and suitable data for analytical model validation.~~
~~3.2.2 Perform modal test validation and model update of FEM based on test data provided by government or external partners.~~
End R7block deletion
** End R4 block addition **
Deliverables:
R1Task #1(Completed)
- ~~Optical models in electronic format (optical code input files and PowerPoint or Word file with graphics of distorted lens)~~
- ~~Optical ray traces for each configuration and incidence angle (optical code output files and PowerPoint or Word version of graphics which includes geometric reference for solar cell location and width)~~
- ~~Graphs and tables of % Total Power Loss for each lens configuration as a function of incident solar radiation angle~~
- ~~Graphs and tables of % Cell Fill for each lens configuration as a function of incident solar radiation angle~~
- ~~Written report of design and analysis approach and description of results.~~

Begin R1 block addition
Task #2
Begin R2 block requirements redefinition
- Images of FEM model structural dynamic mode-shapes in .jpeg and .mpeg formats
- Images of FEM model deformations under uniform gravity loads in jpeg and mpeg formats.

Begin R7block deletion
- ~~FEM output required to define state-space system models for control design- Pro-Engineer~~

~~solid body model of test article designs.~~
~~- VRML models for control system simulations in Matlab~~
*****End R7block deletion*****

- Graphs and data tables showing results of engineering design trade studies in electronic and hard copy form.

** Begin R4 block addition **
- Graphs and data tables showing correlation of analytical model and modal test data in electronic and hard copy form.

** End R4 block addition **
- Electronic copies and detailed descriptions of structural models.
- Informal technical presentation of progress to funders
- Written report of design and analysis approach and description of results in electronic format.

End R2 block requirements redefinition
End R1 block addition
** Begin R4 block addition **
Task #3
*****Begin R7block deletion*****
~~- Images of FEM model structural dynamic mode-shapes in .jpeg and .mpeg formats~~
~~- Images of FEM model deformations under uniform gravity loads in jpeg and mpeg formats.~~
~~- Graphs and data tables showing results of engineering design trade studies in electronic and hard copy form.~~
~~- Graphs and data tables showing correlation of analytical model and modal test data in electronic and hard copy form.~~
~~- Electronic copies and detailed descriptions of structural models.~~
~~- Informal technical presentation of progress to funders and external partners.~~
~~- Written report of design and analysis approach and description of results in electronic format.~~
*****End R7block deletion*****
** End R4 block addition **
Schedule:
Start as soon as possible with completion no later than C1 ~~4/27/01~~ R1~~5/7/01~~ R2~~12/31/02~~ R3 ~~9-30-03~~ R3.1~~12-31-03~~ R4 ~~7/31/~~04 12/31/04
Metrics/Standards:
R1~~Before proceeding with the subtask 1.3, diagrams of the optical geometry of each configuration from 1.1 and the analysis results from 1.2 shall be provided to the Technical Monitor for approval to proceed.~~ (Completed)
R1,R2~~All tasks will be considered to meet the minimum acceptable (MA) level if the models are representative of the physical system and the deliverables are met.~~
R1Task #1 ~~will be considered to exceed MA if work is completed by C1 4/23/01 4/27/01.~~

	(Completed) Task #2 **Begin [R2] block requirements redefinition** *****Begin [R7]block deletion***** ~~Meets:~~ ~~The task will be considered to meet MA if the models are representative of the physical system, the final dynamically-scaled model is physically realizable, [R4]the analytical results correlate well with the modal test results, and the deliverables are met.~~ ~~Exceeds:~~ ~~The task will be considered to exceed MA if the results are provided in a timely manner and are 'value-added' to include comments and suggestions based on the insight and experience of the Contractor when possible.~~ *****End [R7]block deletion***** **End [R2] block requirements redefinition** **Begin [R4] block addition** Task #3 Meets: The task will be considered to meet MA if the models are representative of the physical system, the analytical results correlate well with the modal test results and the deliverables are met. Exceeds: The task will be considered to exceed MA if the results are provided in a timely manner and are 'value-added' to include comments and suggestions based on the insight and experience of the Contractor when possible. **End [R4] block addition**
3.	**<u>Government Furnished Items</u>**: The government will provide 1 Description of the lens material and geometry 2 Three-dimensional structural vibration modeshapes, frequencies and amplitudes 3 Definition of '% Total Power Loss' and '% Cell Fill' **Begin [R1] block addition** 4 Access to NASTRAN for analysis. 5 Initial NASTRAN model of full-scale lightweight antenna and associated design parameters. 6 Instructions on outputting dynamic model for control system simulations and locations for

	input and output points. **End R1 block addition**
4.	**Other information needed for performance of task**: Task #1 is a short-term, urgent task. **Work may be performed off-site to accommodate short period of performance. (Paragraph F.3, NAS1-00135)** 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.
5.	**Security clearance required for performance of work**: None
6.	**Period of Performance**: Planned start date: 4/11/01 Completion date: C1 ~~4/27/01 (at the latest)~~ R2 ~~12/31/02~~ R3 ~~9-30-03~~ R3.1 ~~12-31-03~~ R4 ~~7/31/04~~ R6 ~~12/31/04~~ R7 ~~9/30/05~~ ***12/31/05***
7.	**NASA Technical Monitor**: R7 ***James L. Gaspar*** M/S: 230 Phone: 757-864-***4326*** **NASA Directorate/Other Technical Coordinator**: S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 10RDE Revision: 4 Date of Revision: 7/6/04

Title: Airline, Corporate, & General Aviation Technical Expertise and Test Subject Delivery

1. **Purpose, Objective or Background of Work to be Performed:** (DC21, NAS1-96014)

The Crew Systems Branches have an ongoing responsibility to conduct pilot performance studies of flight deck systems concepts for various projects. The purpose of this task is to provide airline, corporate, and general aviation (GA) technical perspectives and test subjects with experience in national airspace system (NAS) operations, specifically (but not limited to) airline, corporate and GA operations; air traffic control (ATC); dispatchers; and flight service stations (FSS) to participate in these activities. The subtasks are to be completed [R1] ~~September 30, 2001~~ [R2] ~~September 30, 2002~~ [R3] ~~September 30, 2003~~ [R4]~~September 30, 2004~~ ***December 31, 2005***.

Note: 1. The performance studies support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor with the *Technical Expertise and Subject Request* submitted through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated items below.)

2. The schedule sensitive nature of this task order is such that requirement cancellation or change subsequent to definition could result in incurred costs by the Contractor or NASA without contributing to the research objective(s). Therefore a subsequent NOR will be used to document requirement changes for items as described in the previous paragraph.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see [R1] above and below).

Revision 2: Extends the period of performance one year in continuation of and with no change in NASA's support requirements and documents the Technical Monitor change that was effective 1/24/02 (see [R2] above and below).

Revision 3: Extends the period of performance one year to September 30, 2004, in continuation of NASA's support requirements with no changes in the detailed requirements and changes the technical monitor (see [R3] above and below).

Revision 4: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support requirements with no changes in the detailed requirements (see [R3] above and below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following subtasks:

A. Subject Recruitment

1. Recruit willing participants for future experiments.
2. Administer to potential subjects recruited from Subtask A1 an *Applicant Background*

Questionnaire provided by NASA.
3. Establish and maintain a database of subjects who completed the *Applicant Background Questionnaire* administered in Subtask A2.
4. Have the database generated in Subtask A3 searchable by NASA Langley researchers.

Note: Because of privacy and personal services issues, the data available to NASA shall exclude information such as name, social security number, and other person-specific information that would enable NASA to easily identify the individual(s) possessing the background information needed for a particular experiment.

Deliverables for *A. Subject Recruitment*:
(1) The database developed in Subtask A3.
(2) The search engine developed in Subtask A4.

Schedule for *A. Subject Recruitment*:
(a) Subtasks A1–3 shall be started by Jan 31, 2001.
(b) Subtask A4 shall be searchable by Apr 30, 2001.

Metrics and Standards for *A. Subject Recruitment*:

a. Methods of recruitment (*e.g.*, trade publications, the web, FBO, companies, trade organizations, etc.)
[Subtask A1]
MEETS if 3 methods of recruitment are used.
EXCEEDS if more than 3 methods of recruitment are used.

b. Number and types of potential participants who filled out the *Applicant Background Questionnaire*
[Subtask A2]
MEETS if types of potential participants include commercial airline pilots, corporate pilots, and GA pilots.
EXCEEDS if applicant can complete the background questionnaire online.

c. Number of searchable fields, which shall include, as a minimum:, (1) age, (2) sex, (3) type of pilot, (4) years of piloting experience, (5) time in type, and (6) whether *Applicant Background Questionnaire* from online or not.
[Subtask A4]
MEETS if searchable fields are the 6 listed above.
EXCEEDS if searchable fields are more than 12.

d. Method of accessing the database.
[Subtask A4]
MEETS if database is searchable by NASA Langley Researchers.
EXCEEDS if database is searchable by NASA Langley researchers without the need for purchasing specialized software and is accessible remotely.

B. Technical Expert Participation in Planning and Conducting Experiments(NOR)

1. Provide technical experts to participate in experiment planning. The specific requirements will be detailed in the NOR, but is anticipated that an average of 1 technical expert not to exceed 3 per NOR and 3 NORs for the current period of performance will be submitted.
2. Provide technical experts to help conduct experiments. The specific requirements will be detailed in the NOR, but it is anticipated that an average of 1 technical expert not to exceed 2 per NOR and 2 NORs for the current period of performance will be submitted.

3. Coordinate and provide all transportation, lodging, meals, incidental costs, and fees for each expert supplied by Subtasks B1 and B2 when s/he participates at the behest of NASA Langley Research Center.
4. Coordinate and provide all the necessary paperwork for participants' on-site access.
5. Report to the task monitor the estimated anticipated cost of Subtask B3 items for each NOR submitted. This estimate can be a rough order of magnitude (ROM) and will be used for internal NASA customer initial cost sharing determination only.
6. Report to the Task Monitor the (1) specialty of the expert participating in a particular experiment, (2) dates s/he (they) will be at NASA Langley Research Center, and (3) principal investigator (PI) for each NOR submitted.
7. Report to the task monitor the estimated incurred cost of Subtask B items for each NOR submitted. This estimate will be used for internal NASA customer final cost sharing determination only.

Deliverables for *B. Technical ExpertParticipation:*

(1) Technical experts to participate in planning of experiments (Subtask B1).
(2) Technical experts to help conduct experiments (Subtask B2).
(3) Report of the anticipated cost estimate for each NOR submitted (Subtask B5).
(4) Report of participant data for each NOR submitted (Subtask B6).
(5) Report of the incurred cost estimate for each NOR submitted (Subtask B7).

Schedule for *B. Technical Expert Participation*:

(a) Subtasks B1–2 shall be delivered in the timeframe indicated in the NOR. It is anticipated that at least three weeks lead-time will be provided in each NOR.
(b) Subtask B5 shall be delivered within 2 weeks after the NOR is received by the Contractor.
(c) Subtask B6 shall be delivered within 1 week after a change within a week's timeframe.
(d) Subtask B7 shall be delivered within 4 weeks after the last technical experts leaves or after a 4-week break in utilizing a technical experts.

Metrics and Standards for *B. Technical Expert Participation*:

a. Number of hours of experience.

[Subtasks B1 and B2]
MEETS if the technical expert has the experience requested in the NOR.
EXCEEDS if 80% of the technical experts have experience of 200 hours more than that requested in the NOR.

b. Time to deliver participants from the date requested in the NOR, which will be no less than 3 weeks.
[Subtasks B1 and B2]
MEETS if 70% of the participants are delivered at the time requested in the NOR.
EXCEEDS if 90% of the participants are delivered at the time requested in the NOR.

c. Delivery time of anticipated incurred cost estimate.
[Subtask B5]
MEETS if report is received 2 weeks after the NOR is received by the Contractor.
EXCEEDS if report is received less than 2 weeks after the NOR is received by the Contractor.

d. Delivery time of participants data report.
[Subtask B6]
MEETS if report is received 1 week after a change within a week's timeframe.
EXCEEDS if report is received less than week after a change within a week's timeframe.

e. Delivery time of incurred cost report.
[Subtask B6]
MEETS if report is received 4 weeks after the last technical expert leaves or after a 4-week break in utilizing a technical expert.
EXCEEDS if report is received 2 weeks after the last technical expert leaves or after a 2-week break in utilizing a technical expert.

C. Test Subjects (NOR)

1. Provide test subjects. The specific requirements will be detailed in the NOR, but is anticipated that an average of 8 subjects not to exceed 40 per NOR and 15 NORs for the current period of performance will be submitted.
2. Coordinate and provide all transportation, lodging, meals, incidental costs, and fees for each subject supplied by Subtask C1 when s/he participates at the behest of NASA Langley Research Center.
3. Coordinate and provide all the necessary paperwork for subjects' on-site access.
4. Deliver subjects at the time and place requested in the NOR.
5. Report to the Task Monitor the estimated anticipated cost ofSubtask C items for each NOR submitted. This estimate can be a rough order of magnitude (ROM) and will be used for internal NASA customer initial cost sharing determination only.
6. Report to the Task Monitor the subject schedule for each NOR submitted.
7. Report to the Task Monitor the estimated incurred cost of Subtask C items for each NOR

submitted. This estimate will be used for internal NASA customer final cost sharing determination only.

8. Update the database generated in Subtask A3 with the experiment(s) participated in by subject.

Deliverables for *C.Test Subjects*:

(1) Subjects for experiments (Subtask C1).
(2) Report of the anticipated cost estimate for each NOR submitted (Subtask C5).
(3) Report of the subject schedule for each NOR submitted (Subtask C6).
(4) Report of the incurred cost estimate for each NOR submitted (Subtask C7).
(5) Updated database (Subtask C8).

Schedule for *C. Test Subjects*:

(a) Subtasks C1 and C4 shall be delivered in the timeframe indicated in the NOR. It is anticipated that at least three weeks lead-time will be provided in each NOR.

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(b) Subtask C5 shall be delivered 2 weeks after the NOR is received by the Contractor.
(c) Subtasks C6 and C8 shall be delivered within 1 week after a change within a week's timeframe.
(d) Subtask C7 shall be delivered within 4 weeks after the last subject is delivered.

Metrics and Standards for *C. Test Subjects*:

a. Time to deliver first subject dated from time request was received by Contractor.
   [Subtask C1]
   MEETS if within 3–4 weeks.
   EXCEEDS if less than 3 weeks.
b. Scheduling of subjects.
   [Subtask C1]
   MEETS if 70% of the subjects used for an experiment are scheduled within normal business hours (8:00 am to 5:00 pm) or the hours specified in the NOR.
   EXCEEDS if 90% of the subjects used for an experiment are scheduled within normal business hours (8:00 am to 5:00 pm) or the hours specified in the NOR.
c. Delivery time of subjects.
   [Subtask C4]
   MEETS if 70% of the subjects used for an experiment are delivered within 20 minutes of the scheduled time and to the correct location.
   EXCEEDS if 90% of the subjects used for an experiment are delivered within 20 minutes of the scheduled time and to the correct location.
d. Delivery time of anticipated cost estimate.
   [Subtask C5]
   MEETS if report is received 2 weeks after the NOR is received by the Contractor.
   EXCEEDS if report is received less than 2 weeks after the NOR is received by the the

	Contractor. e. Delivery time of subjects' data report. [Subtask C6] MEETS if updates are reported 1 week after a schedule change within a week's timeframe. EXCEEDS if updates are reported less than 1 week after a schedule change within a week's timeframe. f. Delivery time of incurred cost report. [Subtask C7] MEETS if report is received 4 weeks after the last subject is delivered <u>or</u> after a 4-week break in subject delivery. EXCEEDS if report is received 2 weeks after the last subject is delivered <u>or</u> after a 2-week break in subject delivery. g. Updated database. [Subtask C8] MEETS if database is updated in 4 weeks from subject delivery. EXCEEDS if database is updated in less than 2 weeks from subject delivery <u>and</u> if the updated information includes the PI.
3.	**<u>Government Furnished Items</u>:** 1. Applicant Background Questionnaire 2. Technical Expertise and Subject Request provided by NOR 3. Server to maintain database generated in Subtasks A3 and C8
4.	**<u>Other information needed for performance of task</u>:**
5.	**<u>Security clearance required for performance of work</u>:** All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines.
6.	**<u>Period of Performance</u>:** **Planned start date:** January 2, 2001 **Completion date:** R1 ~~September 30, 2001~~ R2 ~~September 30, 2002~~ R3 ~~September 30, 2003~~ R4 ~~September 30, 2004~~ ***December 31, 2005***
7.	**NASA Technical Monitor:** R3 Pamela J. Stacy M/S: 152 Phone: 757-864-4918 NASA Competency/Other Technical Coordinator: AirSC/ M/S: Phone:

Task Order Number: 10RFQ Revision: 4 Date of Revision: 10/21/04

Title: Analytical Laboratory Investigations

1.	**Purpose, Objective or Background of Work to be Performed:** The purpose of the proposed task is to conduct analytical investigations in conjunction with a variety of projects that are being conducted by or have submitted samples to the NASA LaRC Facilities Engineering Laboratory for analysis and/or evaluation. Typical studies will attempt to identify or to measure specific properties of these samples that come from wind tunnel operations, material and structures research and environment requirements. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements with reduced estimated samples (see R1 below). Revision 2: Extends the period of performance one year in continuation of NASA's support requirements with reduced estimated samples (see R2 below). Revision 3: Extends the period of performance one year to October 31, 2004, in continuation of NASA's support with no change in detailed requirements for the new period of performance (see R3 in Section 6 below). Revision 4: Extends the period of performance one year to October 31, 2005, in continuation of NASA's support with no change in detailed requirements for the new period of performance (see R4 in Section 6 below).
2.	**Description of the Work to be Performed:** NASA will submit approximately R1, R2 ~~500~~ 100 samples per year to the Contractor for analysis or for evaluation. These samples are generally small aliquots of larger quantities or small contaminate deposits and can be in gas, liquid or solid form. The Contractor shall perform the analysis appropriate for the submitted sample using the furnished equipment listed and the laboratory facilities of the Facilities Engineering Laboratory. Types of analysis and requirements to be performed by the Contractor include ASTM testing of lubricants, gas chromatography, x-ray fluorescence, atomic emission spectroscopy using inductively coupled plasma (ICP), thermal analysis, scanning electron microscopy, Infrared and Ultraviolet spectroscopy, acid digestion for composite fiber volume, plasma ashing, production of microspheres for wind tunnel flow visualization and particle sizing. Other instrumental and wet chemical methods also may necessarily be employed to perform the required tasks. The Contractor shall be required to perform normal instrument maintenance and assure proper functioning using manufacturer's calibration procedures on those instruments listed with an asterisk. The Contractor shall maintain a laboratory notebook with the details, procedures and data from each analysis performed, an update chemicals and equipment inventory computer listing, a weekly hazardous materials storage and disposal logbook and also maintain a safe operating laboratory environment per LaRC laboratory and safety procedures and the equipment manufacturers procedures and instructions. The Contractor shall provide as deliverables: a) The results of each analysis are to be immediately reported either verbally or a short

written synopsis to the Facilities Engineering Laboratory manager, to be recorded in the laboratory notebook, to be synopsized in a written monthly report and the analysis data delivered to the submitting party

b) A laboratory notebook (Government furnished) containing daily entries of work performed, analysis data, submitting party and laboratory status. When full is a deliverable and another notebook will be furnished.

c) Updated maintenance of the computer listing of chemical and equipment inventory.

d) Informal monthly reports listing the tasks completed during the month and a final yearly report summarizing the tasks performed, submitting unit at LaRC and analysis results.

e) A logbook containing the weekly status of hazardous material storage and disposals.

Schedule and Metrics of Deliverables

Analyses completed within five working days are considered to meet minimum requirements; analysis completed in less than five days are considered to exceed task requirements. The work performance by the Contractor will be judged by accuracy of the analysis, analysis response time and the operation and maintenance of the laboratory in a safe manner as per NASA Safety Office inspections. Since the Facilities Engineering Laboratory is involved in the development and use of new instrumental analysis techniques, Contractor submitted suggestions for instrument improvement that are accepted by NASA shall be considered as exceeding minimum performance levels as well as any Contractor implemented improvements in analysis efficiency or property determination.

3. **Government Furnished Items:**

The Contractor will have access to the following laboratory equipment **(Buildings 1208, 1294, 1293, and 1272)** to perform this task:

*Thermo-Jarrell Ash Model Atomscan 25 ICP Spectrometer

Perkin-Elmer Model PE 1600 Infrared Spectrometer

*Varian Model 3600 Gas Chromatograph

Perkin-Elmer Model 1700 DTA

*Brinkmann Model 684 Karl-Fisher Coulometer

*Hach model DR/2000 Spectrometer

Hitachi Model S-510 Scanning Electron Microscope

*Olympus Model BH-2 Microscope and Image Analysis System

*CEM Model 205 Microwave Digestion System

*Shimedzu Model SALD-1100- Laser Diffraction Particle Size Analyzer

	*Spectrace Model 6000 X-Ray Fluorescence Spectrometer
4.	**Other information needed for performance of task:** No formal travel is expected to be needed for performance of the tasks; only occasional attendance at local workshops and demonstrations by commercial instrument manufactures. A yearly government provided physical examination is required for monitoring of health due to exposure to hazardous chemicals listed on NASA LaRC safety permit (Arsenic, Cadmium, Benzene, Formaldehyde, Chloroform and Methylene Chloride.) Contractor shall have demonstrated safety training and performance in the operation of a chemical laboratory. 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.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:** **Planned start date:** January 2, 2001 **Completion date:** October 31, R1 ~~2001~~ R2 ~~2002~~ R3 ~~2003~~ R4 ~~2004~~ ***2005***
7.	**NASA Technical Monitor:** Warren C. Kelliher M/S: 416A Phone: 757-864-4172

Task Order Number: 11RAD Revision: ____ Date of Revision:

Title: Trade Studies For Advanced Aircraft

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

The NASA Advanced Aircraft Program performs system-level studies 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 define the requirements and performance characteristics of advanced military aircraft and to determine the high risk/high payoff areas for NASA research. Mission effectiveness, operational considerations and cost models can be an integral part of these studies. 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.

The Contractor shall conduct trade studies of integrated advanced concept vehicles. Appropriate vehicle performance parameters (range, payload (weight and volume), aerodynamic 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; mission capability, life cycle cost, reliability, and development risk; 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 for the Contractor will be defined in classified subtask descriptions that 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.

2. Description of the Work to be Performed:

Specific work elements will be defined in classified subtask descriptions that will be provided by the NASA Technical Monitor. The Contractor will lead two broadly categorized 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 required in conducting the classified system level studies. The Contractor shall document any methods that are developed as a result of conducting the two systems studies. The Contractor will identify deficiencies that exist and will recommend a plan to address these deficiencies, whether they are improvements to analytical tools or databases.

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. Timely communication of technical progress is desired and should not be limited to the bimonthly reports.

Schedule:

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

Metrics & Standards:

The Contractor will meet the critical path elements and provide the deliverables as specified by the subtask descriptions. If the Contractor's efforts result in savings (milestones accomplished early, money saved) to the NASA program, then the Contractor will have exceeded the expected performance. Specific metrics and standards will be called out in the classified subtask descriptions.

Task Order Number: 11RAD Revision: ____ Date of Revision:

Title: Trade Studies For Advanced Aircraft

3. Government Furnished Items:

NASA FLOPS code for conducting system level studies. Pro-E and ACAD graphics software for configuration development, Macintosh, PC and graphics workstations for program development, planning, analysis, and reporting.

4. Other information needed for performance of task:

A moderate amount of travel is anticipated for the subtasks.

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.

5. Security clearance required for performance of work:

Top Secret Required

6. Period of Performance:

Planned start date: 01/01/01 Completion date: 01/01/02

7. NASA Technical Monitor:

Thomas M. Moul / William J. Small
M/S: 411 Phone: 757-864-5292
NASA Competency/Other Technical Coordinator: Willard R. Weaver, Jr.
M/S: 328 Phone: 757-864-6053

Task Order Number: 11RBJ Revision: 5 Date of Revision: 2/17/04

Title: R3 Implementation of Wall Interference Assessment and Correction Systems

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

R3 Selected existing wind tunnel wall interference assessment and correction R3 (WIAC) methods and codes will be modified and installed in the Langley Research Center (LaRC) R3 14- by 22-Foot Subsonic Wind Tunnel (14x22) and the National Transonic Facility (NTF) to enable post-point and post-test computation of wall interference effects. Wind tunnel wall and aerodynamic model data will be analyzed to support implementation of the methods and to enhance measurement system performance. Operational support, documentation and training will be provided to Research Facilities Branch (RFB) staff R3 and contractors.

Revision 1: Adds NTF PANCOR implementation as Subtask 2.4 and puts some Subtask 1 and 2 work on hold due to tunnel schedule changes and upgrades.
Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines/updates the requirements for the new period of performance.
Revision 3: Extends the period of performance through December 31, 2003, in continuation of NASA's support with updated title, redefined work description, and new Technical Monitor for the extended period of performance (see R3 above and below). Note: For details of issued original, Revision 1, and Revision 2 SOWs see ETOS files *11RBJ.doc, 11RBJ01u.doc, and 11RBJ02.doc*, respectively.
Revision 4: Extends the period of performance two months to February 29, 2004, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see R4 below, Section 6).
Revision 5: Extends the period of performance two months to April 30, 2004, in continuation of NASA's support with no changes in detailed requirements (see R5 below, Section 6).

2. **Subtask Descriptions of the Work to be Performed:**

Begin R3 block requirements redefinition

2.1. **TWICS Implementation for Post-Test Assessment and Correction:**

2.1.1. **Subtask Description:** The Contractor shall deliver an operational version of the Transonic Wall Interference Correction System (TWICS), developed by Ames Research Center, to the NTF and the 14x22 for post-test correction of data obtained during solid- and slotted-wall full- and semi-span tests where appropriate. The Contractor shall establish and develop TWICS procedures to enable post-test delivery of wall interference corrections. The Contractor shall also carry out post-test WIAC analyses on an as-requested basis.

2.1.2. **Deliverables:**

a) Development of the TWICS code for the NTF;
b) TWICS support on an as-requested basis for customer tests;
c) TWICS support on an as-requested basis for facility characterization, including test section calibration, check standard model and probe tests,

and Tunnel Validation tests;

d) Oral reports and written documentation, including

1) Informal analysis reports for all supported tests;

2) Draft TWICS manuals for the NTF and the 14x22;

3) Oral status report presentations, as required.

2.1.3. **Minimum Acceptable Performance:**

a) TWICS implemented for the 14x22 for solid walls for full- and semi-span testing by 09/30/03;

b) TWICS implemented for the NTF for solid and slotted walls for full-span testing by 09/30/03;

c) Analysis reports delivered within one month of test completion if requested.

2.1.4. **Exceeds Acceptable Performance:**

a) Draft TWICS manual(s) for the 14x22 and/or the NTF delivered by 09/30/03;

b) TWICS implemented for the NTF for solid and slotted walls for semi-span testing by 09/30/03;

c) AIAA papers and/or NASA Contractor Reports for TWICS implementation in either the NTF or the 14x22;

d) Requested analysis reports delivered within two weeks of test completion;

e) Development and implementation of improvements to the TWICS system for either the NTF or the 14x22.

2.2. **Classical Method Implementation for Post-Point Assessment and Correction:**

2.2.1. **Subtask Description:** The Contractor shall develop and implement an appropriate version of the Classical Method (CM) for solid and slotted walls to be used as a post-point correction method during full- and semi-span testing in the NTF. The Contractor shall also support, on an as-requested basis, improvement of the existing Classical/Heyson post-point correction code in the 14x22.

2.2.2. **Deliverables:**

a) CM development and implementation for post-point corrections for solid and slotted walls in the NTF;

b) CM support on an as-requested basis for customer tests;

c) CM support on an as-requested basis for facility characterization, including test section calibration, check standard model and probe tests, and Tunnel Validation tests;

2.2.3. **Minimum Acceptable Performance:**

a) CM implemented for post-point processing of NTF data for solid and slotted walls for full- and semi-span testing by 09/30/03;

b) Analysis reports delivered within one month of test completion if requested.

2.2.4. **Exceeds Acceptable Performance:**

a) Draft CM manual for the NTF delivered by 09/30/03;

b) CM implemented for post-point processing of NTF data for solid and slotted walls for semi-span testing by 09/30/03;

c) AIAA papers and/or NASA Contractor Reports for CM implementation in the NTF;

d) Requested analysis reports delivered within two weeks of test completion;

e) Development and implementation of improvements to the CM system for either the NTF or the 14x22.

2.3. **Data Quality Analysis and Improvement:**

2.3.1. **Subtask Description:** The Contractor shall analyze existing and new tunnel wall and facility characterization data from the NTF and the 14x22. The Contractor shall perform data quality analyses and develop analysis tools that will (1) establish and verify performance of tunnel-wall-effects instrumentation, (2) streamline the analysis process, and (3) aid implementation of the TWICS system. The Contractor shall suggest enhancements to orifice installations and monitor any orifice installations and related instrumentation changes. The Contractor shall design and monitor new wall orifice installations for NASA installation and fabrication, as required.

2.3.2. **Deliverables:**

a) Analysis plots of wind tunnel wall data and tunnel characterization data;

b) Analysis methods and results documented by informal memos;

c) Tools which simplify analysis and implementation;

d) Orifice installation reports, drawings, and designs;

2.3.3. **Minimum Acceptable Performance:**

a) Analysis plots of tunnel characterization data;

b) Analysis for facility testing, including test section calibration, check standard probe and model tests, and Tunnel Validation tests;

c) Analysis of customer tests;

d) Monitor tunnel wall instrumentation hookup and installation.

2.3.4 **Exceeds Acceptable Performance:**

a) Automated methods that significantly enhance and speed data analysis;

b) Report defining design and performance of wall pressure data systems for use in the TWICS system;

c) Development and implementation of process and instrumentation improvements for the TWICS system;

Task Order Number: 11RBJ Revision: 5 Date of Revision: 2/17/04

Title: R3 Implementation of Wall Interference Assessment and Correction Systems

	d) AIAA papers and/or NASA Contractor Reports for the wall pressure measurement health system. **End R3 block requirements redefinition**
3.	**Government Furnished Items**: The Contractor will be provided with the following specialized items: a) Data analysis and CFD-implementation computers with appropriate speed, memory, and software, connected to the LaRC area network; b) Accounts on all appropriate RFB and LaRC file servers; c) Appropriate software for tool development, including, as a minimum, Netscape, Telnet, X-Windows, and RFB DAS.
4.	**Other information needed for performance of task**: The Contractor may be required to travel to NASA Ames Research Center for training and consultation with TWICS code developers (1 trip, 4 days). Year 2000 Compliance. All code to be used in this task will be furnished by NASA and the Contractor has no requirement to certify Y2K Compliance of the code or modifications of the code.
5.	**Security clearance required for performance of work**: Contractor shall be required to provide the appropriate security and proprietary clearances as needed by the required wind tunnel tests and test data.
6.	**Period of Performance**: Planned start date: R2 ~~01/02/01~~ R3 ~~01/02/02~~ 01/02/03 Completion date: R2 ~~12/31/01~~ R3 ~~12/31/02~~ R4 ~~12/31/03~~ R5 ~~2/29/04~~ ***4/30/04***
7.	**NASA Technical Monitor:** R3 Michael J. Hemsch M/S: 280 Phone: 757-864-2882 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 11RCB Revision: 4 Date of Revision: 3/31/2005

Title: Operation of Structural Testing Laboratory for the Transonic Dynamics Tunnel

1. **Purpose, Objective or Background of Work to be Performed:** The objective of this task is to provide for the set up, maintenance, and operation of a structural testing laboratory as part of the model preparation capability at the Transonic Dynamics Tunnel (TDT). The primary requirement is maintenance of a state-of-the-art vibration test capability. Other structural testing activities, such as static loads, mass and inertia measurements etc. will also be supported. Also, structural analysis in support of the test activities may be required. The Contractor will be expected to perform the following general requirements as applicable to models undergoing testing at the TDT:

- Maintain Ground Vibration Test (GVT) computer/data acquisition and reduction systems. The Aeroelasticity Branch (AB) currently uses the MTS I-DEAS TEST software along with [R2]personal computers (PCs) and compatible data acquisition systems. These systems are relatively mobile so that can be used in various facilities, including the TDT test section. The goal of the branch is to keep two independent systems functioning so that a single system failure will not interfere with the wind-tunnel schedule.

- Perform and/or provide technical support for GVTs on models to be tested in the TDT, or other models of interest to AB.

- Maintain instrumentation used in structural testing in accordance with LMS.

- Support model structural testing in areas other than vibration testing.

- Perform structural analysis related to structural testing activities.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the requirements for the new period of performance. See original issued SOW and [R1] details in ETOS files *11RCB.doc and 11RCB01.doc,* respectively.
Revision 2: Extends the time period of performance through September 30, 2004 with redefined/clarified requirements (see [R2]above and below).
Revision 3: Extends the time period of performance through June 30, 2005 to allow transition to ROME contract and deletes Subtask 2 anticipated NORs list (see [R3] below).
Revision 4: Extends the period of performance three months to September 30, 2005 to allow transition to ROME contract (see [R4] below).

2. **Description of the Work to be Performed:**

Subtask 1: Maintenance of Vibration Testing Capability. The Contractor shall develop and maintain a GVT facility according to the following criteria.

1. Two independent GVT systems shall normally be kept in operational readiness and meet LMS criteria. In the event of a failure or obsolescence rendering either system inoperable, immediate action shall be taken to bring the system back into operational readiness.

2. The latest versions of SDRC I-DEAS TEST software shall be installed on the GVT computers, and the computer system configurations shall be kept efficient for test activities through the use of backups, file storage, virus protection, etc. Coordination with the designated system manager will be a key part of this activity.

3. Sufficient quantities of instrumentation (acceleromenters, signal conditioning boxes, impact hammers, load cells etc) shall be kept in good working condition and in calibration IAW LMS procedures. Other equipment such as shakers, cables, stands, etc. shall be maintained in good working order and kept current IAW LMS.

Deliverable: [R2]Two operating GVT systems that meet the above criteria.

Performance Measurement:
1) For minimum acceptable performance:

a) At least one GVT system must be available as needed, and in good operating condition, to support the TDT schedule.

b) Two operable GVT systems should be operable most of the time. Maintenance action should be in progress for a system that is not operable.

2) To exceed minimum performance, the Contractor can:
Provide expert advice and training on GVT practices, perform or assist in GVTs, perform system management functions (such as installing "TEST" software), and provide innovative improvements to the structural testing laboratory or in its practices.

Schedule: [R2]Deliverable is ongoing.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of

requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Subtask 2: Ground Vibration and other Structural Tests. (NOR) The Contractor shall perform GVTs or specified technical support functions for structural tests in response to NORs which will be issued by AB throughout the performance period as specific requirements and schedules are defined. Following is a list of anticipated activities and dates for which NORs will be issued. Additional requirements related to structural testing, currently unknown, may be issued.

Begin R3 block deletion

~~**Begin R2 block redefinition**~~

1. ~~GVTs, static loads tests, and a wind-tunnel test of the Stone Soup Active Aeroelastic Wing wind-tunnel model is planned for October 03 through March 04.~~
2. ~~A GVT and wind-tunnel test of the High Speed Slotted Wing model is planned for October and Novemeber 03.~~
3. ~~Continued Support of the Shuttle PAL Ramp Removal Study via analysis of dynamic data is anticipated.~~
4. ~~Aeroelastic models of the Joint Strike Fighter may require laboratory testing and wind-tunnel support in FY 04.~~

~~**End R2 block redefinition**~~

End R3 block deletion

Deliverables: Will be specified in NORs.

Performance Measurement: Will be specified in NORs.

Schedule: Will be specified in NORs.

3. **Government Furnished Items:**

All items and facilities needed will be furnished by the government.

4. **Other information needed for performance of task:**

Task Order Number: 11RCB Revision: 4 Date of Revision: 3/31/2005

Title: Operation of Structural Testing Laboratory for the Transonic Dynamics Tunnel

5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: 10/15/2001 Completion date: R1 ~~9/30/2002~~ R2 ~~9/30/2003~~ R3 ~~9/30/2004~~ R4 ~~6/30/2005~~ ***9/30/2005***
7.	**NASA Technical Monitor:** Vic Spain M/S 340 Phone: 757 864-1265 **NASA Competency/Other Technical Coordinator:** Dina Weiss M/S 285 Phone: 757-864-5293

	Task Order Number: 11RDH Revision: Close Date of Revision: 7/31/03 Title: Radiometer Test Development

1.	**Purpose, Objective or Background of Work to be Performed:** The objective of this task is to develop Synthetic Thinned Array Radiometer (STAR) measurement techniques and system designs for enhanced calibration and stability, and to develop a conceptual design for a 183 GHz radiometer for atmospheric sounding. The STAR elements of this task will include performance measurements and development and characterization of a system to demonstrate a method for on-orbit calibration of a thinned array. The atmospheric sounder element will be breadboard and test for the conceptual design of an aircraft instrument to be developed in the future. Revision 1: Adds Subtask 3 and extends the completion date (see [R1] below). Revision 2: Adds Subtasks 4 and 5 and extends the completion date one year in continuation of NASA's support requirements (see [R2] below). Revision 3: Adds Subtask 6 and extends the completion date to December 31, 2003 (see [R3] below). Revision 4: Adds new requirements as Subtasks 7 and 8 and updates deliverables and GFI (see[R4] below). Close: Effective 7/31/03 for NASA's convenience with three deliverables deleted (see [C] below).
2.	**Description of the Work to be Performed:** (1) Calibration Techniques for STAR Systems (a) The Contractor shall modify two channels of the Hydrostar POC front-ends to include a broadband mutual coupling calibration mode. This calibration mode will be an automated feature where noise will be intermittently injected into each channel via mutual coupling between antenna array elements. A bench test set-up will be used to provide direct coupling during hardware development, then g-matrix calibration tests will be run in the LaRC Low Frequency Chamber. A correlation measurement using the Hilbert Transform Correlator will provide an estimate of the mutual coupling by measuring the common noise between channels. (b) The Contractor shall develop a Dual-Channel Correlation Noise Source (DCNS) for the characterization of coherent radiometers such as polarimeters and STAR systems. The DCNS shall provide 2 broadband noise output signals at L-Band with variable correlation between the two. The Contractor will develop the detailed design, fabricate, and fully characterize the DCNS. The DCNS shall be characterized using the Hilbert Transform Correlator. (2) 183 GHz Aircraft Atmospheric Sounder Concept Development The long term plan is to develop an atmospheric sounder for conducting measurements from an aircraft coincident with the infrared sounder NAST I. Under this task, the Contractor shall provide a design for, and identify components for, a 183 GHz front-end and a 1-10 GHz IF to be used in stability tests for atmospheric sounder design studies. [R1] (3) STAR Evaluation Breadboard Development The objective in this subtask is to support the design and development of an evaluation breadboard for a fiber optic based technique for distributing stable, calibrated reference signals in STAR systems. Technical support in the design, fabrication, and testing of the evaluation breadboard will be required. Documentation of the final design and test results

shall be provided as deliverables.

Begin R2 block requirements addition

(4) FPGA-based Hilbert Transform Correlator Development

Design and development of an FPGA-based Hilbert Transform (HTF)/Correlation system. Support shall be provided for system design of the HTF and fabrication of the HTF A/D and interface to the existing NASA/APL ADAPT circuit board. The ADAPT PCB is a Xilinx-based PCI bus design done by NASA/LaRC and APL. Support shall be provided for testing and test data analysis of the HTF.

It is anticipated that any upgrades and enhancements deemed necessary to meet test and measurement requirements that exceed the current capabilities would be funded by the customer. NASA will provide personnel access to the facility and computer support equipment. NASA will provide all specialized tools and other supplies required to complete the task.

(5) Test and Characterization of STAR MMIC Front-Ends

Conduct testing for characterization of MMIC radiometer front-ends currently being developed by Goddard Space Flight Center. Use the DCNS, the POC receivers, the HTC, and standard warm and cold loads already on hand to provide a comprehensive performance characterization of the two as conventional radiometers and as a two channel correlation radiometer. It is anticipated that Goddard will provide the MMIC front-end hardware to Langley by July 1, 2002 in order for the delivery requirements under this subtask to be met.

End R2 block requirements addition

Begin R3 block addition

(6) Test and Characterization of Ultra Wideband Interference on GPS Systems

Conduct development and testing of Interference Signal Simulators incorporating ultra wideband signal sources and GPS constellation signal simulators. Design of test configurations, development of test and data analysis methods, and support in interpretation of results shall also be provided. Existing LaRC hardware, such as the DCNS, the POC radiometers, and the HTC, will be used in testing, and modifications to these systems will be required to operate at the L1 GPS frequency of 1.575 GHz. Both ultra wideband and GPS test articles will be provided by industry and outside government sources according to detailed schedules.

End R3 block addition

Begin R4 block addition

(7) Radiometric Technology Applied to Multi-element Array Antennas

Investigate the feasibility of various technologies being considered for lightweight arrays for remote sensing at L-band. Receiver front-end components, including array elements, band-pass filters, and low noise amplifiers, shall be integrated onto membrane structures suitable for deployable or inflatable antennas. Membrane test articles with integral array elements will be provided and complete front-end assemblies for each radiometer channel will be fabricated. Radiometric measurements will be made to evaluate each channel and the array test article.

(8) Passive Microwave Sensing of Cancerous Tumors in Breast Tissue

Develop and evaluate applicators and passive measurement techniques for detecting cancerous tumors at L-band and C-band using phantoms to simulate breast tissue. Develop an anechoic enclosure that will provide RF isolation for the phantom under test and a thermal technique for simulating various sizes of tumors as hot spots embedded in breast tissue. Evaluate various designs of open ended coax applicators and methods of imaging that enable detection of the simulated tumors. Existing phantoms previously bought for this purpose will be used and existing radiometers will be used. Iterations on applicator design will be investigated using existing low loss air-line components and .141 semi-rigid coax.**End [R4] block addition**

Deliverables
The Contractor shall provide the following deliverables under this task:

1) a. Interim report on the development of the modified POC hardware. (3/30/01)
Final report on validation tests of the mutual coupling technique. (9/30/01)
b. Interim report on the development of the DCNS. (6/30/01)
Final report on the characterization of the DCNS. (9/30/01)

2) Interim report on the development of the 183 GHz stability and calibration test-bed. (6/30/01)
Final report on the evaluation of the 183 GHz noise source. (9/30/01)

[R1] 3) Monthly written progress reports shall be submitted. A final report on the design and test results for the evaluation breadboard shall be submitted by December 31, 2001.

Begin [R2] block requirements addition
4) Oral status reports shall be delivered at periodic project meetings, and a final written report on design and test results shall be submitted by 12/31/02.

5) Interim status reports shall be provided, and a final written report shall be submitted by December 31, 2002.
End [R2] block requirements addition

6) Interim status reports shall be provided, [C]~~and a final written report shall be submitted by December 31, 2003~~.

Task Order Number: 11RDH Revision: Close Date of Revision: 7/31/03
Title: Radiometer Test Development

[C]~~7)~~ [R4] ~~A final written report, summarizing measurement results and conclusions from the technology investigation, shall be delivered at the end of the performance period~~

~~8)~~ [R4]Interim status reports shall be provided upon request [C]~~and a final informal, written report shall be provided on completion.~~

Metrics for Deliverables:

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 10th day of month.

Meets:
Status report completed on schedule describing major milestones completed and addressing remaining issues related to the task.
Exceeds:
Status report completed on schedule, describing major milestones completed and addressing remaining issues related to the task, well as, presenting approach(s) to mitigate the identified challenges for the respective tasks. For subtask 3, identifying design alternatives and improvements based on fabrication and test results will be considered exceeding the requirements. [R2] For subtasks 4and 5, identifying new approaches and issues related to the task will be considered exceeding the requirements.

3. Government Furnished Items:
Use of room and all test equipment located in 237 of building 1299. All parts identified in [R2] all subtasks will be provided by LaRC. All mechanical fabrication and assembly will be provided by LaRC. [R4]Array antenna test article identified in sub-task 7 will be provided.

4. Other information needed for performance of task:
None

5. Security clearance required for performance of work:
None

6. Period of Performance:
Planned start date: 1/1/01 Completion date: [R1]~~9/30/01~~
~~[R2] 12/31/01~~
[R3]~~12/31/02~~
[C]~~12/31/03~~ ***7/31/03***

7.	**NASA Technical Monitor**: James W. Johnson M/S: 473 Phone: 757-864-1963 NASA Competency/Other Technical Coordinator: TBD M/S: TBD Phone: 757-864-TBD

Task Order Number: 11RFJ Revision: 4 Date of Revision: 5/29/03

Title: **Gas and Aerosol Monitoring Sensorcraft (GAMS) IIP Technologies, Technical Support**

1.	**Purpose, Objective or Background of Work to be Performed:** The purpose of the work to be performed under this task order is to assemble, align, characterize, and conduct post field deployment evaluation, realignment, and characterization of the GAMS Instrument Incubator Program (IIP) developmental evaluation unit spectrometer, sun-sensor and sun-imager sub-systems. The Government has the design and fabrication responsibility of the unit . The objective of the work to be performed under this task order is to test and characterize, verify/realign the instrument in the lab, and conduct post field test characterization of the GAMS IIP spectral and spatial performance in response to radiometric input signals to the instrument from external light sources; and to develop/enhance procedures. This characterization shall be accomplished by using all necessary assembly, alignment, and measurement procedures that are needed to ascertain the performance characteristics of the developmental evaluation unit to provide critical input for the planned proposal and space flight opportunity effort underway. [R2]This evaluation will also provide input necessary to effectively incorporate/transfer the GAMS IIP technologies into select Center/Agency programs and projects [R3]to include the GAMS-LAABS (Langley Airborne A-Band Spectrometer) field campaign. Revision 1: Adds post field deployment activity, changes the Technical Monitor, and extends the completion date. Some minor wording changes for clarification only. (For details see in statement of work file *11RFJ01.doc* located on the electronic task order system [ETOS].) Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by adding transfer of the GAMS technologies to other programs/projects (See [R2] above and below). Revision 3: Adds implementation and re-alignment/calibration of GAMS technologies as part of DC-8 GAMS-LAABS Mission, notes travel requirement, and extends the period of performance 6 months (see [R3] above and below). Revision 4: Adds special purchase requirement in Section 4 and extends the period of performance 6 months to December 31, 2003 (see [R4] below).
2.	**Description of the Work to be Performed:** **Assembly, alignment, verification/re-alignment, re-assembly, and characterization of the [R2]modified (as applicable) GAMS IIP instrument [R2]technologies** The Contractor shall assemble, align and measure the performance of modified (as applicable) GAMS IIP optical sub-systems before and after [R2]post deployment modification. The performance measurements shall include tests to quantify spectral and spatial resolution, wavelength calibration, instrument field-of-view, radiometric throughput, optical-component and optical-mounting characterization and bore-sight alignment of the spectrometer, sun-sensor and sun-imager. The measurement data shall include results from both laboratory light sources, solar source radiance, and civil servant conducted flight field tests.

	Begin R3 block addition The Contractor shall support the installation, alignment, and validation of the GAMS-LAABS instrument on the aircraft to include verification of performance/function. The Contractor shall support the field campaign conducting re-align/calibration as required during/between data takes **End R3 block addition** **Schedule:** This task shall be completed by R2,R3 ~~12/31/02~~ 6/30/03and is contingent upon the timely delivery of all necessary components needed for completion of the task. Delivery of the required components is the responsibility of the civil servant contingent. **Deliverables:** A report containing the measurement data that demonstrates that the spectral and spatial characteristics of these sub-systems have been determined. The Contractor is not responsible for the assembled unit meeting the GAMS R2or applicable program/project requirements but is responsible for providing the data that demonstrate the actual performance. **Performance Criteria**: The Contractor meets the minimum success criteria with assembly/alignment/characterization procedures detailed in bullet format and instrument/component performance data that is acquired by using a single measurement technique. The Contractor exceeds the minimum criteria for assembly, alignment, and characterization procedures with comments and explanations of the rationale behind each step that would enable someone else to perform these procedures. Performance data on the sub-systems that is acquired using more than one technique and which give similar results will exceed the minimum success criteria.
3.	**Government Furnished Items:** Use of room and all test equipment located in room 242 of Building 1202, including Tektronix oscilloscope, optical measurement instrumentation and data acquisition system
4.	**Other information needed for performance of task:** **Begin R3 block addition** Travel is anticipated to include 1) two two-week trips to Dryden Flight Research Center in November-December 2002 to support the installation, alignment, and validation of the GAMS-LAABS instrument on the NASA DC-8 aircraft to include verification of performance/function and 2) a five-week trip to Sweden in January-February 2003 to support the field campaign [SAGE III Ozone Loss and Validation Experiment II (SOLVE-II) by conducting instrument re-alignment/calibration as required. R4***In order to perform subtasks in a timely manner, material purchase may be required***. **End R3 block addition**
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:**

Task Order Number: 11RFJ Revision: 4 Date of Revision: 5/29/03

Title: **Gas and Aerosol Monitoring Sensorcraft (GAMS) IIP Technologies, Technical Support**

	Planned start date: January 2, 2001 **Completion date:** [R2,R3] ~~December 31, 2002~~ [R4]~~June 30, 2003~~ ***December 31, 2003***
7.	**NASA Technical Monitor:** [R1]Bill Luck M/S: 468 Phone: 757-864-1857 NASA Competency/Other Technical Coordinator: Clayton Turner M/S: 468 Phone: 757-864-7103

Task Order Number: 12RAB Revision: 10 Date of Revision: 3/4/2005
Title: Advanced Space Systems Concepts Technical and Analytical Support for the Systems Analysis and R10***Concepts Directorate (SACD)***

1. Purpose, Objective or Background of Work to be Performed:
R10***Systems Analysis and Concepts Directorate (SACD)*** is the NASA Langley organization that develops and delivers advanced concepts, systems analyses, and multidisciplinary methods that enable programs to meet objectives and that enable the Agency to develop future aerospace technologies. R10***SACD will support implementation of the NASA Vision for Space Exploration, including (but not limited to): development of alternative Lunar and Mars mission architectures, conceptual design and analysis of associated spacecraft and subsystems, campaign analysis of the alternative architectures, and technology assessments and trade studies.***

R10***SACD*** also supports development and analysis of advanced systems concepts within the LaRC Creativity and Innovation (C&I) initiative, an activity that offers LaRC employees an opportunity to explore new ideas and technologies. The FY04 C&I activity supported by R10***SACD (formerly as ASCAC) was*** the "Mars Tumbleweed," a study examining the feasibility of using Martian surface winds for rover mobility.

Revision 1: Adds structural models and telescope analysis (Requirements D and E) and some objective clarification.
Change 1: Adds off-site performance in section 4 as required for schedule/period of performance.
Revision 2: Extends the period of performance 11 months in continuation of NASA's support requirements, redefines the requirements for the new period of performance, and changes the Technical Monitor.
Revision 3: Extends the period of performance and schedule two months to enable planning of FY03 work.
Revision 4: Extends the period of performance one year in continuation of NASA's support with redefined and updated requirements, new title, and new Technical Monitor for the extended period of performance.
Revision 5: 1) Changes the scope to include communications analysis and architecture support and remove orbital mechanics support; 2) Provides more defined deliverables and due dates and other clarifications now that the RASC mission areas and support needs have been confirmed.
Revision 6: Adds requirements as Subtask b) deliverables and updates and/or clarifies other info.
Revision 7: Extends the period of performance two months to March 31, 2004, in continuation of NASA's support, deletes/updates obsolete requirements, and adds requirements for the new period of performance.
Revision 8: Extends the period of performance one year to March 31, 2005, in continuation of NASA's support, redefines the requirements for the new period of performance, updates other info, and changes the Technical Monitor (see R8 above and below).
R8***Note:*** For historical details deleted for clarity and/or convenience see previous versions of this

Task Order Number: 12RAB Revision: 10 Date of Revision: 3/4/2005
Title: Advanced Space Systems Concepts Technical and Analytical Support for the Systems Analysis and R10***Concepts Directorate (SACD)***

Statement of Work located on the electronic task order system (ETOS) as "doc" files *12RAB_1, 12RAB01, 12RAB011u, 12RAB02, 12RAB03, 12RAB04, 12RAB05, 12RAB06, and 12RAB07.*
Revision 9: Adds requirements and updates the deliverables schedule in Subtasks a) and c) (see R9 below).

Change 1: Contractor initiated to adjust staffing and extend period of performance for NASA's priorities (see R9.1 below).

Revision 10: Extends the period of performance eight months in continuation of NASA's support and updates subtask schedules, requirements, task order title, and other info (see R10 above and below).

2. Description of the Work to be Performed:
(a) **Structural Modeling and Analysis Support for R10*Exploration* missions:**
The Contractor shall identify materials and deliver structural models of concepts and vehicles for selected R10***Exploration*** mission studies. Such models, developed in concert with CAD models, will depict the structural layout of the major components of each concept. In addition, a report describing the analyses and salient features of each concept shall be delivered at the end of this task. These models and analyses will be utilized to define and indicate structural designs, structural layouts, and high-level structural analyses for the R10***Exploration*** mission studies:
Begin R8block redefinition
~~1) Exploration Building Blocks for Human Lunar and Earth Neighborhood Missions~~

Structural Modeling and Analysis Deliverables and Due Dates [(**I**)nitial results; (**M**)id-term results; (**F**)inal results]:

(1) Based on a given spacecraft architecture/configuration, develop a preliminary design of the spacecraft structural system for the Exploration Building Blocks that will support a Human lunar return. These building blocks will include a R10***crew vehicle***, an in-space injection stage, a lunar lander and a lunar habitat. Also, provide structural engineering expertise in support of Mars robotic precursor concepts for human exploration. The output should include a graphical overview of the major structural elements and recommendations of potential materials to be used for these elements, with associated material properties, including, but not limited to: mass density, areal density (where appropriate), mass per length (where appropriate), tensile ultimate strength, tensile yield strength, Young's modulus, and Poisson's ratio. **Due date: (I) June 15, 2004 (M) October 29, 2004 (F) R9~~August 15, 2004~~ January 28, 2005**

(2) Provide quick response trade studies and engineering assessments for advanced aerospace system concepts using rapid turn-around, possibly low fidelity analysis

techniques, and expert opinion with historical basis. Analyses in the areas of vehicle structural arrangement, structural design, and mass properties may be required.
Due date: (I) Informal written report due 3 weeks after assigned start date **R10*(M) June 30, 2005 (F) December 31, 2005***

(3) Provide final report documentation of all structural modeling and analyses performed for R10***Exploration*** mission studies in appropriate electronic document format.
Due date: R10*(M) June 30, 2005 (F) December 31, 2005*

(4) Provide final presentation slides of all structural modeling and analyses performed for R10***Exploration*** mission studies in appropriate electronic document format.
Due date: R10*(M) June 30, 2005 (F) December 31, 2005*

(b) **Communications Architecture and Analysis and SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) support for R10*Exploration* missions:**

The Contractor shall provide communications architecture and analysis support for Exploration mission studies. The Contractor shall enhance and utilize the SPASIM software tool in conducting these assessments and analyses, to include dynamic simulations and report generation. These enhancements and analyses shall be utilized to define and indicate communications capabilities available for the R10***Exploration*** mission studies:

(1) Situational analysis of Moon/Mars neighborhood communications architectures and concepts to support selected R10***Exploration*** missions
(2) Lagrange point orbiting mission capability added to the tool, to support R10***Exploration*** mission architectures as relay points for communications

The result of the effort shall support infrastructure definition in communications architectures between the Earth, spacecraft, Lunar/Mars orbiting relays and Lunar or Mars landers. The effort shall provide multiple waypoint tracking from a single spacecraft to multiple points that are varying their position with respect to the spacecraft, orbiting celestial bodies, or located at Lagrange points. The following shall be provided:

(1) Provide antenna pattern modeling into SPASIM.
(2) Provide outputs that indicate angular rate changes (degrees or radians per second) and distance rate changes (km per second) between spacecraft antenna vectors & each waypoint over the course of a defined simulation.
(3) Full moon selection as a celestial body to provide mission simulation capability to support R10***Exploration***

(4) Lagrange point orbiting capability for a spacecraft and/or a waypoint. *[Can either be a link to another off-line tool, or incorporated into SPASIM]*
(5) Provide link margins between the waypoints and Lagrange point orbiting spacecraft, as well as between waypoints and orbiters or landers, where necessary.
(6) New receive antenna system noise calculations to support S/C and waypoints in link margin analyses

Communications Architecture and Analysis and SPASIM Development Deliverables and Dues Dates [(**I**)nitial results; (**M**)id-term results; (**F**)inal results]:

(1) Define format(s) for output report modifications and files for all analysis simulations, to include results that list: (a) Lagrange point spacecraft to Earth/waypoint link margins; (b) Moon vehicle(s) to waypoint(s) & Earth link margins; (c) angular rate changes and distance rate changes from S/C to waypoints;
Due date: September 1, 2004

(2) Utilization of SPASIM version 1_06dev to provide multiple waypoint tracking and RF link analysis from a single spacecraft orbiting a Lagrange point to multiple waypoints that are varying their position with respect to the spacecraft, or in orbit around celestial bodies including the moon, or co-located at Lagrange points:

- Provide SPASIM outputs that indicate angular and distance rate changes from spacecraft to each waypoint over the course of a defined simulation. Angular rate changes are determined between the R10***spacecraft*** antenna vector & the R10***spacecraft***-to-waypoint pointing vector.
  (a) Include Doppler rate calculations between spacecraft and Waypoints, spacecraft and Ground Stations; and validate the results.
  Due date: R10***[(I) September 1, 2004 (F) April 30, 2005]***

- Provide SPASIM outputs that indicate RF link margins between Lagrange point orbiting spacecraft and Earth; and between Lagrange point orbiting spacecraft to each waypoint over the course of a defined simulation.
  Due date: [(M) September 1, 2004 (F) March 31, 2005]

- Provide SPASIM selection of antenna types, defined gains & beamwidths, and ability to accept an antenna radiation pattern. Utilize these selections for computing link margins from the spacecraft to waypoints, landers or Earth stations.
  Due date: [(M) September 1, 2004 (F) March 31, 2005]

(3) Incorporate new antenna system noise temperature calculations for both S/C receive system and waypoint receive systems for more accurate link margin assessments.
Due date: [(M) September 1, 2004 (F) March 31, 2005]

(4) Generate output report modifications and files (readable in Excel) for all analysis simulations, to include results that list: (a) Lagrange point spacecraft to Earth/waypoint link margins; (b) Earth/waypoint to Moon link margins; (c) maximum and minimum angular rate changes referenced to S/C antenna vector and S/C-to-Waypoint vector and distance rate changes between R10***spacecraft*** and waypoints; and R10***(d) Doppler calculations between Spacecraft-to-Waypoints and Spacecraft-to-Earth stations.***
   (a) Additionally, provide a series of output reports that summarize the Lunar Exploration Architecture demonstration being provided to NASA HQ. These reports should be a collection of the architecture elements simulated and analyzed for the demonstration.

Due date: R10*[(I) September 1, 2004 (M) June 30, 2005 (F) December 31, 2005]*

(5) Provide final report documentation of all communications analyses performed and SPASIM development in appropriate electronic document format.
   (a) Additionally, provide a series of reports that summarize the Lunar Exploration Architecture demonstration being provided to NASA HQ. These reports should be a collection of the architecture elements simulated and analyzed for the demonstration.
   (b) Indicate the connectivity and performance parameter data transferred between SPASIM and SEE.

Due date: R10*(I) June 30, 2005 (F) December 31, 2005*

(6) Provide final presentation slides of all communications analyses performed and SPASIM development in appropriate electronic document format.
Due date: R10*(I) June 30, 2005 (F) December 31, 2005*

(7) Provide documentation of SPASIM modifications and applicable user's guide for utilizing the enhancements in appropriate electronic document format for inclusion into SPASIM documentation.
Due date: R10*[(I) September 1, 2004 (M) June 30, 2005 (F) December 31, 2005]*

(8) Update the on-line SPASIM manual to reflect all changes as of R10***December 2005***
Due date: R10*(I) June 30, 2005 (F) December 31, 2005*

(c) **Mars Tumbleweed Rover Structural Analysis Support:**
The Contractor shall develop a structural mass estimation capability for the Tumbleweed Design and Sizing Tool and conduct structural analyses of Tumbleweed wind tunnel models for the C&I "Mars Tumbleweed" study.

Mars Tumbleweed Rover Structural and Materials Deliverables and Due Dates [(**I**)nitial results; (**M**)id-term results; (**F**)inal results]:

(1) Structural Analysis - Incorporate previously developed Materials Database and results from JPL structural impact analysis into the spreadsheet-based Tumbleweed Design and Sizing tool. Develop the capability for the tool to provide rough order of magnitude estimates of the structural mass for various Tumbleweed concepts.
Due date: (I) R9~~July 30, 2004~~ October 8, 2004 (F) R9~~September 17, 2004~~ November 19, 2004

(2) Wind Tunnel Models - Perform structural analysis of Tumbleweed wind tunnel models to insure proper compatibility with SBRT and BART balances and sting attachments.
Due date: (I) April 30, 2004 (M) July 30, 2004 (F) R9~~May 28, 2004~~ September 17, 2004

(3) Provide presentation slides for all rover structural analysis support in appropriate electronic document for C&I status presentation.
Due date: July 9, 2004

(4) Provide final report documentation for all rover structural analysis support in appropriate electronic document format for C&I final report.
Due date: R9~~September 28, 2004~~ December 3, 2004

Metrics:
1. Clarity, completeness, usefulness, and technical soundness of the analyses
2. Coding development efficiency and innovative application to the concept assessment, along with detailed update to the online Users guide in the case of SPASIM.

Standards:

Task Order Number: 12RAB Revision: 10 Date of Revision: 3/4/2005
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The Contractor will be considered to *meet* the required performance standards if the analyses provide credible results and reports, and the software coding is executable on the R10***Architecture, Missions, and Science Branch (AMSB)*** computing platforms. The Contractor will be considered to *exceed* the required performance standards if the results are published in technical publications and the software coding is user friendly to R10***AMSB*** personnel (i.e. SPASIM: Users guide is explicit and detailed for use/instruction).

3. Government Furnished Items:

Access to Systems Analysis and R10***Concepts Directorate (SACD)*** Collaborative Engineering Center (CEC) software and hardware environments. Access to specialized software capabilities of the R10***SACD AMSB***, including the SEE (Synergistic Engineering Environment), SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions), MATLAB/SIMULINK, and Satellite Tool Kit (STK). R10***SACD*** computer hardware environments include SGI workstations and Windows based PCs.

4. 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.

5. Security clearance required for performance of work:

None.

6. Period of Performance:

Planned start date:	R2 3/1/~~01~~	Completion date:	R2 12/31/~~01~~
	R4 ~~1/1/02~~		R3 ~~11/30/02~~
	R8 ~~2/1/03~~		R4 ~~1/31/03~~
	4/1/04		R7 ~~1/31/04~~
			R8 ~~3/31/04~~
			R9.1 ~~3/31/05~~
			R10 ~~4/30/05~~
			12/31/05

Task Order Number: 12RAB Revision: 10 Date of Revision: 3/4/2005
Title: Advanced Space Systems Concepts Technical and Analytical Support for the Systems Analysis and R10***Concepts Directorate (SACD)***

7. NASA Technical Monitor: Jeffrey Antol
M/S: R10***462*** Phone: 757-864-5804
NASA Competency/Other Technical Coordinator (above branch level): Mike Fitzgerald
M/S: R10***449*** Phone: 757-864-3681

Task Order Number: 12RBA Revision: 06 Date of Revision: 09/30/03

Title: Evaluation of Computational Methods for Application to Rotorcraft in the Subsonic Aerodynamics Branch

1. **Purpose, Objective or Background of Work to be Performed:** (DA18, NAS1-96014)

The application, validation, and calibration of Computational Fluid Dynamics (CFD) methods for the rotorcraft interactional aerodynamics problem are essential for predicting areas of separated flow along the helicopter fuselage. Used in concert with experimental evaluation such as wind tunnel and flight test data, the selective application of CFD technology can significantly impact the cost of systems under development.

Note: [R2] Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

For Change 1 and Revision 1, see ETOS (electronic task order system) SOW (statement of work) file *12RAB01.doc*.

Revision 2: Extends the period of performance through FY02 in continuation of NASA's support requirements with an anticipated 50% reduction in prorated funding emphasis and redefines the requirements for the new period of performance (see [R2] above and below)

Revision 3: Adds the requirement to use the new version of Gridgen (Version 14.01) and production of a point-matched volume grid. Updates travel requirement. (see [R3] below).

Revision 4: Extends the period of performance through FY03 and updates the requirements for the new period of performance. The requirements are appropriate for approximately 1/2 workyear's funding emphasis (see [R4] below).

Revision 5: Adds requirements through redefinition of minimum acceptable performance (see [R5] below).

Revision 6: Extends the period of performance two months to November 30, 2003, updates the requirements for the new period of performance, and changes the technical monitor (see [R6] below)

2. **Description of the Work to be Performed:**

3.1.2 [R2] (Terminated)

3.1.6 (NOR) The Contractor shall identify and use a CFD solution technique to model the Comanche 15% scale model (tested in the 14- by 22-Foot Subsonic Tunnel in March

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Title: Evaluation of Computational Methods for Application to Rotorcraft in the Subsonic Aerodynamics Branch

2001 R4R5~~and Nov. 2002~~ Dec. 2002/Jan. 2003). The CFD solutions will be for at least three flight conditions that correspond to wind tunnel test conditions. Such cases may involve CFD evaluation of different tail configurations, different pylon shapes, store drag, weapons bay door drag, the flow field associated with open weapons bay doors (including the cavity), and the effect of the main rotor. The Contractor shall construct the grid for modeling each configuration. R3The Comanche configuration volume grid shall be generated using the latest version of Gridgen (Version 14.01). The grid shall be a point-matched grid to the extent possible (rather than a general overset grid).

Deliverable: Calculations to provide pressure, lift, drag, and pitching moment data for the Comanche model. If a rotor is present in the calculation, trim will be provided. An electronic format suitable for transfer by electronic medium will be acceptable for the deliverable. R6***All applicable grid, input and solution data files shall be included. All computer data files shall be provided in ASCII standard format.***

Minimum acceptable performance: R4Code solutions for the baseline Comanche R6***(no tail)*** over a wide range of yaw R6***and alpha*** angles (39 points). Code solutions for one V-tail R6***and one T-tail*** configuration for a velocity sweep (R6***3 points each***). Calculations are to be made with the OVERFLOW/ Generalized Dynamic Wake Theory system. R5 R6 ~~The creation of one patched grid from an existing overset grid (baseline Comanche). TLNS3D and CFL3D code solutions for one yaw sweep (13 points).~~

Exceeds minimum acceptable performance: R6***Additional code solutions for one V-tail and one T-tail configuration for a velocity sweep (3 points each). Calculations are to be made with the OVERFLOW/ Generalized Dynamic Wake Theory system. TLNS3D code solutions for the baseline configuration for one yaw sweep (5 points).***

3. **Government Furnished Items:** Office space, phone, Silicon Graphics 3D Graphics Workstation, account on supercomputers with hours as necessary to complete calculations, terminal to access supercomputer and codes, yaw post hardware and Compumotor hardware, software platform for PLC communications, access to SBRT wind tunnel, wind tunnel instrumentation and data acquisition, software for post-processing output. Computer codes: INS3D-R, OVERFLOW, CFL3D, CDISC, Tecplot, GRIDGEN, VSAERO, MSES, HYPGEN, PEGSUS, FAST, FRAMEMAKER, NSU2D, ZONI3G, USM3D, and others as identified to accomplish configuration analysis. Comanche flight conditions and geometry, Comanche 15 percent model wind tunnel test conditions, and Comanche geometry variations will be supplied by the Government.

4. **Other information needed for performance of task:** R4 No travel is planned at this time.

5. **Security clearance required for performance of work:** A security clearance is required for access to Comanche and proprietary data. After hours access to Building 1212 and 1212C is

Task Order Number: 12RBA Revision: 06 Date of Revision: 09/30/03

Title: Evaluation of Computational Methods for Application to Rotorcraft in the Subsonic Aerodynamics Branch

	required for the timely performance of these tasks.
6.	**Period of Performance:** R2 Planned start date: R4 ~~3 Dec. 2001~~ Completion date: ~~30 Sept. 2002~~ R6 ~~1 Nov. 2002~~ ~~30 Sept. 2003~~ ***1 Oct 2003*** ***30 Nov 2003***
7.	**NASA Technical Monitor:** R6 ***Henry E. Jones*** M/S: 286 Phone: 757-864-***2158*** NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	**Page 1 of 6**

Task Order Number: 12RCE Revision: _ Date of Revision:
Title: **Advanced Materials Testing and Analysis**

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

The purpose of this task is to conduct mechanical testing and microstructural analyses on materials systems, with the primary focus being advanced metallic materials. The objective is to establish processing-microstructure-property relationships for the material systems for aerospace applications. ***In addition, this task includes activities for chemically cleaning and surface modification of metallic materials for subsequent processing and/or analysis.***

Note: ***Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)***

The requirements described below represent a revision of previous task order 08RCE. This revision extends the period of performance one year in continuation of NASA's support requirements, changes the title and number, updates the NOR note, redefines the requirements for the new period of performance, and defines some previous Subtask 2.3 work as new Subtask 2.4 (see ***bold italic font*** above and below).

2. Description of the Work to be Performed:

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1 Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written work request basis (NOR). The Government will provide the materials which will primarily be metallic-based, although other materials may be included on a limited basis. Preparation techniques will include sectioning, mounting, mechanical and chemical or electrochemical polishing of specimens suitable for optical metallography, x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis. The Contractor shall ensure equipment is operational prior to and after analyses. Specific analyses and quantities are detailed below:

- Utilize a variety of optical microscopes in conjunction with SEM with energy- and wavelength-dispersive spectrometry (EDS and WDS) systems and a microtexture analysis system to analyze the chemistry, morphology, and orientation of individual grains and/or particles and of the bulk microstructure (up to ***100***).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to ***40***).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques (up to ***20***).
- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to ***40***).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to ***25***).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to ***30***).
- Conduct hardness and microhardness tests on metallic materials (up to 50).

Deliverables (for 2.1):
- For each analysis request, brief informal statement (written or oral) of types of analyses to be conducted and estimated time for completion to the Requester within 5 working days after receipt of the work request.
- For each analysis request, informal written and oral report of results to the Requester within 5 working days after completion of the analysis. The report shall include description of analyses and interpretation of results. The report shall include any photomicrographs, compositional analyses, x-ray and electron diffraction data relevant to the microstructural characterization performed.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of analyses conducted, standards and procedures used, and any specialized analysis techniques and procedures developed. (12/31/***2002***)

Performance Standards (for 2.1):

MEETS:
- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports

- Work requests completed by requested due date
- Cost

EXCEEDS:
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost

Subtask 2.2: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written work request basis (NOR) to determine the mechanical behavior of materials from cryogenic to elevated temperatures, with the majority of tests being conducted at room temperature. The Government will supply the specimens machined from aluminum, titanium, and ***nickel*** based alloys and composites, although other materials may be included on a limited basis. Product forms may include, but not be limited to, foils, sheets, plates, rods, forgings, and extrusions. The Contractor shall ensure equipment is operational prior to and after tests. Specific tests and quantities are detailed below:
- Tensile and compression tests to measure strength, modulus, and elongation (up to ***400***).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to ***50***).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to ***30***).
- S-N fatigue tests on notched and un-notched test specimens (up to ***50***).
- General and stress corrosion tests in salt solutions (up to ***40***).

Deliverables (for 2.2):
- For each test request, tested specimens (with fracture surfaces intact and preserved) and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of test procedures, calibrations, specimen dimensions, test anomalies, and electronic data files for each test.
- Informal written monthly reports that list work requests completed during the reporting period, costs, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (12/31/***2002***)

Performance Standards (for 2.2):

MEETS:
- Adherence to ASTM or other relevant standards

- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completed under cost

Subtask 2.3: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written work request basis (NOR). The materials will comprise primarily aluminum, titanium, and nickel based alloys, although other materials may be included on a limited basis. Product forms may include, but not be restricted to, foils, sheets, plates, rods, forgings and extrusions. Work assignments shall include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to ***800***) limited to 36 inches by 12 inches in dimension, but usually on the order of 1 inch by 4 inches in size. The Contractor shall be responsible for maintaining chemical cleaning baths and monitoring, neutralizing, and coordinating disposal of hazardous materials.

Deliverables (for 2.3):
- For each work request, an informal written and/or oral report of the results to the Requester within 3 working days after completion of the work. The report shall include description of the surface preparation procedures, results, and anomalies.
- Informal written monthly reports that list work requests completed during the reporting period, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of surface preparation activities conducted, standards and procedures used, and any specialized techniques and procedures developed. (12/31/***2002***)

Performance Standards (for 2.3):

MEETS
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)

- Cost

EXCEEDS
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost.

Subtask 2.4: Laboratory Chemical Inventory

The Contractor shall maintain adequate chemical supplies for performing the Subtask 2.3 requirements within the Surface Preparation Laboratory and the Light Alloy Laboratory. This subtask shall include maintaining a catalog of the appropriate materials safety data sheets (MSDS's) and the Chemical Materials Tracking System (CMTS).

Deliverables (for 2.4):
- ***MSDS catalog (throughout period of performance)***
- ***CMTS website input (throughout period of performance)***
- ***Written informal midterm report summarizing the chemical supply inventory and the CMTS and MSDS activity. (6/30/2002)***
- ***Written informal midterm report summarizing the chemical supply inventory and the CMTS and MSDS activity. (12/31/2002)***

Performance Standards (for 2.4):
MEETS
- ***CMTS data meets NASA standards***
- ***MSDS catalog remains up-to-date***

3. Government Furnished Items:

Specialized surface preparation equipment located in Metals Cleaning Laboratory (Building 1229A) including deionized water supply, chemical cleaning and rinse tanks, anodizing equipment, electroplating equipment and supplies, acids, bases, precleaners, neutralizing chemicals, supplies, and related safety equipment.

Specialized mechanical test equipment located in the Light Alloy Laboratory (Building 1205) and the High-Temperature Test Laboratory (Building 1205), including cryogenic and elevated temperature chambers, test machines, strain and displacement measurement instrumentation, and System 4000 and Fracture Testing Associates data acquisition systems.

Specialized metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEM's, TEM's, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation

	apparatus and supplies.
4.	**<u>Other information needed for performance of task</u>:** 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, <u>comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation</u>, describing how the IT items demonstrate Year 2000 compliance.
5.	**<u>Security clearance required for performance of work</u>:** None.
6.	<u>Period of Performance</u>: Planned start date: 1/2/***2002*** Completion date: 12/31/***2002***
7.	**NASA Technical Monitor:** Keith Bird M/S: 188A Phone: 757-864-3512 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 12RDA Revision: 3 Date of Revision: 12/5/01

Title: Handling Qualities and Maneuver Sensitivity Studies for Crew Transfer Vehicle Concepts

Revision 1: This revision is primarily a combination of the original ART task (RD06) and the previous (first) version of the SAMS task (12RDA); therefore, it includes requirements that were contained in both of these previous task order descriptions. This combination was required primarily because delays that were beyond the control of the Contractor have occurred for all of the deliverables. As a result of these delays, some of the work described for subtasks 1 and 2 has been performed but no deliverables with due dates have yet been fully completed. This revision describes specific short-term deliverables that have been defined based on the high-level planning activities to date. Additional information concerning the long-term outlook for this task is described at the end of section 2.

Revision 2: Extends the task order completion date and subtasks 4 and 5 schedule in continuation of NASA's support requirements and updates standard procedures documentation. The work initially planned for subtasks 1 through 3 has been completed; however, these subtasks will remain open until the completion of subtask 4 in order to accommodate the ongoing need for simulation modifications, based on the receipt of additional relevant information and the results and lessons learned during the execution of subtask 4. (See [R2] below.)

Revision 3: This revision is primarily an extension of the completion date for the period of performance to accommodate delays that were beyond the control of the Contractor. (See [R3] below.)

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

The Vehicle Dynamics Branch (VDB) plans to conduct piloted and batch simulation studies to define the sensitivity of key handling qualities and maneuvering characteristics of crew transfer vehicles to fundamental vehicle design characteristics. It is anticipated that the results will be used in follow-on studies and/or other related studies such as those that involve vehicle design trades and optimization, including crew systems considerations.

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

Subtask 1: Plan initial study.

Subtask 2: Define and request implementation of simulation modifications to the existing HL-20 simulation model that are required for the initial study.

Subtask 3: Verify the modifications of subtask 2.

Subtask 4: Conduct initial study.

Subtask 5: Define and request implementation of simulation modifications that are required for the second study.

Deliverables for all subtasks:

a) Monthly status reports delivered electronically to the Task Monitor.
b) Attendance at and support of team and other project-related meetings as needed and called by the Task Monitor, but no more frequently than an average of one time per week.

Metric for all subtasks: Progress achieved in meeting the Performance Standards on time within the Contractor's planned cost and reported in the monthly status reports will be used as surveillance.

Performance standards for subtasks 1, 2, and 5:

a) Quality of technical execution and documentation, as determined by evidence of the appropriateness, completeness, relevance, realism and utility of the study plans and simulation modifications, and the readability/effectiveness of the supporting documentation. The quality of technical work is the predominant standard and will be used to determine the distinction between "excellent", "very good", and "good" performance.
b) Timeliness in meeting the schedule for the deliverable. On time delivery is considered to be consistent with "excellent" to "very good" performance. Delivery that is no more than two weeks late is considered to be consistent with "very good" to "good" performance.

Subtask 1: Plan initial study.

Requirements:

a) The Contractor shall review documentation pertaining to previous related studies.
b) The Contractor shall develop a plan for the study. The objective of the study is to obtain preliminary and representative results from an assessment of the use of high-lift devices to enable the use of shorter runways. The plan should be based on information obtained from activities to date that are related to this task order, including planning discussions. This study will be conducted using modified versions of the existing real-time and batch HL-20 simulation model and the Visual Motion Simulator.

Deliverables: Documentation of the study plans, including objectives, experiment methodology and design, and analysis to be performed, and all technical information required for the Simulation Study Request form (LF 395).

Schedule: Due March 1, 2001

Subtask 2: Define and request implementation of simulation modifications to the existing HL-20 simulation model that are required for the initial study.

Requirements:

a) Based on the plans developed in subtask 1, the Contractor shall define the simulation modifications required for the study. These modifications shall include the capability to perform parametric variations of selected relevant vehicle performance parameters. The Contractor shall define the number and range of values to be evaluated for each parameter.

b) The Contractor shall request that the HL-20 real-time and batch simulations be modified accordingly.

Deliverables: Documentation describing the simulation modifications, including their purpose, the methodologies required for their implementation in the simulation model, and the documentation generated to request these modifications.

Schedule: Due March 9, 2001

Subtask 3: Verify the modifications of subtask 2.

Requirement: The Contractor shall verify the completeness and accuracy of the modifications to the simulation model that were requested in subtask 2. The Contractor may be required to assist in the test procedures for the modifications during the time that they are being implemented.

Deliverable: Summary documentation describing evidence of the completeness and accuracy of the simulation modifications.

Schedule: Due two weeks following notification that implementation and testing of the modifications have been completed.

Performance Standards:

a) Quality of technical execution and documentation, as determined by evidence of the appropriateness, completeness and accuracy of the simulation modifications and the readability/effectiveness of the supporting documentation. The quality of technical work is the predominant standard and will be used to determine the distinction between “excellent”, “very good”, and “good” performance.

b) Timeliness in meeting the schedule for the deliverable. On time delivery is considered to be consistent with "excellent" to "very good" performance. Delivery that is no more than two weeks late is considered to be consistent with "very good" to "good" performance.

Subtask 4: Conduct initial study.

Requirement: The Contractor, using the Visual Motion Simulator and the batch simulation, as required, shall conduct the study.

Deliverable: Summary documentation of the study plan, experiment design and methodology used, the analysis performed, and the results obtained, for the study.

Schedule: Due R3R2 ~~three months following the completion of subtask 3December 31, 2001~~ ***March 31, 2002***

Performance Standards:

a) Quality of technical execution and documentation, as determined by evidence of the completeness and relevance of the evaluations, the utility of the results, and the readability/effectiveness of the supporting documentation. The quality of technical work is the predominant standard and will be used to determine the distinction between "excellent", "very good", and "good" performance.

b) Timeliness in meeting the schedule for the deliverable. On time delivery is considered to be consistent with "excellent" to "very good" performance. Delivery that is no more than one month late is considered to be consistent with "very good" to "good" performance.

Subtask 5: Define and request implementation of simulation modifications that are required for the second study.

Requirements:

a) The Contractor shall prepare for a second study by defining the real-time and batch simulation modifications required to provide the capability to perform parametric variations of selected relevant vehicle stability and control parameters. The Contractor shall define the number and range of values to be evaluated for each parameter.

b) The Contractor shall request that the real-time and batch simulations be modified accordingly.

Deliverables: Documentation describing the simulation modifications, including their purpose, the methodologies required for their implementation in the simulation model, and the documentation generated to request these modifications.

Schedule: Due R3R2 ~~April 1, 2001 December 31, 2001~~ ***March 31, 2002***

Task Order Number: 12RDA Revision: 3 Date of Revision: 12/5/01

Title: Handling Qualities and Maneuver Sensitivity Studies for Crew Transfer Vehicle Concepts

For information purposes only:

Currently, it is anticipated that there will be a requirement for multiple simulation studies to be conducted by the Contractor; however, the long-term funding for the completion of the initial study and for the follow-on studies has not yet been finalized. Also, the planning process, schedule, and specific requirements for the additional studies will be influenced by the results of the initial study and anticipated interactions with organizations other than VDB that perform related work. Depending on the outcome of these funding and planning activities, it is possible that this task order will continue in effect through at least FY 02.

3. Government Furnished Items:

a) Existing NASA HL-20 simulation databases, code, and documentation

b) Access to NASA's Visual Motion Simulator with HL-20 simulation model implemented

c) Research pilot support

4. Other information needed for performance of task:

a) Relevant publications:

- Jackson, Rivers, and Bailey: Effect of Lift-to-Drag Ratio in Pilot Rating of the HL-20 Landing Task. AIAA Journal of Spacecraft and Rockets. Vol., 30, No. 5, pps. 543-548, 1993.
- Jackson, Cruz, and Ragsdale: Real-Time Simulation Model of the HL-20 Lifting Body. NASA Technical Memorandum 107580, 1992.
- Jackson, Rivers, Chowdhr, Ragsdale, and Geyer: Launch Pad Abort of the HL-20 Lifting Body. AIAA Journal of Guidance, Control, and Dynamics. Vol. 17, No. 6, pps. 1345-1349, 1994.

b) All planning, preparation, and testing must adhere to the following NASA Langley standard procedures, as appropriate:

- [R2] ***LMS-CP-0960, "Conducting Simulator and Aircraft Service Activity Experiments"***

5. Security clearance required for performance of work: None

6. Period of Performance:

Planned start date: January 2, 2001

Completion date: [R3R2] ~~September 30, 2001~~ ~~December 31, 2001~~ ***March 31, 2002***

7.	**NASA Technical Monitor:** Marilyn E. Ogburn M/S: 153 Phone: 757-864-1175 NASA Competency/Other Technical Coordinator: Anita Thomas M/S: 162 Phone: 757-864-9119

Task Order Number: 12RFL Revision: 5 Date of Revision: 10/27/04
Title: Turbulence Lidar for [R3]NASA Aircraft, Weather Accident Prevention Program (WxAP)

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

The WxAP program intends to utilize [R3]~~the NASA Langley Boeing 757 (B-757) Airborne Research Integrated Experiments System (ARIES) research aircraft,~~ [R1] the NASA Dryden DC-8 aircraft, and a government owned Lidar system to support efforts being conducted for the Turbulence Detection and Mitigation (TDAM) project.

The TDAM project will develop enabling technologies that will provide accurate and timely atmospheric turbulence hazards information to pilots, dispatchers, and air traffic controllers. On-board, forward-looking turbulence detection sensors will be developed to warn pilots of upcoming turbulence. A flight program must be executed to test the performance of these candidate technologies in a real flight environment.

The objective of this program is to install a stand-alone Lidar system in [R3]~~the NASA LaRC B-757 aircraft and~~ [R1]the NASA DFRC DC-8, and use it to detect clear-air turbulence ahead of the aircraft during flight.

The purpose of this task is to integrate, [R1,R3]~~design equipment mounting hardware,~~ install, test, modify, and support the operation of a Government supplied Lidar system during flight research on [R3]~~the NASA LaRC B-757 and~~ [R1]the DFRC DC-8 aircraft.

Revision 1: Adds DFRC DC-8 aircraft requirement and associated changes and extends the Completion date for NASA's convenience (see [R1] above and below).
Revision 2: Extends the period of performance ten months in continuation of NASA's support requirements (see [R2] below).
Revision 3: Extends the period of performance 12 months in continuation of NASA's support requirements, updates requirements and title, and deletes the 757 ARIES from current consideration (see [R3] above and below).
Revision 4: Extends the period of performance 12 months to 10/29/04 in continuation of NASA's support requirements with detailed requirements unchanged except for restoring LaRC ground test support in Subtask 1 (see [R4] below).
Revision 5: Extends the period of performance 5 months to March 31, 2005 in continuation of NASA's support requirements with updates in GFI and travel (see [R5] below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following requirements/subtasks:

Subtask 1:
In conjunction with the instrument manufacturer [R1,R3]~~design mounting hardware for the lidar system equipment in the NASA DFRC DC-8~~, install the instrument on the [R3]~~NASA B-757 and~~ [R1]DFRC DC-8 aircraft pallets, generate ground and airborne checkout procedures, and operate the system during ground [R1] testing at [R3]~~LaRC and~~ [R4]***LaRC and*** DFRC ~~Electromagnetic Interference (EMI) testing, and Flight Systems Integration Laboratory (FSIL) testing~~. Perform

Task Order Number: 12RFL Revision: 5 Date of Revision: 10/27/04
Title: Turbulence Lidar for R3NASA Aircraft, Weather Accident Prevention Program (WxAP)

the end-to-end tests of the fully integrated Lidar system after it is installed on the R3~~B-757~~ ~~R1 and~~ DC-8 aircraft

Performance Standards and Evaluation Criteria:
Meets:
Instrument meets all aircraft certification and science requirements R1 and mechanical design meets NASA QA requirements.

Exceeds:
Contractor-suggested system modifications that improve the installation/or operation of the system on R3~~the NASA LaRC B-757 or~~ R1the DFRC DC-8.

Subtask 2:
Perform the pre-flight test of the Lidar system and operate the system during flight testing on the R3~~NASA LaRC B-757 and~~ R1the DFRC DC-8.

Performance Standards and Evaluation Criteria:
Meets:
Instrument meets all requirements to support follow on missions.

Exceeds:
Contractor suggested system modifications that improve the operation of the system.

3. Government Furnished Items:

1. Government supplied Lidar System including scanner
2. Government Building R5***and room*** for Testing R1 at LaRC and government building and GSE for testing at DFRC.
3. Government supplied, as built drawings, schematics, environmental test data, performance specifications, and vendor supplied operational procedures for the Lidar.

Government supplied electronic/mechanical fabrication facilities

4. Other information needed for performance of task:

1. Travel (R3,R5***two visits***) to the equipment manufacturer in Boulder, Colorado R1 and R3two visits to DFRC for equipment inspections, testing, and reviews.
2. Commercial travel to R3two possible test sites in the R5~~Western United States~~ ~~R1 and~~ ~~R3one test site in the~~ southeastern US to conduct Lidar test flights may be required.
3. The NASA Laser Safety class will be required R1 for the personnel operating the system.

5. Security clearance required for performance of work:

	Task Order Number: 12RFL Revision: 5 Date of Revision: 10/27/04 Title: Turbulence Lidar for R3NASA Aircraft, Weather Accident Prevention Program (WxAP)

	None
6.	**<u>Period of Performance</u>:** Planned start date: 1-2-01 Completion date: R1~~9-30-01~~ R2~~12/31/01~~ R3~~10/31/02~~ R4~~10/31/03~~ R5~~10/31/04~~ ***3/31/05***
7.	**NASA Technical Monitor:** Charles R. Hyde M/S: 488 Phone: 757-864-7997 NASA Competency/Other Technical Coordinator (*above branch level*): *name (This is the management interface between COTR and TM for efficiency in PBC, technical focus, timely funding, modifications, scheduling, and award fee evaluations--selected by Competency/Office.)* M/S: *nnn* Phone: 757-864-*nnnn*

	Task Order Number: 13RAB Revision: 6 Date of Revision: 5/6/2004 Title: Spacecraft Systems Analysis and TMC (Technical, Management, and Cost) Reviews

1.	**Purpose, Objective or Background of Work to be Performed:** The LaRC Aerospace Systems, Concepts, and Analysis Competency (ASCAC) Spacecraft and Sensors Branch (SSB) is often required to produce systems analyses for a wide range of Earth orbiting, [R5]heliocentric, and planetary spacecraft missions. These assessments are high-priority, short duration efforts in response to inquiries from NASA Headquarters. The Contractor will be required to provide analysis and consultation for, and enhancement of analysis software and methods used in, spacecraft systems analyses. Revision 1: This revision contains substantial rewording of the previous requirements that were received too late to make the transition to SAMS from SAERS and includes Revolutionary Aerospace Systems Concept (RASC) studies and other clarifications. That rewording was originally submitted as revision 1 by the TM and is not annotated. This revision includes the TM's previous revision 1 and the TM's second revision where the annotated changes are for PBC concerns and technical clarifications, Pluto-Kuiper Belt Step I and II TMC (Technical, Management, and Cost) studies, and an additional element to update the analysis tool User's Guides. Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance. Revision 3: Extends the period of performance four months in continuation of NASA's support requirements, reduces and/or redefines the requirements for the new period of performance, and updates the title. Revision 4: Extends the period of performance through 1/30/2004 in continuation of NASA's support requirements, updates the requirements for the new period of performance, and updates other supporting information. [R5] *Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 13RAB, 13RAB01, 13RAB02, 13RAB03, and 13RAB04.* Revision 5: Extends the period of performance 7.5 months to August 14, 2004, in continuation of NASA's support with redefined requirements for the new period of performance, and updates other info (see [R5] above and below). Revision 6: Extends the period of performance 5 months to January 14, 2005, in continuation of NASA's support with additional requirements for the new period of performance (see [R6] below).
2.	**Description of the Work to be Performed:** **General Requirements Summary** The Contractor shall conduct analyses for spacecraft systems and perform tool development to support work ongoing in the SSB, including, but not limited to: Explorer, ESSP (Earth Systems Science Pathfinder), Mars Scout, New Frontiers, and Discovery

TMC (Technical, Management, and Cost) Reviews.

The Contractor shall develop detailed plans to perform the work, including schedules of the deliverable products. The primary products shall be final reports summarizing technical analyses conducted as well as the associated cost and schedule and/or modifications to existing software tools.

The Contractor, in cooperation with SSB shall develop schedules for the final reports and/or the tools.

The Contractor shall implement the work plans to perform tool development and analyses which encompass the following technical areas.

(a) Guidance, Navigation, and Control
(b) Propulsion
(c) Power
(d) Command and Data Handling
(e) Thermal
(f) Structures
(g) Launch Vehicles
(h) Cost Estimating
(i) Reliability, Maintainability, and Quality Assurance
(j) Communications and data transfer Operations
(k) Crew Systems
(l) Microsoft Office Programming
(m) MATLAB®/Simulink® Programming
(n) Other associated areas

During the tasks the Contractor shall provide in-depth cost, schedule, technical analyses, and software development.

Deliverables:

(1) The plan, cost, and schedule for each task 1-week after the start of each task. A final report summarizing the technical effort at the completion of each task.

Metrics:

Minimum acceptable performance:
(1) The final technical report shall be evaluated for the following.

(a) technical accuracy
(b) findings must be clearly stated
(c) alternative concepts must be clearly stated
(d) recommendations must be consistent with the analysis
(e) overall assessment must be provided
(f) executive summary

(2) Software products shall be evaluated for completeness and supporting documentation.

Exceeds minimum performance:
(1) The final technical report shall be evaluated for the following.
(a) findings to improve design and development process
(b) proposed alternative concepts that will benefit the government
(c) recommendations for improving efficiency, capability, cost, and quality
(d) executive summary identifying risks.

(2) Software enhancements that improve the efficiency and operations of tools

Requirements by Element/Subtask

1.0 SmallSat systems analysis for New Frontiers, [R6]*SMEX (Small Explorers), and Discovery* [R5]TMC (Technical, Management, and Cost) Review.

The Contractor shall perform SmallSat based systems analysis for the New Frontiers TMC Review, [R6]***the SMEX Downselect TMC Review, and the Discovery TMC Review***.

The Contractor shall use the SmallSat (spreadsheet based Phase A design and system sizing) tool, to model subsystem architectures, and perform systems analyses and interpret the associated results.

The specific tasks associated with this element follow.

(a) Collect and review related component, system, and mission data.
(b) Modify SmallSat and related tools to address review specific requirements.
(c) Generate SmallSat design for each proposed spacecraft and quantify variances from given configurations.
(d) Interpret subsystem variances that exceed statistically significant limitsand identify potential design risks in a SmallSat analysis report.
(e) Provide systems engineering input in review telecons and meetings.
(f) Document leveled analysis results for use by the [R5]review team.
(g) Provide systems engineering input in the [R5]TMC [R6]***plenaries***.
(h) [R6]***Participate as the systems analysis specialist in Downselect TMC site visits.***
(i) Provide the Program Acquisitions Manager with clarifications of findings during the debrief phase.

(j) Address analysis tool and data deficiencies uncovered during the review.

Deliverables:

(1) The plan, cost, and schedule for the task 1-week after the initiation of the task.
(2) Phased delivery of initial analysis reports during the 6-R5 12 weeks following the receipt of proposal sets R6 ***or CSRs (Concept Study Reports).***
(3) Leveled analysis reports the week before the R6 ***TMC plenaries and the Downselect*** TMC initial plenary.
(4) Compiled electronic versions of the final reports and SmallSat models R5 8 weeks after the TMC R6 ***and Downselect TMC final plenaries***.

(5) Updated analysis tools and associated documentation R5 12 weeks after the TMC R6 ***and Downselect TMC final plenaries***.

Metrics:

Minimum acceptable performance:
(1) Analysis results shall be evaluated for completeness and supporting documentation.

Exceeds minimum performance:
(1) Software enhancements that increase analysis capabilities and/or improve the efficiency and operations of tools

2.0 SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) based dynamic simulation for New Frontiers, R6 *SMEX (Small Explorers), and Discovery* R5 TMC (Technical, Management, and Cost) Reviews.

The Contractor shall perform SPASIM based dynamic simulations for the New Frontiers R6 ***and Discovery*** TMC Reviews R6 ***and for the SMEX Downselect TMC Review***.

The Contractor shall perform MATLAB/®/Simulink®programming, model subsystem architectures, and perform SPASIM based dynamic simulations and interpret the associated results.

The specific tasks associated with this element follow.

(a) Collect and review related component, system, and mission data.
(b) Modify SPASIM and related tools to address review specific requirements.
(c) Define mission, payload, and subsystem models and associated timelines for each

proposed spacecraft.
(d) Perform targeted subsystem analyses. Quantify and interpret variances from given configurations.
(c) Provide appropriate systems engineering input in the review telecons and meetings.
(d) Document leveled analysis results for use by the R5review R6***teams***.
(e) Provide appropriate systems engineering input in the R5TMC R6***plenaries***.
(f) R6***Participate as the systems analysis specialist in Downselect TMC site visits.***
(g) R5Provide the Program Acquisitions Manager with clarifications of findings during the debrief phase as necessary.
(h) Address analysis tool and data deficiencies uncovered during the review.

Deliverables:

(1) The plan, cost, and schedule for the task 1-week after the initiation of the task.
(2) Phased delivery of initial analysis reports during the 6-R512 weeks following the receipt of proposal sets ***or CSRs (Concept Study Reports)***.
(3) Leveled analysis reports the week before the TMC R6***plenaries and the Downselect TMC initial*** plenary.
(4) Compiled electronic versions of the final reports and SPASIM models R58 weeks after the TMC R6***and Downselect TMC final plenaries***.
(5) Updated analysis tools and associated documentation R512 weeks after the TMC R6***and Downselect TMC final plenaries***.

Metrics:

Minimum acceptable performance:
(1) Analysis results shall be evaluated for completeness and supporting documentation.

Exceeds minimum performance:
(1) Software enhancements that increase analysis capabilities and/or improve the efficiency and operations of tools

3. **Government Furnished Items:**

Computer resources (required to prevent unauthorized access to proprietary data).

Access to special software analysis tools and environments.

Access to secure web sites for uploading and downloading of analysis results.

Proposals R6***and CSRs (Concept Study Reports)*** for the TMC (Technical, Management, and Cost) R6***and Downselect TMC Reviews***, ***respectively***.

4. **Other information needed for performance of task:**

	Task Order Number: 13RAB Revision: 6 Date of Revision: 5/6/2004
	Title: Spacecraft Systems Analysis and TMC (Technical, Management, and Cost) Reviews

[R6]***The SMEX (Small Explorers) Downselect TMC (Technical, Management, and Cost) Review site visits will require 2.5 weeks of travel. An additional*** [R5]2 weeks of travel will be required for conference attendance and/or training.

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.

5. **Security clearance required for performance of work:**

None. However, current non-disclosure agreements must be on file for all Contractors required to handle proposals [R6]***and CSRs (Concept Study Reports***. In addition, all changes to the analysis tools must be reviewed by a team member with a current non-disclosure agreement on file.

6. **Period of Performance:**

Planned start date:		Completion date:	
	[R2]~~1/2/2001~~		[R2]~~12/31/2001~~
	[R3]~~1/2/2002~~		[R3]~~11/30/2002~~
	[R4]~~12/2/2002~~		[R4]~~3/31/2003~~
	[R5]~~4/1/2003~~		[R5]~~1/30/2004~~
	[R6]~~2/1/2004~~		[R6]~~8/14/2004~~
	6/1/2004		***1/14/2005***

7. **NASA Technical Monitor:** Washito A. Sasamoto
M/S: 328 Phone: 757-864-1923

NASA Competency/Other Technical Coordinator: ASCAC/Michael P. Fitzgerald

M/S: 327 Phone: 757-864-3681

Task Order Number: 13RBF Revision: 10 Date of Revision: 3/14/05

Title: **Structural Acoustic Modeling and Laboratory Support**

1. **Purpose, Objective or Background of Work to be Performed:** (DF26, NAS1-96014)

The Structural Acoustics Branch is the agency's lead research organization for structural acoustics, sonic fatigue and interior noise control for aircraft, launch vehicles and spacecraft. This work requires the development and validation of measurement, prediction, and simulation technology as well as the development and validation of noise and vibration control technology, including both passive and active technologies. Many aspects of this work require that finite element models of component technologies up to complete fuselage systems be developed and validated through modal analysis and other testing. Further, real time simulation capabilities are required to provide [R1] assess sound quality and optimization efforts. The purposes of this task are to 1) provide finite element model [R1] and boundary element development using MSC/NASTRAN and COMET/Acoustics; 2) support experimental validation of these models by performing model updates; 3) provide laboratory support with regard to design and calibration of existing and upgraded acoustic facilities, test techniques, and data acquisition; and 4) develop and support equipment and computer interfaces for day-to-day testing and evolving test techniques including real time PC and controller hardware.

Note: The modeling and update support described below is by its research nature, indefinite delivery and indefinite quantity (IDIQ). [R2] This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. Each NOR [R2] is subject to the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

Revision 1: Substantially updates Subtasks 1 and 2, discontinues Subtask 3, deletes Subtask 4, adds Subtask 6 as cleanup of work from previous contract, and updates GFI (see [R1] above and below).

Revision 2: Extends the period of performance eight months in continuation of NASA's support requirements, adds requirements to Subtask 1 and extends its schedule, and adds new Subtasks 7 and 8. The NOR note is also updated. (See [R2] above and below.)

Revision 3: Extends the schedule of Subtasks 7 and 8, adds requirements as new Subtasks 9 and 10, adds to GFI, and extends the overall period of performance four months (see [R3] below).

Revision 4: Extends the schedule of Subtasks 7 (to 1/30/03) and 10 (to 11/15/02) and the overall period of performance (to 1/30/03) and adds requirements to Subtask 10 (see [R4] below).

Revision 5: Extends the schedule of subtasks 7 (to 6/15/03) and 10 (to 11/30/02), adds subtasks 11, 12, 13, and 14 and extends the period of performance to 11/1/03 (see [R5] below).

Revision 6: Extends deliverables schedule in subtasks 7 and 11, rescinds subtasks 13 and 14, and adds new requirements as subtask 15 (see R6 below)
Revision 7: Extends deliverables schedule in subtasks 7, 12, and 15, extends the task period of performance to January 15, 2004, and adds new requirements to subtask 15 (see R7 below).
Revision 8: Extends the period of performance nine months to September 30, 2004, in continuation of NASA's support, updates/adds requirements to and extends Subtask 15, and adds new requirements as Subtasks 16-19 with updated GFI in Section 3 (see R8 below).
Revision 9: Extends the period of performance six months to March 31, 2005 to accommodate delays and NASA's continued technical requirements in Subtasks 7, 15, 16, 17, and 19 and rescinds Subtask 18 (see R9 below).
Revision 10: Extends the period of performance five months to August 31, 2005 with schedule adjustments in Subtasks 7, 15, 17, and 19 (see R9 below).

2. **<u>Description of the Work to be Performed</u>:**
The Contractor shall perform the following requirements/subtasks:

**Begin R1 block **

1. (NOR) <u>Modeling and update support for MSC/NASTRAN models of the aluminum testbed cylinder</u>. Under Contract NAS1-96014 (Task Order DF26) a MSC/NASTRAN model was developed and updated through 3 configurations based upon data provided by the Structural Dynamics Branch, the Structural Acoustics Branch and physical measurements of the test article and its mounting fixture in the Structural Dynamics Laboratory. Updates shall incorporate experimental results from modal measurements provided to the Contractor by NASA. Relevant modal test data shall be made available to the Contractor as acquired and in a timely fashion during the course of the period of performance. The Contractor shall refine the NASTRAN models as required to a frequency of 450 Hz. It is anticipated that no mare than 2 additional modeling and update cases will be required and shall include configuration 4 with the end panels and configuration 5 with the fiberglass end domes installed.

Begin R2 block

Comparisons of modal frequencies for 2 non-zero internal pressurization cases in the final configuration 5 shall also be performed to assess the model's validity with a pressure differential across the cylinder skin. These shall correspond to the test cases acquired by the NASA.

End R2 block

Metric: Since the purpose of this task is to provide a numerical model of the Aluminum Testbed Cylinder (ATC)that provides the best fidelity to the experimental measurements being taken in the Structural Dynamics Laboratory, the minimum acceptance criteria is the delivery of updated working MSC/NASTRAN data decks and PATRAN journal files for the 2 additional ATC configurations that reproduce the measured mode frequencies to within an accuracy of 10%. Performance exceeding the acceptable level will be evaluated based on final accuracy and efficiency of implementing refinements that model the as-built structure.

Deliverables: MSC/NASTRAN data decks and PATRAN journal files of the updated ATC model and a report summarizing the results.

Schedule: Updated MSC/NASTRAN models to be provided within 60 days from time experimental data files are provided to the Contractor by NASA with final data provided no later than R2~~August~~ October 30, 2001. Final report is due by R2~~October~~ December 31, 2001.

2. Binaural simulation validation experiments. Binaural simulation is the simulation of sound from a specified source as it is heard by a listener (including the effects of interaural time differences, interaural intensity differences, and acoustic scattering about the head, pinnae, and torso). Binaural simulation utilizes the time domain characteristics of the source and the goal of this subtask is to provide the data necessary to validate a binaural simulation from a radiating structure.

   In particular, the Contractor shall and a binaural recording mannequin in the three-dimensional receiver space of the transmission-loss suite. Further, the Contractor shall design a system to determine the position and orientation of the imaginary line segment that connects the two microphones inside the ears of the mannequin. Three measurements sets are to be acquired:

   1) Transfer function measurements between point source(s) on the panel and the panel response are to be made over the extent of the panel with a fine spatial resolution using accelerometers and/or a laser vibrometer.
   2) Transfer function measurements between the point source(s) on the panel and radiated sound are to be made at a number of positions in the radiated field. The radiated sound field measurements are to be made using microphones and a binaural recording mannequin at several locations and head orientations in the anechoic receiver space.
   3) For various input sources (e.g. narrow band, broadband random, and transient), the excitation time history, panel response time history at selected points, and the radiated sound time history at the locations and type acquired in 2) shall be simultaneously measured.

For the measurements made in 2) and 3) above, the receiving space shall be configured under two conditions: anechoic and the presence of a single hard-wall reflective surface. All experimental facilities, apparatus and instrumentation are to be supplied as GFI.

Metric: The minimum acceptable performance is measurement of the data indicated above for a single excitation point source location and one of the several source types indicated in 3) above. Performance exceeding the acceptable level shall be based on measurement of the data indicated above for multiple excitation point source locations and several source types indicated in 3) above.

Deliverable: Data from each receiving space case shall be made available in electronic form by June 1, 2001 (anechoic), and June 30, 2001 (single-reflective surface). For each data set, test configuration information including location and identification of measurement points shall also be supplied. An informal report documenting the results shall be delivered at the end of the subtask.

Schedule: Subtask 2 shall be completed by June 30, 2001

3. Data Acquisition and Analysis Software for HP 1432 and associated equipment. The objective of this task is to implement production software which provides user interface to the HP 1432 data acquisition system. This subtask will proceed in 3 parts as described below.

- Prototype Design. The Contractor shall outline the design of a data acquisition system and a user interface that provides time and frequency data acquisition and streaming of data to host PC disk. The user interface shall be graphical and provide the baseline functionality of HP DacEasy software for control of the HP 1432 as well as averaging capability for both time and frequency data. This software shall also provide capability for 'quick look' acquisition and display of data without streaming to disk. This software will be considered developmental and not be subject to Langley LMS software procedures.
- ~~Laboratory Support. The Contractor shall support use of the above prototype software in tests performed in the Structural Acoustics Branch's facilities. Augmentations to the software shall be done in cooperation with NASA personnel.~~
- ~~Implementation. Upon approval from the Technical Monitor, the Contractor shall implement the design specification for the functionality of the software required to support the laboratory tests performed by Structural Acoustics Branch personnel. The Contractor shall present progress at bimonthly meetings to discuss implementation issues and how they affect usability. A final user manual shall be written which describes the software functionality and how it supports the hardware functionality of the HP 1432 in StAB facilities.~~

Metric: The above subtask parts must be completed in the sequence given with the first two prototyping activities to be completed before the final production software can be implemented in StAB facilities. Thus, the timeliness in which an acceptable design specification is derived is important to the successful execution of this task. StAB personnel will be utilizing the prototype software until production software becomes available. The capability of the prototype software to perform accurately and reliably in the interim is also important to successful completion of this task. The HP DacEasy software package will be considered the baseline functionality for the completed software package. Capabilities in synchronous data acquisition, integration of signal sources and utilization of hardware capabilities in excess of the HP DacEasy software as well as ease of use will be will be used to assess the level of performance exceeding the acceptable level. Due to the emergence of commercial implementations of similar software, this task will conclude with delivery of the prototype design.

Deliverable: The deliverable for this task will conclude with only delivery of the prototype design and the source code. Due to the availability of alternative solutions, the requirement of a user manual is deleted.

Schedule: Subtask 3 shall be complete by March 9, 2001

4. Digital signal processor (DSP) based, auditory system for performing binaural simulation. Deleted due to the scaling back of the ISE (Intelligent Synthesis Environment) program.

End R1 block

5. Thermal Acoustic Fatigue Apparatus (TAFA) in Building 1221A. The TAFA has been characterized for the repeatability of dynamics experiments and measurements in a previous task order (DF26 of NAS1-96014). The purpose of this task is to build upon that previous work by conducting a series of approximately eight fatigue tests using identical simple aluminum panels. These tests will ascertain the variability of measured fatigue lives in the facility. A second objective for these tests is to provide a data base for validating linear and nonlinear response prediction codes and fatigue life estimation methods. To facilitate these objectives, the Contractor shall be responsible for providing a test plan for these experiments acceptable to the government and also assume primary responsibility for the data acquisition, reduction and reporting components of these experiments.

Metric: Since the database generated by these experiments is an essential part of the lightweight technologies program for the coming years, the acceptable level of performance on this task shall be the generation of a formal contractor report (NASA CR) documenting these experiments and delivery of the experimental data.

Deliverable: Informal test plan due within 30 days, formal final report and experimental data for each experiment on compact disc due upon completion.

Schedule: Subtask 5 is to be completed by 30 Sept. 2001.

Begin R1 block

6. Provide final updated report for MSC/NASTRAN model of the Raytheon Premier sidewall section mounted in the Structural Acoustic Loads and Transmission Facility. Under a Contract NAS1-96014 (Task Order DF26) a MSC/NASTRAN model was developed based upon data provided by Raytheon and physical measurements of the test article and its mounting fixture in the SALT facility. Updates incorporated results from modal measurements provided to the Contractor by NASA. Final modal test data and forced response data shall be made available to the Contractor March 30. The Contractor shall prepare a contractor report (NASA CR), conference paper and presentation detailing the final comparisons of the NASTRAN model and data to a frequency of 450 Hz.

Metric: Since the purpose of this task is to provide a numerical model of the Premier sidewall section that provide the best fidelity to the experimental measurements being taken in the Structural Loads and Transmission Facility, the minimum acceptance criteria is the delivery of updated working MSC/NASTRAN data decks and PATRAN journal files for this sidewall section that reproduces measured mode frequencies to within an accuracy of 10%. Performance exceeding the acceptable level will be evaluated based on final accuracy and efficiency of implementing refinements that model the as-built structure.

Deliverables: MSC/NASTRAN data decks and PATRAN journal files of the updated Raytheon Premier sidewall section model, a detailed contractor report, conference paper and presentation summarizing the results of this work.

Schedule: All MSC/NASTRAN models, contractor report and conference paper shall be provided to NASA no later than May 30, 2001.

End R1 block

Begin R2 block

7. Structural Acoustics Model of Aluminum Testbed Cylinder. Task 1 above has been concerned with developing and validating a structural dynamics model of the Aluminum Testbed Cylinder (ATC). Under this new task, the Contractor shall develop a structural acoustics model of the ATC utilizing COMET/Acoustics and the NASTRAN structural model developed in task 1. Updates shall incorporate experimental results from acoustic and structural data provided to the Contractor by NASA. This structural acoustic test data will be made available to the Contractor in a timely fashion during the course of the period of performance. The Contractor shall refine the COMET/Acoustic model as required to a frequency of 450 Hz. The model configuration shall be that for which the

structural acoustic data was acquired and is that of configuration 5 with the fiberglass end domes installed. Comparisons of interior noise and structural response shall be compared for the zero internal pressure case and for the 2 non-zero internal pressurization cases in configuration 5 for which acoustic data was acquired. These shall correspond to the test cases acquired by the NASA.

Metric: Since the purpose of this task is to assess the accuracy of the structural acoustic prediction code, the acceptable level of performance on this task shall be the generation of a formal contractor report (NASA CR) documenting the development of the model and the theory/data comparisons. Performance exceeding the acceptable level will be evaluated based on accuracy and efficiency of implementation and depth of assessment.

Deliverables: COMET/Acoustics data decks, any updated MSC/NASTRAN data decks and PATRAN journal files of the ATC model and a NASA contractor report summarizing the results.

Schedule: COMET/Acoustics models to be provided within 90 days from time experimental data files are provided to the Contractor by NASA with final data provided no later than R3~~March~~ R4~~July~~ R5~~October 31, 2002~~ January 31, 2003. Final report is due by R3 ~~June~~ R4~~October 30, 2002~~ R5~~January 30,~~ R6~~June 15,~~ R7~~August 31 , 2003~~ R9~~January15, 2004~~ R10~~March 31, 2005~~ ***August 31, 2005***.

8. The use of visco-elastic and/or constrained layer damping has become common in vibration and noise control. However, optimization of these treatments beyond manufacturers recommendations is not widespread. Past work has focused on the geometry and materials of the layers and to a lesser extent the surface geometry and distribution. In order to take best advantage of these materials, accurate modeling of the installed materials must be available and integrated with structural acoustic design capability. To this end, the Contractor shall survey the available numerical models available in the literature and produce a white paper comparing their applicability for aircraft sidewall vibration control, ease of integration with existing FE/SEA analysis, accuracy, generality, etc…The goal of this subtask is to assess the state-of-the-art of modeling these materials and the general capability to integrate them with existing structural acoustic prediction codes.

Metric: Since the purpose of this task is to provide an assessment of current modeling capability and accuracy, the minimum acceptable performance is the provision of a white paper that outlines the state-of-the-art of modeling installed visco-elastic and constrained layer damping materials or systems. The models considered must include the effect of the damping material on the structural system to which it is attached.

Performance exceeding the acceptable level shall be based on the range of models assessed, the depth of consideration for those models assessed and results that may be clearly interpreted.

Deliverable: White paper that outlines the state-of-the-art of modeling installed visco-elastic and constrained layer damping systems.

Schedule: Subtask 8 shall be completed by R3 ~~February~~ July 15, 2002

End R2 block

Begin R3 block addition

9. The continued use of the transmission loss apparatus (TLA) in building 1208, room 136 requires an update of the acoustic treatment in the receiving room. New treatment materials have become available that make this desirable. To this end, the Contractor shall make an assessment of available materials, including currently available acoustic panels and wedges and the achievable useful frequency range of operation for this room. The goal of this task is to assess and recommend the most cost effective upgrade of the acoustic absorption system in this room in terms of available volume, frequency range and cost.

Metric: Since the purpose of this task is to recommend an upgrade of the acoustic absorption system in this room, an informal report and a briefing shall be be provided to the NASA detailing the results of this study. Performance exceeding the acceptable level shall be based on the range of options assessed, the depth of consideration for those options and results that may be clearly interpreted.

Deliverable: Informal report and briefing on acoustic treatment options for the receiving room of the transmission loss apparatus.

Schedule: Subtask 9 shall be completed by July 30, 2002

10. This task represents a support effort related to NASA research involving shape memory alloys (SMAs), which are currently under investigation for advanced structural concepts to reduce vibration and noise transmission and to control structural shape for a variety of applications. Recent work at StAB has included SMA actuator processing and characterization, fabrication of hybrid composite specimens with embedded SMA actuators, and testing of the SMA hybrid composite (SMAHC) specimens for static and dynamic thermo-mechanical responses. This capability will require a new test and measurement capability and the goal of this task is to provide LabVIEW Virtual Instruments (VIs) for extracting temperature data from an infrared (IR) camera system and to control the current/voltage of a DC power supply. These shall be combined such that the current/voltage from the power supply will be controlled in a feedback loop to attain a specified average or peak temperature as indicated from the infrared camera or other thermal data as from a single or multiple thermocouples. In addition, the

temperature distribution of the panel shall be available for storage on the LabVIEW computer for later data analysis in a format that is compatible for import into Microsoft Excel and TecPlot. **Begin R4 block addition** The Contractor shall also integrate the above developed VI's with a user interface VI that provides a sequencing attaining and maintaining of panel temperature set points between a user prescribed starting temperature and ending temperature for a user prescribed number of temperature increments. These temperature increments shall be definable as equal increments or as arbitrary increments. In addition, the VI shall provide functionality to control the specimen temperature over a user specified number of complete thermal cycles (heating and cooling). Finally, this VI shall function through either the Contractor supplied PID (proportional integral derivative) or through the PID integrated in the Omega Engineering controller. Details of the user interface shall be mutually agreed by the NASA and the Contractor. **End R4 block addition**

Metric: Since the purpose of this task is to provide a data acquisition and controller system, the task shall be evaluated on the capability of the hardware/software system to acquire the necessary data and attain and maintain the required temperature. Performance exceeding the acceptable level shall be based on the rate of data acquisition, ease of use, accuracy and content of the documentation and ability to deliver the system in a timely manner.

Deliverables:
1. Individual LabVIEW Virtual Instrument modules to interface with the FLIR SC2000 IR camera and HP model 6652A DC power supply.
2. LabVIEW module that interfaces to the above modules and provides the feedback control to maintain the required temperature of a candidate specimen panel.
3. User's Guide describing the setup, operation and formats for stored data for the VIs.
4. R4Provide a virtual instrument utilizing items 1 and 2 that provides for a specified sequencing through a series of arbitrary number of set temperatures between a specified starting and ending temperatures with an additional option to cycle through this heating/cooling sequence a specified number of times. This VI should work with either the contractor supplied PID or the PID supplied with the Omega Engineering controller

Schedule: Subtask 10 shall be completed by R4 ~~September 30~~ November R5~~15~~ 30, 2002
End R3 block addition
Begin R5 block addition
11. Development of a Training System for SMA Actuators: Shape memory alloys (SMAs) exhibit significant material nonlinearity in response to temperature and/or applied stress. These materials also exhibit significant thermal and/or mechanical cycle dependency. Thus, there is a requirement to either measure the cycle dependency or render the material cycle independent. There is a task currently underway that will enable automated measurement of the cycle dependency of certain properties of these materials. It is desirable to extend this capability to allow for "training" the material to render an actuator cycle independent. The goal of this

subtask is to develop software that will enable test machine control and integration with thermal control software for automated thermomechanical "training" of SMA actuators. Further specifications with regard to the software design requirements will be conveyed in one or more Notifications of Requirement (NOR).

In support of this effort, the Contractor shall:

11.1 Develop a LabVIEW VI to interface with the supplied Shimadzu test machine through IEEE 488.2 (GPIB) and analog voltages. Control will be achieved over machine setup, load, and stroke.
11.2 Integrate the VI developed in 2.1 with the previously developed thermal control VI, which comprises interfaces to the FLIR camera and HP/Agilent DC power supplies.

The LabVIEW VI for thermal control and all test hardware, including the Shimadzu test machine, will be supplied as GFI.

Metric: The minimum acceptable performance shall be completion of the items indicated above and as specified in the task order.

Deliverable: A LabVIEW VI to interface and control the Shimadzu test machine and a LabVIEW VI to perform automated thermomechanical cycling of SMA actuators. User's manual(s) for the LabVIEW VIs.

Schedule: This subtask shall be completed by [R6]~~April 15~~, November 1, 2003.

12. Temporal characterization of aircraft noise sources: The synthesis of realistic aircraft flyover noise time histories from frequency domain noise predictions is a difficult task. Because noise predictions are typically time averaged, the phase information critical for reconstructing the time history is lost. Also absent are low frequency oscillations below the audible range which are needed to simulate audible time-varying behaviors. The goal of this subtask is to analyze empirical data from broadband and narrowband aircraft noise sources and provide the temporal information required for prediction-based synthesis.

In support of this effort, the Contractor shall analyze two noise source datasets. The first dataset shall be used to characterize the broadband noise from a jet. It consists of noise measurements made along a line parallel to the axis of a jet. Specific locations to be analyzed shall be provided within an NOR. For this first dataset, the contractor shall:

12.1 Determine the low-frequency temporal characteristics (< 20 Hz) of each 1/3-octave band (20-10kHz center frequency) independent of one another for each selected location. Determine the time-averaged 1/3-octave spectra over the full period for which data is available. Determine the standard deviation of the temporal variations about the time-averaged level for each 1/3-octave band.

12.2 Determine the cross-correlation of low-frequency temporal characteristics across 1/3-octave bands within each selected measurement location.

12.3 Determine the cross-correlation of low-frequency temporal characteristics across the same 1/3-octave band between measurement locations.

12.4 Determine the extent to which the temporal characteristics may be modeled using simple waveforms (e.g. sine, saw-tooth, sample and hold).

The second dataset shall be used to characterize the narrowband noise from a fan. Noise measurement locations and operating conditions to be analyzed shall be provided within an NOR. For this second dataset, the Contractor shall:

12.5 Determine frequency and amplitude variations of the fundamental and harmonics as a function of time.

12.6 Determine the phase relationship between the fundamental and harmonics as a function of time.

12.7 Determine the extent to which the temporal characteristics may be modeled using simple waveforms.

All noise source datasets are to be supplied as GFI.

Metric: The minimum acceptable performance is analysis of the datasets as indicated above for the measurement locations and operating conditions specified in the task order. Performance exceeding the acceptable level shall be based on analysis of measurement locations and operating conditions beyond the minimum.

Deliverable: Analyzed data from the first dataset shall be delivered in electronic form as it becomes available,[R6]~~but not later than April 1, 2003~~. Analyzed data from the second dataset shall be delivered in electronic form as it becomes available, [R6]~~but not later than May 15, 2003~~. For each analysis set, specialized data analysis programs (e.g. Matlab m-files, Fortran programs) shall additionally be made available. An informal report documenting the results shall be delivered at the end of the subtask.

Schedule: This subtask shall be completed by [R7] September 5, 2003

13. Nonlinear Material and Structural Analysis of Smart Structures: [R6]Rescinded

14. Nonlinear dynamic response and high cycle fatigue prediction: [R6]Rescinded

End [R5] block addition

Begin R6 block addition
15. Characterization of transmission Loss Apparatus Receiving Room. The transmission loss apparatus (TLA) in building 1208, room 136 is currently being upgraded with improved acoustic treatment in the receiving room as per the recommendations of the study under subtask 9 above. Upon completion of this upgrade on or before R7~~June 30~~ R8~~September30, 2003~~, January 7, 2004, the Contractor shall characterize the standardized IEC acoustic properties of this space, the source room as a reverberation room, the receiving room as an anechoic chamber, and the transmission loss properties of the window. The goal of this task is to provide a standardized acoustic assessment of this facility for use in future acoustic tests employing this facility. R8The calibration results from the TLA shall be added as a separate section to the previously submitted draft report on the SALT facility in a format suitable for publication as a NASA contractor report.
Begin R7block addition
In addition, with the removal of the chillers in room 154 of B1208, the background noise levels of the Structural Acoustic Loads and Transmission (SALT) facility are anticipated to have been reduced significantly. As the characterization of the SALT facility was the topic of a previous task, the contractor shall re-measure the background noise levels of the SALT facility and update the previously submitted draft report at which time it will be reviewed and published by NASA.
End R7block addition
Metric: Since the purpose of this task is provide an acoustic assessment of these facilities as well as provide a report detailing this characterization to become a part of the facility resume, a formal report to be published as a NASA contractor report shall be prepared and submitted. Performance exceeding the acceptable level will be based on the quality of the assessment, and quality, usability and timeliness and of the final report.

Deliverable: Formal report characterizing the acoustic properties of the transmission loss apparatus in room 136 of building 1208. R8Background noise levels in the SALT facility shall be added to the previously submitted report characterizing the SALT facility.

Schedule: This subtask shall be completed 60 days after R9~~completion of the~~ access to the TLA upgrade R9is permitted and no later than R7~~August 31, 2003~~ R8~~January 15~~, R9~~April 15, 2004~~ R10~~March 31, 2005~~ ***June 30, 2005***.
End R6 block addition
Begin R8 block addition
16. Acoustic Testing of Prototype Launch Vehicle Subcomponents: The X-37 project has as part of its project plan the development of hot-structure control surfaces. These include four subcomponents – a carbon/carbon (C/C) flaperon, a C/C ruddervator, a carbon/silicon carbide (C/SiC) flaperon, and a C/SiC ruddervator. NASA Langley has responsibility for performing acoustic tests of each of the four subcomponents. The acoustic tests are to be conducted in the reverberation room of the NASA Langley Structural Acoustic Loads and Transmission (SALT)

facility located in Building 1208. All tests are to be conducted at room temperature. Each structure is to be exposed to a specified 1/3-octave band acoustic spectrum typical of the Delta IV launch environment for a specified duration (on the order of minutes). Acoustic control is to be performed using a 1/3-octave band control system. Data acquisition is to include acoustic data from microphones located in the reverberation room, and accelerometers and strain gages located on the structure being tested. It is anticipated that total duration of each test including set-up time will be 1-2 days with an additional 1-3 days required for data post-processing and test report generation.

Tentative NASA test schedule: The anticipated date for the C/SiC flaperon acoustic test is the week of February 9, 2004. The anticipated date for the C/C ruddervator acoustic test is the week of April 16, 2004. The anticipated date for the C/SiC ruddervator acoustic test is the week of May 26, 2004. The anticipated date for the C/C flaperon acoustic test is the week of June 11, 2004. All dates are subject to change.

The Contractor shall be responsible for set-up and run of the acoustic control system, set-up and run of the IDEAS data acquisition system, instrumentation set-up including calibration, data post-processing (to be specified within a NOR), and test report generation for: a) an empty chamber acoustic test and b) each of four control surface acoustic tests. The empty chamber acoustic test shall be completed prior to the first control surface acoustic test.

Schedule: This subtask shall be completed upon delivery of the 5th acoustic test report and no later than R9 ~~September 30, 2004~~ January 15, 2005.

Deliverables: An informal test report shall be completed within 5 working days following completion of each test. A total of (5) informal test reports and associated data in digital form. Each test report shall fully document the test and include test logs, digital photographs of the test set-up, data acquisition and signal processing parameters (including instrumentation and calibration), and sample data plots from both control and data acquisition systems. The data post-processing and data format will be specified within a NOR. A technical paper entitled "Controlled Reverberant Acoustic Excitation Capabilities at NASA Langley Research Center" shall be prepared and presented at the 43rd AIAA Aerospaces Meeting and Exhibit on Jan 10-13, 2005.

Performance Evaluation Criteria: The minimum acceptable performance is successful and timely completion of above requirements for each test. Performance exceeding the acceptable level shall be based on completion of the post-test data analysis and report within 3 working days following test completion.

17. Model and Optimize Voided Honeycomb Core Composite Panel: The goal of this subtask is to determine optimum configurations using finite element analysis of voided core design of

honeycomb laminate aircraft sidewall structures. This task involves designing a honeycomb composite panel which has voids cut into the honeycomb. The purpose of the voids is to create areas of decreased wave speed on the panel, thus reducing the panel's radiation efficiency. However, the voids will also create areas of high stress at the junction of the honeycomb and face sheets thereby increasing the likelihood of delamination.

The Contractor shall devise a design for the interface of the honeycomb void and face sheet such that these stresses are relieved. In addition, the Contractor shall take into account structural load specifications as provided by NASA and design the panel to take these loads. And finally the panel shall be designed in such a way that it is feasible to construct and test a physical model.

Schedule:

- Approximate Start Date: January 15, 2004.
- Completion Date: R9~~September 30, 2004~~ R10~~January 31, 2005~~ ***June 30, 2005***.

Deliverable: Informal report documenting the development of the model, available theory/data comparisons, and design specification of Voided Core graphite epoxy/honeycomb panel with results from FEM data showing panel has improved acoustic performance and meets structural requirements.

Performance Evaluation Criteria: The minimum acceptable performance is timely report delivery. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and range of concepts presented with potential for improved performance.

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Subtask 18. Micro-models of Honeycomb Core Composite Panel: R9Rescinded

19. (NOR) Development of a Training System for SMA Actuators – The purpose of this subtask is to extend and/or alter the capabilities of the LabVIEW Virtual Instruments (VI) developed under Subtasks 10 and 11 for data acquisition and control during tests of shape memory alloy (SMA) actuators and SMA hybrid composite structures.

The Contractor shall extend the system developed under Subtask 10 to accommodate specific requirements associated with performing cyclic thermomechanical tests on SMA actuators in the Light Alloy Laboratory (LAL) of B1205. The system developed under Subtask 11 shall be extended to allow for general user specification of the thermomechanical segments involved in training SMA actuators, also associated with tests in the LAL. Finally, extension and/or alteration of an existing LabVIEW VI for PC control of B&K Nexus accelerometer and microphone signal conditioning units shall be performed. Additional software design requirements will be conveyed in one or more Notifications of Requirement (NOR).

Schedule:

- Approximate Start Date: December 20, 2003.
- Completion Date: [R9]~~May 1, 2004~~ [R10]~~January 31, 2005~~ ***June 30, 2005***.

Deliverables: Due by [R9]~~May 1, 2004~~ [R10]~~January 31, 2005~~ ***June 30, 2005***

1. Updated LabVIEW VI to interface and control the Shimadzu test machine.
2. Updated LabVIEW VI to perform automated thermomechanical cycling of SMA actuators.
3. Revised User's manual(s) for the LabVIEW VIs**.**

Performance Evaluation Criteria: Minimum acceptable level will be the timely completion of the deliverables. Performance exceeding the acceptable level will be based on accuracy and efficiency of implementation and depth of assessment.

End [R8] block addition

3. **Government Furnished Items:**

Finite element modeling codes, modal analysis software, database software, engineering workstations for execution of the above programs, data recording hardware, PC and high level graphics workstations and mainframe computer for prediction, simulation, data analysis and presentation. Modal survey data from Structural Acoustics, Loads and Transmission Facility taken on integrally stiffened panel. Desktop workstations, IBM-PC laboratory computer, HP/Agilent 1432 VXI data acquisition system and all required I/O boards for IBM-PC, Microsoft Visual Studio BASIC and C/C++ compilers, MATLAB simulation package, and Labview visualization package, [R3] FLIR SC2000 IR camera and HP model 6652A DC power suppl***y***. Data acquisition, temperature and sound control hardware, and the models required for TAFA measurements and characterization. [R1] Facilities, special apparatus and instrumentation required for binaural simulation validation experiments [R6]and acoustic space characterization. [R5]Shimadzu test machine , [R6]~~ECTE NASTRAN implementation and the NWU-model nonlinear element property subroutine, ABAQUS , ELSTEP analysis code,~~ and jet and fan noise source datasets.

Begin [R8] block addition

Subtask 16: The Reverberation Room of the Structural Acoustic Loads and Transmission Facility, all test equipment, including instrumentation, signal conditioning, control system, data acquisition system, and noise source generation equipment, are to be supplied as GFE. Test articles and fixtures are also to be supplied as GFE.

Subtasks 17 and 18: MSC/NASTRAN, MSC/PATRAN and COMET/Acoustics programs and documentation. Computer workstation with a high-resolution display for modeling and code execution.

Subtasks 19:

1. Hardware: Shimadzu test machine, FLIR SC2000 IR camera, HP model 6652A DC power supply, NI DAQCard, desktop/laptop/notebook PC with appropriate communication ports (RS-232/422 for desktop, PCMCIA for laptop/notebook), device communication cabling, thermocouples, test specimens, Omega Engineering Controller.

2. Software environment: Windows 2000 operating system, LabVIEW 6.x, NI IMAQ Vision image software. Optional: Omega Engineering communication software.

3. Information/Documentation Required: Shimadzu test machine commands and formats, FLIR SC2000 IR camera and HP model 6652A DC power supply operator's manuals, communication protocols, Omega Engineering Operator's Manual.

End R8 block addition

4. Other information needed for performance of task:

Scheduling of branch computational hardware for large jobs is recommended for efficient use of resources as well as access to laboratory equipment must be coordinated with Richard Silcox.

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.

The software developed under this task shall meet the requirements of the Structural Acoustics Branch for conforming to Langley Research Center's ISO standards for software.

5. Security clearance required for performance of work:

All work will be unclassified, however personnel may be required to complete nondisclosure agreements with industry and sign compliance agreements under LERD restrictions.

6. Period of Performance:

Planned start date: Jan 1, 2001

Completion date:

R2 ~~October 31,2001~~

R3 ~~June 30, 2002~~

R4 ~~October 30, 2002~~

R5 ~~January 30, 2003~~

R7 ~~November 1, 2003~~

R8 ~~January 15, 2004~~

R9 ~~September 30, 2004~~

	R10~~March 31, 2005~~ ***August 31, 2005***
7.	**NASA Technical Monitor:** Richard J. Silcox M/S:463 Phone: 757-864-3590 NASA Competency/Other Technical Coordinator: M/S: Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

	Task Order Number: 13RCE Revision: ____ Date of Revision: Title: **Processing of Advanced Metallic Materials**

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

The purpose of this task is to develop and optimize advanced processing techniques for fabricating structures and subelements using advanced metallic materials for aerospace applications. ***In addition, coatings for protection of metallic materials at high temperatures will be developed.***

Note: ***Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)***

The requirements described below represent a revision of previous task order 09RCE. This revision extends the period of performance one year in continuation of NASA's support requirements, updates the NOR note, and makes some adjustments to 09RCE Revision 1 (see ***bold italic font*** above and below).

2.	**Description of the Work to be Performed:**

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1: Materials Processing

The Contractor shall, on a written work request basis (NOR), subject aluminum, titanium, Ti-PMC (polymer matrix composites) hybrid laminate, metal matrix composites, metallic foams, and metallic honeycomb core sandwich specimens to thermomechanical treatments and thermal exposures (isothermal and cyclic). The government will provide all test materials and specimens in the required conditions.

The Contractor shall conduct thermal cycling exposures of selected materials in an air environment in the temperature range from cryogenic temperatures (as low as liquid helium) to 2400°F (up to 30 specimen sets). The government will provide the load-temperature-time profiles for the tests. The Contractor shall conduct high-temperature isothermal exposures on specimens for times up to 100 hours and temperatures up to

Task Order Number: 13RCE Revision: ____ Date of Revision:
Title: **Processing of Advanced Metallic Materials**

2000°F (up to 30 specimen sets). The Contractor shall be responsible for inserting the specimens in appropriate furnaces, cataloging and tracking the specimens throughout the exposures, and removing the specimens from the furnaces at the appropriate times. The Contractor shall process specimens with pressure/load/temperature profiles using hot isostatic press equipment or vacuum hot press equipment (up to 20 runs total). The Contractor shall deposit coatings of thermal-sprayed aluminum, titanium, and nickel onto government-supplied substrates using plasma spray equipment (up to 25 runs). The Contractor shall ensure equipment is operational prior to and after processing runs and conduct periodic maintenance to ensure equipment operability. The Contractor shall conduct processing experiments for fabrication of metallic foams.

Deliverables (for 2.1):
- For each work request, processed specimens and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of processing procedures, calibrations, specimen dimensions, anomalies, and electronic data files for each processing run.
- Informal written monthly reports that list work requests completed during the reporting period, total cost associated with each work request, the scheduling priorities for upcoming work requests, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (12/31/01)

Performance Standards (for 2.1):
MEETS:
- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- Work requests completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:
- work requests completed ahead of requested due date
- "rush" work requests designated by the task monitor expedited
- Completion under cost

3. **Government Furnished Items**:

Specialized materials processing equipment located in the Light Alloy Laboratory (Building

	1205), including the vacuum hot press, hot isostatic press, plasma spray apparatus, and various ovens and furnaces. Specialized materials processing equipment located in the Structures and Materials Laboratory (Building 1148) including superplastic forming facilities and resistance welding equipment.
4.	**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.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:** Planned start date: 1/2/***02*** Completion date: 12/31/***02***
7.	**NASA Technical Monitor:** Dr. Stephen Hales M/S: 188A Phone: 757-864-3128 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 13RDF Revision: 4 Date of Revision: 11/9/04

Title: Runway Incursion Prevention System (RIPS) Development and Flight Simulation Support

1. **Purpose, Objective or Background of Work to be Performed**: R4 ***This is an extensive update of 13RDF for CY05.***

Synthetic Vision Systems (SVS) research activities are aimed at investigating technology as a means of providing “virtual VMC” capability to flight crews in all weather conditions. Specifically, the goal of the research is to generate requirements for a system that can eliminate visibility-induced aviation accident categories such as Controlled Flight into Terrain (CFIT) and Runway Incursions (RI). Prior work in the Transport Systems Research Vehicle (TSRV) simulator, Visual Motion Simulator (VMS), Research Flight Deck (RFD) simulator, and Integration Flight Deck (IFD) simulator have helped to validate system concepts that have been developed to meet this goal. These studies have also led to flight test milestones on NASA’s B-737 and B-757 aircraft R4 ***and a Gulfstream-V aircraft***. In August 1997, a prototype system was demonstrated at the Hartsfield-Atlanta International Airport (ATL). In October 2000, a more advanced system featuring runway incursion alerting and hold short advisory landing technologies was demonstrated at Dallas-Fort Worth International Airport (DFW). A full mission piloted simulation was conducted in March 2002 to assess an enhanced concept under incursion scenarios and weather and visibility conditions that were not available during flight tests.

*****Begin R4 block update*****

The Runway Incursion Prevention System (RIPS) was then integrated with the Synthetic Vision Display Concepts (SVDC) to create one system that would increase safety during all phases of flight. This integrated system was evaluated during flight tests in the summer of 2004 at the Reno/Tahoe International Airport (RNO) and the Wallops Flight Facility (WAL).

*****End R4 block update*****

These activities demonstrated the system’s potential for meeting the research goal to reduce the likelihood of runway incursions for commercial aviation operations.

*****Begin R4 block update*****

The next step is to adapt RIPS for general aviation operations. This includes modifications to the RSM incursion detection algorithm, head-down and alerting display concepts, and pilot interface, as well as integration with the SVS General Aviation (GA) display system. This integrated RIPS-GA system will be evaluated in simulation and eventually in flight. The subtasks listed below are required to implement the RIPS adapted for general aviation operations and integrated with the SVS GA displays in the simulation environment; support of piloted simulation testing and reporting of test results; support of data analysis from the 2004 flight testing; support of the evaluation the Runway Safety Monitor (RSM) incursion detection algorithm using a Monte Carlo simulation; and support for development of a Roanoke airport database for use in future general aviation testing.

*****End R4 block update*****

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Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 13RDF, 13RDF01, 13RDF02, and 13RDF03.

Revision 4: Extends the period of performance 12 months to December 31, 2005, in continuation of NASA's support with requirements updated for the new period of performance (see R4 above and below).

2. **Description of the Work to be Performed**:
When conducting the subtasks defined below, the Contractor shall follow good programming practices such as configuration management and code documentation (e.g. commenting) and by adhering strictly to LMS CP-5528 (see http://lms.larc.nasa.gov for this procedure).

*****Begin R4 block update*****
Subtask 1: RIPS General Aviation (RIPS-GA) Development, Integration, and Testing

The Contractor shall adapt RIPS for general aviation operations (RIPS-GA). This adaptation shall include any necessary modifications to the RSM incursion detection algorithm, head-down and alerting display concepts, and pilot interface. Air traffic control instructions shall be entered into the system through pilot read-back of instructions via voice recognition. Detailed requirements will be provided by NASA.

The Contractor shall integrate the RIPS-GA system with the SVS general aviation (SVS-GA) display system. The integration shall be performed in conjunction with personnel from the General Aviation sub-element of the Synthetic Vision Systems Project. The integration shall include modification to the data interface and display concepts. The merged systems shall be implemented in the Integration Flight Deck (IFD) simulator for development, test, validation, and pilot evaluation. Existing hardware shall be utilized, such as the SVS research display (SVS-RD) and voice recognition system (VRS). The existing RNO airport database shall also be utilized for this study. This integrated system will eventually be evaluated in flight.

The Contractor shall support a formal piloted simulation study in the IFD simulator to evaluate the integrated RIPS-GA system, including performance of the adapted incursion detection algorithm and head-down and alerting display concepts. The Contractor shall also integrate the GA version of PathProx (provided by NASA) into the simulation to enable evaluation.

Prior to the simulation experiments, the Contractor shall support system development, integration, testing, validation, and test scenario development. During the piloted experiments, the contractor shall be available to ensure correct software functionality and to ensure correct data logging. After the flight test experiments, the Contractor shall provide the digital data files in the specified format and document the system modifications and operation and test results.

The relevant system components include adapted RSM algorithm; PathProx GA algorithm; RNO terrain and airport databases; simulated ADS-B traffic data; simulated GPS positioning data; general aviation head-down display concepts; graphical and audible alerting display concepts; transition logic and symbology from enroute to surface operations; voice data/display interface for pilot; and relevant out-the-window scenes with traffic in the IFD simulator.

Deliverables:

- RIPS software adapted for GA operations (RIPS-GA) (April 30, 2005)
- RIPS-GA integrated with SVS-GA, tested, and validated in IFD simulator (July 31, 2005)
- Digital data files delivered within three weeks after piloted simulations complete.
- Report documenting RIPS-GA system modifications and operation and results of simulation testing delivered within six months of completion of testing.

*****End R4 block update*****

Performance criteria:

- Real-time performance demonstrated (>12 Hz)
- Perform according to RSM, R4 ***PathProx***, and RIPS specifications
- Low error/failure rate of the merged system (zero failures during a "production" simulation)
- Adherence to scheduled delivery date

*****Begin R4 block update*****

Subtask 2: Gulfstream-V SVS Integrated Technology Evaluation (GVSITE) Data Analysis

The GVSITE flight test was conducted in the summer of 2004 at the Reno/Tahoe International Airport (RNO) and Wallops Flight Facility (WAL). The Contractor shall continue to support analysis of GVSITE flight test data and documentation of results. This includes delivery of digital data files in the specified format and a report documenting the RIPS/RSM modifications and operation and test results.

Deliverables:

- Digital data files delivered within three weeks after data request made.
- Report documenting RIPS/RSM system modifications and operation and results of flight testing (February 28, 2005)

Performance criteria:

- Adherence to scheduled delivery date

Subtask 3: RSM Algorithm Evaluation

The Contractor shall continue providing support of analysis of the RSM incursion detection algorithm using a Monte Carlo simulation. This analysis is being conducted under a NASA grant. Support shall be provided to integrate RSM to a government provided Monte Carlo simulator and as a technical consultant to the NASA grantee in the operation of the integrated RSM/Monte Carlo simulator. The Contractor shall also assist in interpretation of the results of the analysis and documentation of findings.

Deliverables:

- Report documenting interpretation of the results of the RSM Monte Carlo simulation delivered within six months of receipt of NASA grantee report and data.

Performance criteria:

- Adherence to scheduled delivery date

Subtask 4: Development of Roanoke Airport Surface Map for General Aviation Application

The contractor shall support development of a Roanoke Regional Airport (ROA) database for use in future RIPS-GA flight testing. The database is being created by a NASA Graphical Information Services (GIS) team. The contractor shall work with the GIS team in an iterative manner in order to insure the database meets the required RIPS specifications. The contractor shall also convert the database into the format specific for RIPS system usage.

Deliverables:

- Roanoke airport database in RIPS-specific format two months after delivery by GIS team.

Performance criteria:

- Adherence to scheduled delivery date

****End R4 block update*****

Subtask 5: (Previous Subtask 6) Technology Transfer Activities

One goal of the NASA Synthetic Vision Systems Project is to transfer technology developed under the program to private industry to accelerate implementation of the technology in aircraft. NASA will provide the Contractor with software technology transfer requests. The Contractor shall provide the RIPS and RSM software in the specified format for delivery to the requesting company. Support shall also be provided to integrate the software in the requesting company's facility. NASA will ensure that the requesting company completes the proper paperwork (Software Usage Agreement) before the software is transferred.

R4 ***NASA does not currently have any requests to transfer the RIPS and RSM software.***

Deliverables:

- RIPS and RSM software in specified format for transfer to R4 ***requesting company delivered within four weeks of request***

Performance criteria:

- Adherence to scheduled delivery date

3. Government Furnished Items:

The government shall provide all essential equipment, computers, and software development tools. The government shall also provide access to required laboratories, flight simulation facilities, and test aircraft.

4. 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.

5. Security clearance required for performance of work:

This is unclassified work.

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: R4 ***December 31, 2005***

7. NASA Technical Monitor: Denise R. Jones

M/S: 156A Phone: 757-864-2006

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 13RFL   Revision: 8   Date of Revision: January 27, 2005

Title: Aircraft Acoustic and Dynamics Monitoring System

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

The purpose of this work is to develop, integrate, and test a miniature, self-contained, flight qualified, acoustic and dynamics monitoring system for use on commercial airplanes. The acoustic and dynamics monitoring system shall include tri-axial accelerometers and one audio channel sampled at a rate of 8K samples per second and will initially be used to collect aircraft brake system data from the landing gear of an aircraft and transmit the data to a data collection system mounted in the interior of the plane. The first objective of this task is to take a NASA LaRC developed acoustic and dynamics monitoring system concept and develop a miniature, self-contained, flight qualified acoustic and dynamics monitoring system, test it, install it on the NASA LaRC B-757 aircraft, and use it to acquire brake system data during B-757 flight. The second objective is that once the brake monitoring system is fully developed and proven it shall be easily modified for monitoring multiple aircraft areas. Therefore, creating an aircraft health monitoring system network capable of augmenting the black box capability.

[R3] [R5]~~The purpose of this work is to develop, integrate, and test a miniature, self contained, flight qualified, adaptable vehicle health-monitoring architecture (ADMS) for use on commercial airplanes. The task objective is to redesign the device which has been flight tested. The device shall be redesign, qualified for airworthiness and flight tested on multiple aircraft locations~~.

Revision Record:

[R1]Extended period of performance due to needed design modifications as a result of bench testing, revised GFI for contract compliance.

[R2] Annotates completed status of Subtasks 1-3, redefines Subtasks 4-6 requirements, adds new Subtasks 7 and 8, and extends the completion date one year to reflect NASA's need for continued support.

[R3] Purpose and objective was modified. Extended period of performance due to leadless, passive, non-physical power connection sensor design breakthrough. Deliverables are extended due to NASA constraint. Subtask 4 was modified and Subtask 9 was added.

[R4] Subtask 10 and 11 added. The task expands the scope of the LC Sensor development. Subtask 4, 7, 8 and 9 have been postponed until further notice due to the addition of Subtask 10 and 11. Extends period of performance to December 31, 2003.

[R5]Extended period of performance to September 30, 2004 due to delay in the NASA External Agreement negotiations. Some deliverables of Subtask 10 and 11 were modified. Subtask 12 was added.

[R6] Updates Subtask 10 and 11 Deliverables and postpones Subtask 12 (see [R6] below).

[R7] Extends the period of performance three months to December 31, 2004 and adds requirements as Subtask 13 (see [R7] below).

Change 1: Contractor-initiated change extends the period of performance 2 months to February 28, 2005 (see [R7.1] below, section 6).

Revision 8: Extends period of performance and part of Subtask 13 schedule to June 10, 2005, adds deliverables 6 and 7 to Subtask 13, and adds metrics of performance to Subtask 13 (see R8 below).

2. **Description of the Work to be Performed**:

Subtask 1: R2 (Completed)

Subtask 2: R2 (Completed)

Subtask 3: R2 (Completed)

Subtask 4: R4R3 ~~**1. To Develop RF capability for the Inductor-Capacitor (LC) sensor interrogation**~~ R2 Modify the existing & proven Remote Data Acquisition Unit (RDAU)to be able to use it in multiple aircraft locations and creating a Monitoring Network.
R2 To accomplish this task the RDAU must be modified to: 1.Have RF commands encoded. 2. R3Have sensors external to the housing via flex circuitry. The sensors can also be internal but mounted in the casing vs. the PC Board. R3External Sensors are preferred over internal sensors. It is recommended to use Altera Processor. 3 Use aircraft power. R34. Monitor the fabrication of the new RDAU casing. Some of the RDAU casing could be of a high tensile, high/low temperature, lightweight material. 5. Multiple RDAU shall be fabricated. R46. To Develop RF capability for the Inductor-Capacitor (LC) sensor interrogation. Postponed until further notice due to addition of Subtask 10 and 11.

Deliverables:
R4R3 ~~For Item 1: Scannable RF Circuit designed, prototyped and tested. Investigate methods to increase the interrogation range between the LC sensor element and the scannable RF circuit. Reports on all findings and test to the TM.~~

For Items 1 trough 5:

1. Drawings, schematics, systems test procedures, R3all test results, specifications, cost, and a schedule for the design, integration, and testing of the monitoring system including the onboard storage system and the transceiver system.
2. R3Fabrication Drawings.
3. R2 Modified existing RDAU casing and system, fabricated, installed, tested, documented, and ready for flight-testing on the B-757. R3Postponed until FY'04
4. R2 New multiple flexible RDAU casings and system, fabricated, installed, tested, documented, and ready for flight-testing on the B-757. The number of casings to be determined by the Project. R3Postponed until FY'04
5. R4 For Item 6: Scannable RF Circuit designed, prototyped and tested. Investigate

methods to increase the interrogation range between the LC sensor element and the scannable RF circuit. Reports on all findings and test to the TM.

6. R2 Verbal weekly status reports to the TM indicating progress.

7. R2 Monthly written status report to the TM indicating progress.

R2 Schedule: R3~~Deliverables 1-3 due June 30, 2002~~. Deliverables 1 and 2 due June 30, 2003. Item 5 due March 31, 2003.

Metrics:

Meets: Contractor completes the R2 design modifications with only minor R2 changes on schedule

Exceeds: Contractor completes the R2 design modifications with no R2 changes and two weeks ahead of schedule. Contractor recommends modifications, agreed to by the government, that will improve the capability of the system to acquire aircraft flight data.

Subtask 5: R2 The Contractor shall test the R3interface between the new Command and Control Unit (CCU) R3and the RDAU RF Circuit. The new CCU is based on a Linux Operating System.

Deliverables: R2 The Contractor shall provide tests results to the CCU designer R3 and TM.

R2 Schedule: Within R3 ~~24~~ 72 hours of completed testing

Metrics:

Meets: R2 R3Test results report delivered on schedule to Technical Monitor.
Exceeds: R2 The Contractor suggests improvements (accepted by the government) that improve system performance.

Subtask 6: R2 The Contractor shall identify strategic measurement locations on entire B-757. R3Postponed until FY'04.

Deliverables:
R2 A list of all the possible locations on the B-757 where the RDAU could be installed. The list should be prioritized by order of mounting flexibility and Researcher Priority.

R2 Schedule: January 2, 2002

Metrics:
Meets: Contractor provides [R2] list on schedule.
Exceeds: Contractor [R2] provides list two weeks ahead of schedule.

Begin [R2] block
Subtask 7: The Contractor shall conduct RDAU environmental testing.

Deliverables:
Verified test data, test notes, and a brief test report following the environmental test.

Schedule: Within 24 hours of each test

Metrics:
Meets: Contractor provides the TM with the reduced test data, test notes, and a brief report after each test indicating system performance and any significant problems requiring resolution on schedule.
Exceeds: Contractor suggests improvements (accepted by the government) that improve system performance.

Subtask 8: The Contractor shall participate in test flights on B757 and NASA GA Aircraft. [R3]Postponed until FY'04. [R5] Postponed until further notice.
Deliverables:
Verified flight data, flight notes, and a brief test report following the research flights.

Schedule: Within 24 hours of each test flight

Metrics:
Meets: Contractor provides the TM with the reduced data, flight notes, and a brief report after each test indicating system performance and any significant problems requiring resolution – on schedule.
Exceeds: Contractor suggests improvements (accepted by the government) that improve system performance.
End [R2] block
Begin [R3] block addition
Subtask 9: Provide upon request: test support for Technology Transfer activities related to ADMS. [R4]Postponed until further notice.
Deliverables: Test report to TM within a week of test completion.
Metrics:
Meets: Contractor delivered on schedule.
Exceeds: Contractor suggests improvements (accepted by the government) that improve system performance.

End R1 block addition
Begin R4block addition
R4 ***Subtask 10:*** Design and fabricate a prototype L-C fluid-level sensor which can be used in a metallic cavity (or cavity made of electrically conductive material). L-C fluid-level sensor shall be capable of measuring levels of viscous and nonviscous fluids.

Deliverables: R5 Items 1-R611 Delivered

1. Fabricate prototype capacitive element by June 30, 2003.
2. Identify and characterize inductors suitable for use in aforementioned tasks by June 30, 2003.
3. Characterize radio frequency response of assembled L-C fluid-level sensor. Use viscous fluid such as landing gear fluid, transmission fluid or oil by June 30, 2003.
4. Characterize effect of of inductor magnetic field to conductive surface proximity by June 30, 2003.
5. Characterize effect of placing capacitive element into closed metallic cavity by June 30, 2003.
6. All drawings, documentation (test procedures) and data from deliverables items 1 trough 5 by July 31, 2003.
7. Characterize fluid capillary effect on landing gear fluid measurements by Aug 29, 2003.
8. Characterize the effect of residual viscous fluid film on capacitance element by August 29, 2003.
9. Identify and characterize electrically insulative material suitable for use in landing gear fluid. This information may be provide external to NASA by September 30, 2003.
10. All drawings, documentation (test procedures) and data obtained and/or produced from deliverables items 7, 8 and 9 by October 17, 2003.
11. R5Assist the PI in the temperature and environmental characteristic testing of the fluid-level sensor. Test procedure to be provided by the PI. Task to be done by January 30, 2004
12. R5 Canceled All drawings, documentation (test procedures) and data obtained and/or produced from deliverables item 11 by December 5, 2003.
13. Provide all design, data, drawings, prototype of L-C fluid-level sensing element and interrogation unit for transfer to industry. Transfer will be done according to NASA R5External Agreement with Industry. (May 30, 2004)
14. R5Assist the Principal Investigator on the L-C fluid level sensing element testing at industry locations as needed. – Date varies between December 2003 and August 2004. The testing might involve traveling to the industry site with a possible duration of one week at the time. R6ONGOING

Metrics:

Meets: The contractor delivers all products on schedule.
Exceeds: The contractor suggests improvements (accepted by the government) that improves system performance and delivers all products two (2) weeks ahead of schedule.

R4 ***Subtask 11:*** Develop a portable analog L-C sensing element interrogation unit which shall power L-C sensing element via Faraday induction; receive radio frequency response from inductive element; identify resonant frequency of received response; and convert response to digital signal. Unit shall be housed in container of dimensions less than 8 in x 5 in x 3 in. Antenna is external to container but electrically coupled to electronics within container.

Deliverables: R5 Itens 1-4 Delivered R6 Items 5-10 Completed

1. Identify all electrical components which are necessary to develop aforementioned unit. Components shall include portable antenna (outer dia less than 12 in); electronics for switching antenna from transmitting to receiving antenna; electronic components to produce broadband radio frequency transmission; electronics to tune range of radio frequency transmission; electronics to sample the radio frequency response from the inductor by July 30, 2003.
2. Characterize antenna suitable for use in aforementioned tasks by June 30, 2003.
3. Configure and test the components on a circuit breadboard by August 30, 2003.
4. Electricaly couple antenna to breadboard circuit and test the following:
   a. Radio frequency transmission and reception by September 30, 2003.
   b. Acquire radio frequency response from inductive element of L-C sensing element by September 30, 2003.
5. R5 Provide a draft design of the inductor element. – Due date is January 30, 2004.
6. R5 Preliminary design of the interrogation unit. – Due date is January 30, 2004.
7. R5 Fabricate prototype of the portable interrogation unit by March 31, 2004. The interrogation unit shall have a graphical display and a means for inputting commands (e.g. a keypad). The use of a laptop with the breadboard interrogation unit will be acceptable for drop test if the unit has not been ready for the drop tests (scheduled for August 30, 2004). The unit shall be capable of making static and quasi static fluid level measurements.
8. Validate use of portable interrogation unit for the acquiring fluid-level measurements by R5 ~~November 30, 2003~~ April 30, 2004.

Begin R5 block addition

9. Provide technical assistance to the Principal Investigator to characterize fluid-level sensor in a shock-strut assembly. Due date is April 30, 2004.

Begin R6 block update

10. Complete rugged breadboard unit drawings – April 30, 2004.
11. Fabricate rugged breadboard unit – May 31, 2004.

12. Rugged breadboard unit testing completed – June 4, 2004..
13. Provide technical assistance in the main landing gear strut at Messier Dowty Inc facilities in Toronto. The first set of tests will occur June 14-18, 2004 will require support in Toronto, Canada..Testing for the duration of the cooperative agreement between LaRC and industry partner strut tests
14. Design and fabricate self-contain measurement acquisition unit with hardware functionality of the breadboard unit listed in item 7 with the addition of a graphical display and keypad interface – Delivery date is at the end of the cooperative agreement between LaRC and industry partner.

End R5block addition

15. Provide input on the design of the self-contain measurement acquisition unit throughout the design phase listed above on number 14.
16. Integrate measurement system, graphical display and keypad into unit housing. – Delivery date is by the end of the cooperative agreement between LaRC and industry partner.
17. Test and validate self-contain measurement acquisition unit. – Delivery date is by the end of the cooperative agreement between LaRC and industry partner. Some testing of unit may be done in Toronto. The testing may require a second visit to the Messier Dowty facilities. Dates TBD but tentatively scheduled for FY04 last QTR

End R6block update

Metrics:

Meets: The Contractor delivers all products on schedule.
Exceeds: The Contractor suggests improvements (accepted by the government) that improves system performance and delivers all products two (2) weeks ahead of schedule

End R4block addition
Begin R5block addition

Subtask 12: The following Subtask will be completed after all the testing done and data obtained from Subtask 10 and 11 are satisfactory to the Principal Investigator. The static/ quasi static portable interrogation unit shall be modified to be able to make dynamic measurements.

Deliverables: R6Items 1-3Postponed

1. Portable Interrogation Unit capable of measuring dynamic fluid level measurements. Due date is R6~~September 30, 2004~~.
2. Validate use of portable interrogation unit for the acquiring of dynamic fluid level measurements. Fluids includes oxygen, methane, carbon monoxide, resin. Due date is R6~~September 30, 2004~~.
3. Provide all design, drawings, data, documentation pertaining to the L-C sensor and the Portable Interrogation Unit to NASA Langley Research Center. Due date is

R6 ~~September 30, 2004~~.

Metrics:

Meets: The contractor delivers all products on schedule.

Exceeds: The contractor suggests improvements (accepted by the government) that improves system performance and delivers all products two(2) weeks ahead of schedule.

End R5 block addition

Begin R7 block addition

R7 ***Subtask 13:*** Develop a hand-held magnetic field response measurement acquisition unit which shall power magnetic field response sensors via Faraday induction; receive magnetic field response from sensor; identify attributes (frequency, amplitude and bandwidth) of received response; and convert response to alpha-numeric readout on liquid crystal display. Components of unit are aforementioned electronics on printed circuit board, liquid crystal display, batteries and battery case, unit housing and antenna. Unit shall be housed in container of dimensions less than 7 in x 4 in x 1.5 in. All components are internal to unit housing. Unit is to be powered by 4 AA batteries.

Deliverables:

1. Identify all electrical components which are necessary to develop aforementioned unit. Components shall include antenna; electronics for switching antenna from transmitting to receiving antenna; electronics to select and produce magnetic field harmonics; electronics to sample the radio frequency response from a magnetic field response sensor by August30, 2004. R8 ***Completed***
2. Preliminary design of the interrogation unit. – Due date is Sept 30, 2004. R8 ***Completed***
3. Fabricate prototype of the portable interrogation unit by R8 ~~Nov 25,~~ 2004 ***June 10, 2005***. The interrogation unit shall have an alpha-numeric display and a means for inputting commands (e.g. a keypad). Software updates/modifications to unit will be via electrical connection to external personal computer. The unit shall be capable of acquiring measurements at rate of one measurement per 30 sec.
4. Validate use of portable interrogation unit for the acquiring magnetic field response measurements by R8 ~~Nov 30, 2004~~ ***June 10, 2005***.

*****Begin R8 block addition*****

5. A self contained electrical circuit for two antenna with microprocessor by June 10, 2005.
6. All hardware, software, drawings and documentations developed by the Contractor must be delivered to LaRC in order and excellent working conditions at the end of the task

*****End R8 block addition*****

Provide technical assistance to the Principal Investigator to characterize magnetic field response sensors

****Begin R8 block addition*****

Metrics:

Meets: The Contractor delivers all products on schedule.

Exceeds: The Contractor suggests improvements (accepted by the government) that improves system performance and delivers all products two (2) weeks ahead of schedule

****End R8 block addition*****

End R7 block addition

3. R1 **Government Furnished Items**:

1. Personal ground computers loaded with specialized software for the generation of schematics and documentation.
2. Special laboratory equipment
3. Special computer and software for the onboard data collection system.
4. Laboratory space in NASA LaRC Buildings 1202, 1244, R3 and 1250.
5. Government facilities and special equipment for environmental testing.

4. **Other information needed for performance of task**:

1. Major system buildup, installation and validation will occur at Langley Research Center (LaRC) Building 1202, R7Structural Dynamics Research Laboratory in Bldg 1293 or Aircraft Hanger (Building 1244).
2. There are times when aircraft access is restricted, such as C-Checks; the B-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 B-757 aircraft. No exceptions are allowed in flight hardware inspection. Inspection must be scheduled.
4. All flight data systems soldering, crimping, etc., must be performed to NASA Standards.
5. Wiring, crimping, installation, etc., of aircraft hardware must be performed by certified personnel.
6. 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” and meet flight requirements as per NASA LHB-7910.1
7. New or modified instrumentation drawing must meet NASA Drawing Procedure LAPG 7320.1.
8. Component environmental testing will occur at NASA LaRC unless vendor performed.
9. Repair of Government furnished items may be scheduled through NASA-funded equipment repair facilities.
10. 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 of equipment may be scheduled through NASA-funded calibration facilities

	traceable to National Calibration Standards. 11. Contractor may use NASA environmental (Environmental Test Facility, Building 1250) and EMI test facilities to qualify flight hardware. 12. Contractor may utilize NASA furnished parts and components. 13. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards. 14. Contractor may utilize NASA furnished fabrication facilities/resources to complete fabrication, packaging and assembly of flight hardware, including mechanical hardware and wiring. 15. 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. 16. [R3]All documentation, drawings and hardware are to be treated as US Government NASA LaRC Property, except for those that are agreed upon by NASA LaRC Technology Transfer Office.
5.	**Security clearance required for performance of work**: NONE
6.	**Period of Performance**: Planned start date: January 2, 2001 Completion date: [R1] ~~March 30, 2001~~ [R2] ~~September 30, 2001~~ [R3] ~~September 30, 2002~~ [R4]~~September 30, 2003~~ [R5]~~December 31, 2003~~ [R7]~~September 30, 2004~~ [R7.1]~~December 31, 2004~~ [R8]~~February 28, 2005~~ ***June 10, 2005***
7.	**NASA Technical Monitor: Guillermo A. Gonzalez** M/S: 356 Phone: 757-864-7107 NASA Competency/Other Technical Coordinator**:** [R3]Dr. Stanley E. Woodard M/S: 230 Phone: 757-864-4346

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

	Task Order Number: 14RAC Revision: ____ Date of Revision: Title: Low Speed Wind Tunnel Tests of Engine Thrust Effects on Inboard-Wing Transport Model

1.	Purpose, Objective or Background of Work to be Performed: Tests are to be made in the ViGYAN Low Speed Wind Tunnel to determine the effects of simulated engine thrust on the aerodynamic characteristics of an inboard-wing transport model. Force and moment tests for a conceptual Inboard Wing model have previously been made in the same tunnel. The proposed engine thrust effects tests will be made with a geometrically similar semispan model of the same scale mounted on a reflection plane. The simulated engine thrust will be produced with an external compressed air bottle ejecting controlled air through the base of the model body. The semispan model will be constructed in order to facilitate the passage of air from the compressed air bottle to the model base. The semispan wing and horizontal tail will be mounted on a strain gage balance. .
2.	Description of the Work to be Performed: The Contractor shall design, fabricate, and test the thrust effects model as follows: Model design and fabrication (as shown in the attached sketch, last page) **The model shall be sized to obtain the best results in the Vigyan low-speed tunnel. Precise sizing will require discussions between the technical monitor and the Contractor.** One semispan wing One semispan horizontal tail One fuselage One vertical tail with provisions for removal and for varying the incidence angle One wing tip extension One underwing flow-through nacelle with shock body One fuselage engine inlet A reflection plane with minimal clearance for the wing and tail and provisions for mounting the model to a strain gage balance A compressed air system with air flow controls and piping to the fuselage base with provisions for adjusting the jet direction Test Requirments Force and moment balance measurements for various flow levels Surface oil flow and wake visualization Angle of attack range about -4 to 10 degrees

	Task Order Number: 14RAC Revision: ____ Date of Revision: Title: Low Speed Wind Tunnel Tests of Engine Thrust Effects on Inboard-Wing Transport Model

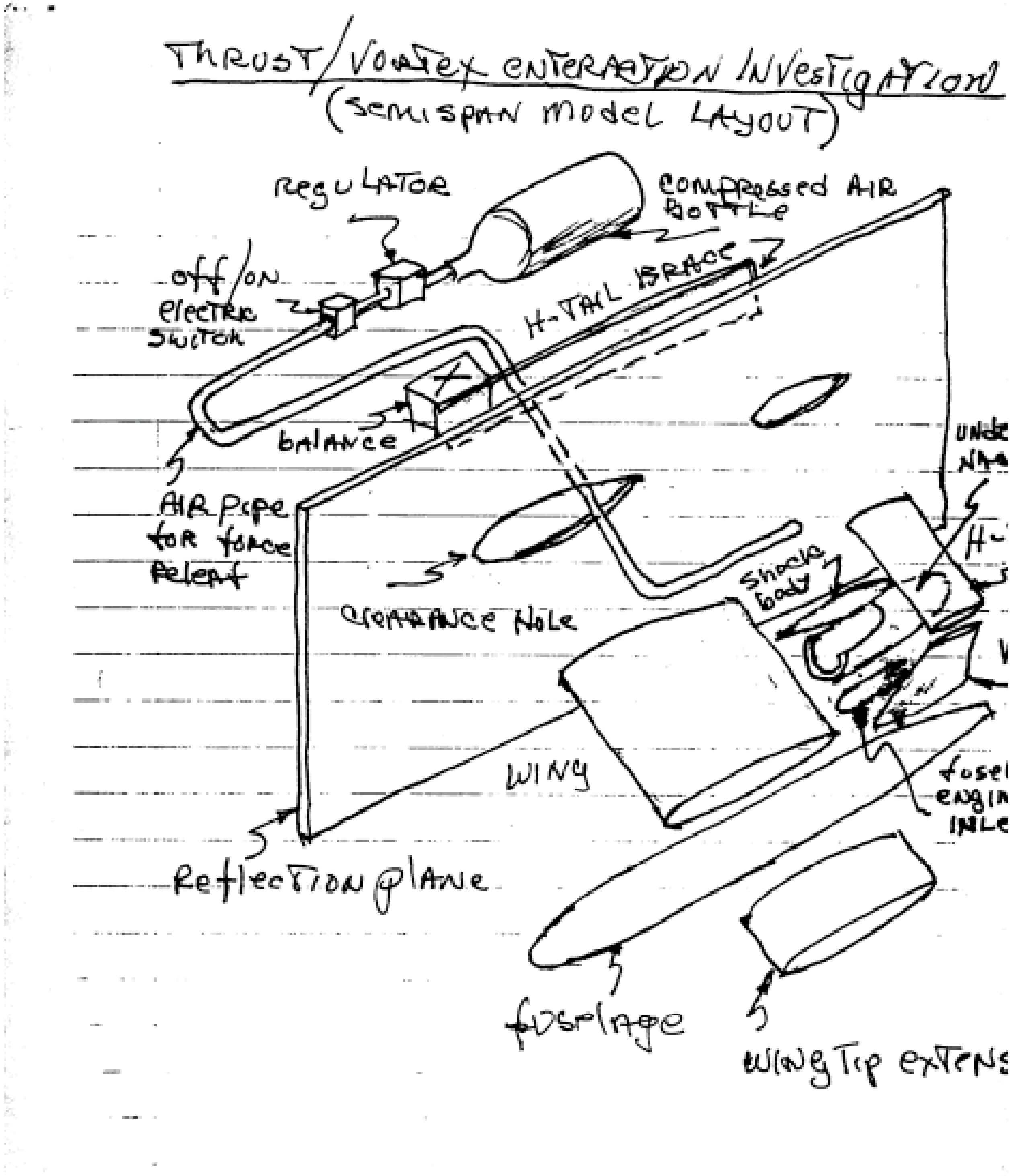
	<u>Test Configurations</u> Wing and fuselage (with and without tip extension) Wing, fuselage, vertical tail (with and without tip extension) Wing, fuselage, vertical tail, horizontal tail (with and without tip extension) Complete model with underwing nacelle and shock body Complete model with fuselage inlet <u>Deliverables</u> 3-view drawing of as-built test article Test conditions and run log Test data in printouts, plots, and electronic media Photographs of surface oil flow and trailing wake <u>Meets</u> Provide raw plots and data per deliverables for each test configuration as follows: C_L vs. C_D, C_L vs. □, and C_M vs. □ Provide flow visualization photos for each test configuration tested. Deliver results by 30 November, 2001. <u>Exceeds</u> Provide plots with annotations indicating data correlation between configurations (e.g., superimposed plots, configuration icons, unexpected results) Provide a research report on the findings of this test activity. OR Deliver results by 15 November, 2001. <u>Period of Performance</u> Planned start date August 20, 2001 Completion date November 30, 2001
	<u>Government Furnished Items</u>: Model details.
4.	<u>Other information needed for performance of task</u>: None.
5.	<u>Security clearance required for performance of work</u>: Unclassified.
6.	<u>Period of Performance</u>: Planned start date: August 20, 2001 Completion date: November 30, 2001

	Task Order Number: 14RAC Revision: ____ Date of Revision: Title: Low Speed Wind Tunnel Tests of Engine Thrust Effects on Inboard-Wing Transport Model

7.	NASA Technical Monitor: M. Leroy Spearman M/S: 348 Phone: 757-864-5226 NASA Competency/Other Technical Coordinator Robert McKinley M/S: 348 Phone: 757-864-7572

Task Order Number: 14RAC Revision: ____ Date of Revision:

Title: Low Speed Wind Tunnel Tests of Engine Thrust Effects on Inboard-Wing Transport Model



Task Order Number: 14RBG Revision: 10 Date of Revision: 2/23/05

Title: Support for the Development of Optical Measurement Techniques

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

Begin R5 block redefinition

The work to be performed under R6this task will be in support of developing a Laser Induced Thermal Acoustics (LITA) system for use in supersonic wind tunnels with densities below 1 atmosphere. This work is sponsored by the LaRC Aersopace Vehicle Sytems Technology (AVST) program office under the Efficient Aerodynamic Shapes and Integration (EASI) subprogram for Advanced Instrumentation Development.

End R5 block redefinition

Begin R6 block addition

Additional work will be to provide continued support for the development of an optical multi-point vibrometer. The vibrometer work has been ongoing for several years and has been sponsored by the Quiet Aircraft Technology program within AVST.

End R6 block addition

Begin R9 block addition

The new work (Subtask 6) to be performed under this task will be in support of developing an iodine-based optical instrumentation diagnostic for CFD aero-heating validation of cavity flows. This work is sponsored by the shuttle return-to-flight program.

Begin R9 block addition

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, and redefines the requirements for the new period of performance with former Subtask 3 extended one month and renumbered as Subtask 1. For contract compliance, GFI wording is also revised.

Revision 2: Extends the schedule of Subtasks 5 (two months for out-of-spec vendor supplied equipment) and 6 (one month for additional required electronics design work) and the overall completion date one month and adds travel requirements.

Revision 3: Extends the period of performance eleven months in continuation of NASA's support requirements, redefines the requirements for the new period of performance, and updates the title.

Revision 4: Adds a deliverable to Subtask 1 and extends its schedule and the task order period of performance one month to November 30, 2003.

R5*Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as doc files 14RBG, 14RBG01, 14RBG02, 14RBG03, and 14RBG04.*

Revision 5: Extends the period of performance from November 30, 2003, to March 12, 2004, in continuation of NASA's support requirements with redefined requirements and updated information for the new period of performance (see R5 above and below).

Revision 6: Extends the period of performance 7.5 months to October 31, 2004, in continuation of NASA's support, new requirements added as Subtasks 2 and 3 for the new period of

performance, and updates other info (see R6 above and below).
Revision 7: Extends the period of performance one month to November 30, 2004, in continuation of NASA's support with some descoping of Subtask 3 and added requirements as Subtask 4 (see R7 below).
Revision 8: Extends the period of performance three months to February 28, 2005, in continuation of NASA's support with requirements added as Subtask 5 (see R8 below).
Revision 9: Adds new requirements as Subtask 6, documents TM change that became effective December 1, 2004, and extends the period of performance one month to 3/31/05 (see R9 above and below).
Revision 10: Extends the period of performance seven months to October 31, 2005 in continuation of NASA's support with Subtask 5 schedule extended three months and an added deliverable and new requirements as Subtask 7 (see R10 below).

2. Description of the Work to be Performed:

The Contractor shall perform the following subtasks:
Begin R5 block requirements redefinition

Subtask 1: The Contractor shall conduct reviews of the currently available and emerging literature pertaining to application of resonant and non resonant LITA in densities below one atmosphere and at supersonic speeds. These reviews shall encompass all sectors of the technology base, including industry, academia, and government institutions such as NASA and DoD. The outcome of these reviews shall be a summary report, suitable for publication as a NASA Contractors Report, and shall include (a) summary descriptions of resonant and non resonant LITA systems that have been and are currently used for measurements in low density supersonic flows, (b) advantages and disadvantages of different approaches, (c) justified conclusions as to which approach is considered most viable, (d) an exhaustive list of references on the subject, and (e) a contact list with full contact information for notable principal investigators or industry leaders that are identified during the technology review.

Deliverables: The Contractor shall provide:
1. Electronic and printed copies of the report as described above. All references that are available electronically shall be provided on CD as Adobe Acrobat *.pdf files. A separate reference list document, in either MS-Word or Excel Format, should be stored on the CD and the reference *.pdf files shall be hyperlinked to this document. This will enable easy recall of the reference documents.

Schedule: Subtask 1 shall be completed by 3/12/04.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:
1. Thoroughness of the technical review

2. Quality, accuracy, and completeness of the summary report

Standards:

Minimum acceptable performance standards:

1. Completion of this subtask within the contracted time and cost

Exceeds minimum performance standards: The Contractor can exceed minimum performance standards by:

1. Formally submitting the deliverable document for publication as a NASA Contractors Report

End R5 block requirements redefinition

Begin R6 block addition

Subtask 2: The Contractor shall assemble and characterize a pulsed Nd:YAG (neodymium: yttrium aluminum garnet) laser for use in a LITA system capable of measurements in supersonic wind tunnels. The outcome of this effort will be a report, suitable for publication as a NASA Contractors Report, containing measured laser characteristics and will include (a) output energy at 1064, 532, and 266 nm, (b) pulse to pulse energy fluctuation at each wavelength, (c) pulse width (full width at half maximum) at each wavelength, and (d) focal spot size at each wavelength with a 1 meter lens.

Deliverables: The Contractor shall provide:

1. Electronic and printed copies of the report as described above. All references that are available electronically should be provided on CD as Adobe Acrobat *.pdf files. A separate reference list document, in either MS-Word or Excel Format, should be stored on the CD and the reference *.pdf files should be hyperlinked to this document. This will enable easy recall of the reference documents.

Schedule: Subtask 2 shall be completed by 6/12/04.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Quality, accuracy, and completeness of the summary report describing the laser performance specifications
2. Rate of progress of assembling the laser

Standards:

Minimum acceptable performance standards:

1. Completion of this subtask within the contracted time and cost

Exceeds minimum performance standards: The Contractor can exceed minimum performance standards by:

1. Formally submitting the deliverable document for publication as a NASA Contractors Report

Subtask 3: The Contractor shall provide continued support for the development of a multi-point optical vibrometer for the measurement of structural vibration. This includes:

- Conducting demonstration tests of the device in the NASA LaRC Acoustic [R7]Physics Laboratory
- Development of enhanced data acquisition, processing, and analysis software
- Evaluation and/or development of sensor arrays for achieving vibration measurements over a 2-D area

Deliverables: The Contractor shall provide:

1. Support for conducting demonstration tests of the multi-point vibrometer in the [R7]Acoustic Physics Laboratory
2. Data from the proof-of-concept tests quantitatively indicating the performance of the multi-point vibrometer
3. Enhanced data acquisition, processing, and analysis software for the multi-point vibrometer
4. A prototype sensor and associated control and acquisition software enabling vibration measurements over a 2-D area.
5. All data, software, and documentation are to be provided to the government for unrestricted use and duplication

Schedule: Subtask 3 shall be completed by [R7]~~October 31, 2004~~November 30, 2004

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

3. Progress toward developing the capability for vibration measurements over a two-dimensional area.

Standards:

Minimum acceptable performance standards:

1. Completion of this subtask within the contracted time and cost
2. Demonstrating the ability of the multi-point vibrometer to measure vibrations over a two-dimensional area
3. Quantifying the performance of the vibrometer, including measurement accuracy specifications, over the two dimensional array of measurement points (determination of accuracy of measurements at the four corners of the measurement area and the center of the measurement area is sufficient)

Exceeds minimum performance standards: The Contractor can exceed minimum performance standards by providing either one of the following:

1. Document results in a report suitable for publication as a NASA Contractors report.

End R6 block addition

Begin R7 block addition

Subtask 4: The Contractor shall provide support for the Nosecone Deployment Trajectory Tracking Test to be conducted in the NASA Langley 8-Foot High Temperature Tunnel. In this capacity, the Contractor shall perform post-test analysis of high speed video data of the nosecone shroud trajectory. The results of the analyses will be tables showing spatial coordinates of registration marks on the nosecone shroud as a function of time after deployment. The Contractor is responsible for designing a camera calibration rig for translating video from the camera coordinate system to the physical coordinate system. In collaboration with Advanced Sensing and Optical Measurement Branch (ASOMB) technician staff, the Contractor is responsible for assembling and testing the calibration rig. In collaboration with ASOMB and 8-HTT technician staff, the Contractor shall install the camera calibration rig in the 8-HTT and calibrate the video camera either pre-or post-test. The Contractor shall participate in all pre-test meetings and coordinate scheduling with the 8-HTT staff. The Contractor shall collaborate with 8-HTT staff to ensure the proper field-of-view for the high speed video camera. The contractor shall develop all software necessary to track the registration marks on the nosecone throughout the deployment. This software is to be tested and validated on at least 5 different simulated nosecone shroud deployments prior to the actual test. The Contractor shall format the test results in Excel spreadsheets, including descriptive plots and documentation, for delivery to NASA LaRC and external partners including Raytheon and the Navy.

Deliverables: The Contractor shall provide:

1. CDs containing the software written to perform the registration mark trajectory tracking on the nosecone shroud, including descriptive documentation.
2. High speed video camera calibration data for transforming image pixel coordinates to real-world spatial coordinates.
3. Excel spreadsheets containing image pixel and real-world spatial coordinates of registration marks on the nosecone shroud after deployment. Includes descriptive plots.
4. Descriptive documentation indicating the accuracy of the results and the procedures performed to quantify the accuracy.

Schedule: Subtask 4 shall be completed by October 1, 2004.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Level of software validation performed prior to test.
2. Preparedness to provide rapid data turnaround after test completion

Standards: Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed the minimum performance standards by either:

1. Integrating different camera calibrations into the analyses to compensate for the change in object (shroud) distance from the camera due to gravity
2. Engage in post-test correspondence among the test partners for further data interrogation and analysis

End R7 block addition
Begin R8 block addition

Subtask 5: The Contractor shall provide support for the installation and of a dual-pump Coherent Anti-Stokes (CARS) system for simultaneously measuring temperature and probing N_2, O_2 and H_2. The existing system was disassembled in 2003 and requires re-assembly in the 2nd floor "CARS Lab" in Building 1221. In collaboration with ASOMB technical staff, the Contractor shall set up and operate one commercial dye laser and one home-made pulsed dye laser, a CCD-camera-equipped spectrometer, data acquisition, and timing systems. The previously-used YAG laser will be replaced by a new injection-seeded YAG laser that is being purchased from Spectra Physics. The previously-used conventional broadband dye laser will be replaced by a "modeless" dye laser that will require design and assembly by the Contractor in collaboration with ASOMB staff. These two modifications to the CARS system will improve the single-shot precision of temperature and mole fraction measurements. Successful completion of this installation will involve application of this system to an existing flat-flame Hencken burner to quantify the improvement in measurement precision.

Deliverables: The Contractor shall provide:

1. Two copies of a laboratory notebook describing the characterization of the new equipment including (i) new YAG laser performance, (ii) design and performance of new modeless dye laser and (iii) schematics of the CARS system setup.

2. Analysis of CARS temperature and N_2, O_2 and H_2 mole fraction measurements in an atmospheric pressure hydrogen-air flame with varying fuel-air ratio. Analysis will include computation of measurement precisions (based on 1 standard deviation of

100 measurements); these precisions will be compared to previously obtained precisions with the older version of the CARS system which was documented in the 2003 ICIASF conference paper by O'Byrne et al. Mean temperatures should be compared with equilibrium calculations as per the 2003 ICIASF conference paper. Data is to be delivered in Excel Spreadsheet format.

R10 ***3. The Contractor shall modify the CARS system to probe Nitrogen and Carbon Dioxide.***

Schedule: Subtask 5 shall be completed by R10 ~~February 28, 2005~~ ***May 31, 2005***.

Metrics: The following metrics will be used to assess the Contractors progress towards meeting the standards:

1. Progress in installing and operating new YAG laser (Spectra Physics' primary responsibility with some assistance provided by the Contractor).

2. Progress in installing and operating commercial dye laser.

3. Progress in installing and operating CCD-camera-equipped spectrometer

4. Progress in designing, installing and operating modeless dye laser.

5. Progress in operating the completed CARS system to obtain temperature, N_2, O_2 and H_2 measurements.

Standards: Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed the minimum performance standards by either:

1. Document the results of this investigation in a conference paper.

2. Modify the system by changing the narrowband laser's dye to allow the system to probe N_2 and CO_2 instead of N_2, O_2 and H_2.

End R8 block addition

Begin [R9] block addition

Subtask 6.0: The Contractor shall conduct reviews of the currently available and emerging literature pertaining to application of continuous-wave(CW) and quasi-CW laser sources for generation of deep ultraviolet radiation capable of iodine excitation. These reviews will encompass all sectors of the technology base, including industry, academia, and government institutions such as NASA and DoD. The outcome of these reviews will be a summary report, suitable for publication as a NASA Contractors Report, which will include (a) list of optical sources currently available from 185-200 nm and 248-249 nm,
(b) advantages and disadvantages of different approaches, (c) justified conclusions as to which approach is considered most viable and cost effective, (d) an exhaustive list of references on the subject, and (e) a contact list with full contact information for notable principal investigators or industry leaders that are identified during the technology review.

Deliverables: The contractor shall provide:
1. Electronic and printed copies of the report as described above. All references that are available electronically should be provided on CD as Adobe Acrobat *.pdf files. A separate reference list document, in either MS-Word or Excel Format, should be stored on the CD and the reference *.pdf files should be hyperlinked to this document. This should enable easy recall of the reference documents.

Schedule: Subtask 6 shall be completed by 3/31/05.

Metrics: The following metrics will be used to assess the contractor's progress towards meeting the standards:
1. Thoroughness of the technical review
2. Quality, accuracy, and completeness of the summary report

Standards:
Minimum acceptable performance standards:
1. Completion of this subtask within the contracted time and cost

Exceeds minimum performance standards: The Contractor can exceed minimum performance standards by:
1. Formally submitting the deliverable document for publication as a NASA Contractors Report

End [R9] block addition

Begin [R10]block addition

Subtask 7: The Contractor shall provide support for two Nosecone Deployment

Trajectory Tracking Tests to be conducted in the NASA Langley 8 Foot High Temperature Tunnel.

The Contractor shall

1. Participate in pretest planning meetings.
2. Perform laboratory reassembly and checkout of dotcard calibration target.
3. Reconfigure and provide refresher on high speed video analysis software.
4. Provide assistance / consultation with reinstallation and checkout of high speed video system and lighting.
5. Reassemble computer system for digitally downloading video from HSV camera.
6. Perform optical alignment of camera system.
7. Recheck lighting system and camera / lens settings to verify appropriate lighting for nosecone deployment.

The following will be done for two different deployments of identical shrouds (no changes to test configuration) occurring within the same tunnel entry:

8. Calibration of camera system, including analysis of calibration imagery (two calibrations should be done because the lighting and camera must be moved in order to move the nosecone in/out of the test section)
9. Calibration of dots on shrouds using FARO arm because dots will be in different places on different nosecones
10. Attend actual deployment tunnel runs
11. Download and archive high speed video from both tunnel runs
12. Deliver data package to customer.
13. Perform posttest analysis / correspondence / consultation
14. Format the test results in Excel spreadsheets, including descriptive plots and documentation, for delivery to NASA LaRC and external partners including Raytheon and the Navy.
15. Analyze high speed video data to obtain quantitative trajectory measurements.

Deliverables: The Contractor shall provide CD’s containing:

1. The software written to perform the registration mark trajectory tracking on the nosecone shroud, including descriptive documentation.
2. High speed video camera calibration data for transforming image pixel coordinates to realworld (2-D) spatial coordinates.

3. Excel spreadsheets containing image pixel and realworld (2-D) spatial coordinates of registration marks on the nosecone shroud after deployment. Includes descriptive plots.
4. Descriptive documentation indicating the accuracy of the results and the procedures performed to quantify the accuracy.

Schedule: Subtask 7 shall be completed by 31 October 2005.

Metrics: The following metrics will be used to assess the contractor's progress towards meeting the standards:

1. Level of software validation performed prior to test.
2. Preparedness to provide rapid data turnaround after test completion.

Standards: Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Standards: The Contractor can exceed the minimum performance standards by either:

1. Integrating different camera calibrations into the analyses to compensate for the change in object (shroud) distance from the camera due to gravity
2. Engage in posttest correspondence among the test partners for further data interrogation and analysis.

*****End R10 block addition*****

3. Government Furnished Items:

Computers loaded with specialized software, video cameras and subsystems, optics, optoelectronics, and specialized instrumentation, media, and electronics required to perform the task will be supplied by the government. Office and laboratory space will be provided by the government in NASA LaRC Building 1200.

4. Other information needed for performance of task:

The Contractor shall have access to government facilities to support this task. The Contractor must be suitably trained in laser safety and follow the laser safety guidelines outlined in LHB 1710.8 when using lasers in a NASA Langley facility.

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

6. Period of Performance:

Planned start date: R5 12/1/2003 Completion date: R6R5 ~~3/12/2004~~

		R7 ~~10/31/2004~~ R8 ~~11/30/04~~ R9 ~~2/28/04~~ R10 ~~3/31/2005~~ ***October 31, 2005***
7.	**NASA Technical Monitor:** R9 R. Jeffrey Balla M/S: 493 Phone: 757-864-4608 **NASA Competency Coordinator:** M/S: Phone:	

Task Order Number: 14RCE Revision: ____ Date of Revision:

Title: **Advanced Materials Analysis and Testing**

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

The purpose of this task is to conduct mechanical testing and microstructural analyses on materials systems, with the primary focus being advanced metallic materials. The objective is to establish processing-microstructure-property relationships for the material systems for aerospace applications. In addition, this task includes activities for chemically cleaning and surface modification of metallic materials for subsequent processing and/or analysis.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

The requirements described below represent an update of previous task order 12RCE. This revision extends the period of performance one year in continuation of NASA's support with some clarification of requirements and a change in the title and number for the new period of performance.

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1 Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written ***NOR*** basis. The Government will provide the materials which will primarily be metallic-based, although other materials may be included on a limited basis. Preparation techniques will include sectioning, mounting, mechanical and chemical or electrochemical polishing of specimens suitable for optical metallography, x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis. The Contractor shall ensure equipment is operational prior to and after analyses. ***The Contractor***

shall ensure equipment is within current calibration, where appropriate. Specific analyses and quantities are detailed below:

- Utilize a variety of optical microscopes in conjunction with SEM with energy- and wavelength-dispersive spectrometry (EDS and WDS) systems and a microtexture analysis system to analyze the chemistry, morphology, and orientation of individual grains and/or particles and of the bulk microstructure (up to 100).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to 40).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques (up to 20).
- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to 40).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to 25).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to 30).
- Conduct hardness and microhardness tests on metallic materials (up to ***30***).

Deliverables (for 2.1):

- For each ***NOR***, brief informal statement (written or oral) of types of analyses to be conducted and estimated time for completion to the Requester within 5 working days after receipt of the ***NOR***.
- For each ***NOR***, informal written and oral report of results to the Requester within 5 working days after completion of the analysis. The report shall include description of analyses and interpretation of results. The report shall include any photomicrographs, compositional analyses, x-ray and electron diffraction data relevant to the microstructural characterization performed.
- Informal written monthly reports that list ***NORs*** completed during the reporting period, costs, the scheduling priorities for upcoming ***NORs***, and any other pertinent issues
- Written informal final report summarizing the number and types of analyses conducted, standards and procedures used, and any specialized analysis techniques and procedures developed. (***12/31/2003***)

Performance Standards (for 2.1):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- ***NORs*** completed by requested due date (accounting for complexity and competing

requests)
- Quality of reports
- ***NORs*** completed by requested due date
- Cost

EXCEEDS:
- ***NORs*** completed ahead of requested due date
- "rush" ***NORs*** designated by the task monitor expedited
- Completion under cost

Subtask 2.2: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written ***NOR*** basis to determine the mechanical behavior of materials from cryogenic to elevated temperatures, with the majority of tests being conducted at room temperature. The Government will supply the specimens machined from aluminum, titanium, and nickel based alloys and composites, although other materials may be included on a limited basis. Product forms may include, but not be limited to, foils, sheets, plates, rods, forgings, and extrusions. The Contractor shall ensure equipment is operational prior to and after tests. ***The Contractor shall ensure equipment is within calibration.*** Specific tests and quantities are detailed below:
- Tensile and compression tests to measure strength, modulus, and elongation (up to 400).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to 50).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to 30).
- S-N fatigue tests on notched and un-notched test specimens (up to 50).
- General and stress corrosion tests in salt solutions (up to 40).

Deliverables (for 2.2):
- For each ***NOR***, tested specimens (with fracture surfaces intact and preserved) and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of test procedures, calibrations, specimen dimensions, test anomalies, and electronic data files for each test.
- Informal written monthly reports that list ***NORs*** completed during the reporting period, costs, the scheduling priorities for upcoming ***NORs***, and any other pertinent issues
- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. (***12/31/2003***)

Performance Standards (for 2.2):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- ***NORs*** completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- ***NORs*** completed ahead of requested due date
- "rush" ***NORs*** designated by the task monitor expedited
- Completed under cost

Subtask 2.3: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written ***NOR*** basis. The materials will comprise primarily aluminum, titanium, and nickel based alloys, although other materials may be included on a limited basis. Product forms may include, but not be restricted to, foils, sheets, plates, rods, forgings and extrusions. ***NOR*** tasks will include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to 800) limited to 36 inches by 12 inches in dimension, but usually on the order of 1 inch by 4 inches in size. The Contractor shall be responsible for maintaining chemical cleaning baths and monitoring, neutralizing, and coordinating disposal of hazardous materials. ***The Contractor shall ensure equipment is operational prior to and after surface preparation activities. The Contractor shall ensure equipment is within current calibration, where appropriate***.

Deliverables (for 2.3):

- For each ***NOR***, an informal written and/or oral report of the results to the Requester within 3 working days after completion of the work. The report shall include description of the surface preparation procedures, results, and anomalies.
- Informal written monthly reports that list **NORs** completed during the reporting period, the scheduling priorities for upcoming **NORs**, and any other pertinent issues
- Written informal final report summarizing the number and types of surface preparation activities conducted, standards and procedures used, and any specialized techniques and procedures developed. (***12/31/2003***)

Performance Standards (for 2.3):

MEETS

- Quality of data generated for each test request (electronic data in ASCII format; can be

downloaded into Excel spreadsheets)
- ***NORs*** completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)
- Cost

EXCEEDS
- ***NORs*** completed ahead of requested due date
- "rush" ***NORs*** designated by the task monitor expedited
- Completion under cost.

Subtask 2.4: Laboratory Chemical Inventory

The Contractor shall maintain chemical supplies for the Surface Preparation Laboratory and the Light Alloy Laboratory. This subtask shall include maintaining a catalog of the appropriate materials safety data sheets (MSDS's) and the Chemical Materials Tracking System (CMTS).

Deliverables (for 2.4):
- MSDS catalog (throughout period of performance)
- CMTS website input (throughout period of performance)
- Written informal ***final*** report summarizing the chemical supply inventory and the CMTS and MSDS activity. (***12/31/2003***)

Performance Standards (for 2.4):

MEETS
- CMTS data meets NASA standards
- MSDS catalog remains up-to-date

3. **Government Furnished Items:**

Surface preparation equipment located in Metals Cleaning Laboratory (Building 1229A) including deionized water supply, chemical cleaning and rinse tanks, anodizing equipment, electroplating equipment and supplies, acids, bases, precleaners, neutralizing chemicals, supplies, and related safety equipment.

Mechanical test equipment located in the Light Alloy Laboratory (Building 1205) and the High-Temperature Test Laboratory (Building 1205), including cryogenic and elevated temperature chambers, test machines, strain and displacement measurement instrumentation, and System 4000/***5000*** and Fracture Testing Associates data acquisition systems.

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	Metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEM's, TEM's, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation apparatus and supplies.
4.	**Other information needed for performance of task:** None.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance**: Planned start date: ***01/01/2003*** Completion date: ***12/31/2003***
7.	**NASA Technical Monitor:** Keith Bird M/S: 188A Phone: 757-864-3512 NASA Competency/Other Technical Coordinator: S&MC/Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 14RDD Revision: 5 Date of Revision: 11/18/04

Title: [R1] **SVS Concept Evaluation and Experiment Support**

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

The NASA Aviation Safety Program's (AvSP) Synthetic Vision Systems (SVS) Project is conducting studies intended to develop and support the implementation of synthetic vision systems for commercial transport and business jet (CaB) [R2]*and general aviation (GA)* applications to improve safety. The effort emphasizes the cost-effective use of synthetic vision displays, worldwide navigation, terrain, obstruction and airport databases, and Global Positioning System-derived navigation to eliminate "visibility-induced" accident precursors for all aircraft and rotorcraft. The Contractor shall provide engineering and technical support for the [R1]Crew Response Evaluation Methodologies sub-element of the CaB effort and other areas of SVS research. The Contractor shall participate in developing, conducting, and documenting SVS concepts, experiments, and demonstrations [R1]in simulation facilities. The measurement, recording, analysis, and interpretation of pilot eye-scanning behavior are considered to be of great value in this area. Of importance to the researcher and designer are how such variables as display size, content, format, and level of feature detail are attended to or viewed by the pilot. One purpose of this task is to accomplish the implementation of eye-tracking methodology for evaluation of SVS concepts.

Begin [R1] block update

Experiments currently planned for this time period involve:

a) Identification of critical display features by adding or removing features or using eye-movement methods to evaluate effectiveness of features.

b) Investigate "cognitive capture" of SVS display and "tunnel" pathway guidance as reflected by changes in eye-scan parameters, task performance, and subjective measures.

c) Explore expected Situation Awareness improvement using SVS displays of detection of anomalous (erroneous) flight path information.

d) Evaluation of extent to which new concepts permit pilot maintenance of Situation Awareness and task engagement / re-engagement.

End [R1] block update

[R4] e) Through simulation and/or controlled part/task techniques identify cues (including color) necessary to uniquely discern terrain features and obstacles and other flight hazards [R5] ***and to identify the pilot's attention to display types and display features when using Advanced SVS Displays***. **Begin [R2] block addition****Note:** Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. When the specific detailed requirements are defined by NASA for the Contractor to perform, the Contractor shall provide an electronic copy of this notice of requirement(s) (NOR) to the COTR. The Contractor shall proceed with performing the requirements that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records. The Contractor will be expected to include a brief tabulated summary of NOR responding activity in the monthly progress reports. (See NOR designated item(s) below.)

End R2 block addition

For the original issued SOW, see ETOS file *14RDD.doc.*

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the new period of performance with a reduced scope, updates the title and background, and changes the technical monitor (see R1 above and below).

Revision 2: Adds PBC and other clarifications and data analyses requirements for the SVS DFW flight test (see R2 above and below).

Revision 3: Extends the period of performance one year in continuation of NASA's support requirements, redefines requirements for the new period of performance, and annotates Deliverable 4 as complete (see R3 below).

Revision 4: Extends the period of performance one year in continuation of NASA's support requirements and adds requirements for the new period of performance (see R4 above and below).

Revision 5: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support requirements and adds requirements for the new period of performance (see R5 above and below).

2. Description of the Work to be Performed:

In support of SVS concept evaluation and experimentation the Contractor shall perform the following task elements:

Begin R1 block requirements redefinition

a) Develop the capability of recording and analysis of eye-tracking data for SVS display concept evaluation experiments in relevant NASA workstation or simulation facilities.

b) Develop and implement methods to insure eye-tracking system data integrity during functional tests and data collection runs.

c) Provide video-recording capability, using NASA supplied video recording hardware, for playback of test runs with eye look-point shown on video using the eye-tracking system.

d) Develop a brief operator's guide or manual for utilizing eye-tracking system and video-recording capability.

e) Document at the experiment design stage the advantages and limitations of eye-tracking methods that are integral to a particular research design and test conditions on an as required basis.

f) Develop and implement scenarios (flight path parameters) in accordance with research team and experiment goals.

g) Develop and implement data/video gathering plans, and post-experiment data and video analyses of SVS experiments and demonstrations using workstations or simulators.

End R1 block requirements redefinition

h) Maintain a small-scale SVS video/reference resource library. This requirement includes recording appropriate video and still images in support of the SVS effort.

i) R2 Evaluate and analyze experimental data from simulation and flight experiments using government furnished analysis packages such as SPSS or other appropriate analysis tools.

j) R3 Items above noting video to also include audio recording when deemed appropriate for experiment goals in accordance with research team plans.

k) R4 Develop and/or implement post-run subjective measurement techniques (via paper or portable electronic devices) as appropriate for the research questions under test.

Begin R5 block addition

l) Evaluate and analyze post-run subjective measurement technique data (item k above) using the appropriate government furnished analysis packages (e.g., SPSS).

m) Provide pertinent data to permit documentation of simulation study results assessing situation awareness, simulated flight performance, and quantitative eye-tracking analysis which identifies pilot's attention and consequences when using advanced SVS display types and display features.

End R5 block addition

Deliverables:

Begin R2 block requirements redefinition

1. (NOR) All specifications-development, planning and pre-execution contributions, and data analyses for the planning and execution of experiments and demonstrations shall be performed in accordance with NORs provided by NASA. Each NOR will specify

objectives, expected accomplishments, and delivery dates to complete the requirements. It is anticipated that three to five NORs of two to five months duration each will be generated during the performance period. Deliverables specified by NOR shall include informal verbal and written reports for experiment and demonstration planning purposes, specifications for data collection and analyses, contributions to plan-of-test documents in support of experiments, post-experiment data reduction and analyses, and post-experiment video editing/ analyses.

2. The Contractor shall support proposed eye-tracking studies to be specified by NASA. This support may include assessing plan-of-test documents for advantages and limitations of eye-tracking methods for particular research designs and test conditions. The Contractor shall be responsible for properly installed, tested, and operational NASA furnished data acquisition equipment, including the eye-tracker system and operator's guide for eye-tracking and video recording systems. This requirement is anticipated for one occurrence during the performance period. Specifications for hardware and software upgrades shall also be provided by the Contractor based on specifications for the studies. Minor system reconfigurations shall be accomplished within two months and major upgrades within six months of Contractor receipt of government supplied specifications and components.

3. Additions to the video/reference resource library shall be made during the performance period to support research objectives, and a catalog of library contents will be maintained for users.

End R2 block requirements redefinition

4. ***R3*** This item completed. R2 ~~The Contractor shall provide analysis of data obtained from the SVS DFW flight test. Analysis conducted shall include a post-processing of the existing data to determine aircraft position relative to runways 17C/35C at DFW. Data analysis shall establish the transition point between runway change and tracking segments of the approach. Path error shall be reported in linear feet in addition to angular error. Statistical data analysis shall be performed on integrated quantities (i.e., such as RMS bank angle, etc.) to establish statistical relationships of dependent and independent parameters. Plots of ground track and altitude error shall also be included. The deliverable shall be completed by 1 March 2002.~~

Standards/Metrics

Meets: Timely delivery of the required R2 *items* with adequate and reasonable detail and clarity R2 *to accomplish specified objectives*. Documentation of the data reduction and analyses should provide adequate detail to support formal NASA reporting.

Exceeds: R2 *Early completion of specified deliverables, quality/quantity of deliverables in excess of requirements, or contributions that result in added value of experiment or* *demonstration results.*

3. <u>Government Furnished Items</u>:

Data acquisition computers [R1]including an eye-tracking system and related peripheral devices (e.g. head tracker, cameras and camera control units, ancillary monitors, mounts in simulation environment for peripheral devices), and desktop computers to host the software packages necessary to complete the required tasks including a host computer for website(s). [R1]Acquisition of hardware and software upgrades will be furnished by the government based on specifications recommended by the contractor. Descriptions of the experiment design for each planned test. The Government will be responsible for providing specifications for schemes to be incorporated in display prototypes [R1]and for types of scenarios to be programmed into simulation software. The Government will also furnish necessary commercial software for required software development, data analysis, database management, flowcharting, etc. as well as a video editing and resource library facility.

4. <u>Other information needed for performance of task</u>:

Software shall be developed in compliance with the LaRC software procedures.

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, <u>comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance.

5. <u>Security clearance required for performance of work</u>:

None of the tasks to be performed will require handling of classified material or documents. However, non-disclosure agreements may be required with industry partners due to the proprietary nature of their contributions. ADP clearance for real-time-computer control, RSIL and SVS lab areas will be necessary.

6. <u>Period of Performance</u>:

Planned start date:	Completion date:
[R1]~~January 1, 2001~~	[R1]~~December 31, 2001~~
[R3]~~January 1, 2002~~	[R3]~~December 31, 2002~~
[R4]~~January 1, 2003~~	[R4]~~December 31, 2003~~
[R5]January 1, 2004	[R5]December 31, 2004
January 1, 2005	***December 31, 2005***

7. NASA Technical Monitor: [R1]J. R. Comstock, Jr.

M/S: 152 Phone: 757-864-6643

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 14RFH   Revision: 1   Date of Revision: 11/16/01
Title: Evaluation of Enabling Technology for Electronics Packaging

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

The objective of this work is [R1]***the development of novel materials and utilization of existing materials for the purpose of advanced electronics packaging***. This work includes development, documentation, and functional/property testing [R1]***of advanced materials and electronics in simulated earth and space environments***.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see [R1] above and below).

2. **Description of the Work to be Performed:**

Begin [R1] block

Three areas of work are to be included under this task:

Subtask 1. – ***Radiation Shielding for microelectronics***

The Contractor shall develop fabricating methods for Shaped Shielding radiation barriers to use on the GIFTS (Geostationary Imaging Fourier Transform Satellite) dosimetry experiment (early 2004). Consideration shall include the following areas:

a. shield number, thickness, and effectiveness
b. composite material binder/filler ratio, particle size/particle mixture effect
c. ground testing to verify shielding effectiveness, thermal cycling effects, and vibration endurance

Subtask 2. – ***CALIPSO materials evaluation and selection***

The Contractor shall assess materials for the packaging of the detector assembly. Consideration shall include the following areas:

a. out-gassing characteristics
b. documenting fabrication processes
c. test development

Subtask 3. - ***Optoelectronics***

Reliability evaluation of the of diode laser pumps. Identification of failure mechanisms responsible for observed device degradation behavior. Consideration shall include the following:

a. Assess performance of pump lasers under stressed CW conditions
b. Analyze test data and identify principle failure mechanisms and their physics
c. Report for Space Qualification of pump lasers

End [R1] block

In each subtask the Contractor shall be responsible for selection of fabrication methods, development of fabrication protocols, evaluation-use of methods and protocols, selection of equipment, and selection of property testing for each application. The Contractor shall also participate in some test evaluations of the product materials.

The Contractor shall keep laboratory records in a way that documents protocols and formulations and any data developed along the way. The Contractor shall provide a quarterly report of activities. This report can be based on the laboratory records and make reference or use of them for the bulk of the report, but this reference or use must clearly indicate where in the records the material is extracted.

Deliverables:
1. Quarterly reports 3/26/***02***, 6/25/***02***, and 9/17/***02***

Performance standard:
Meets:
a. Adherence to schedule.
b. The written report provides the information outlined above.
c. The content of the critique is sufficient to enable NASA personnel to assess the quality of on-going Shaped-Shielding activities.
d. Task completed within cost.
Begin R1 block
Exceeds:
Subtask 1: Coordinate ground testing to verify shielding effectiveness, thermal cycling effects, and vibration endurance for the dosimetry experiment on GIFTS.
Subtask 2: Detailed plans for CALIPSO detector packaging assembly.
Subtask 3: Detailed plans for high power 980nm pump laser package improvement to avoid laser degradation.
End R1 block

3. Government Furnished Items:

The Government will provide all specialized materials and equipment, to conduct the work.

4. Other information needed for performance of task:

The Contractor may be required to participate in travel that is specific to item 1 in section 2. Need for travel will be evaluated as required and budget augmentations provided to cover costs of funding isn't sufficient at that time. For planning purposes two trips: each to GSFC for a period of 4 days
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.

5. Security clearance required for performance of work:

6.	**Period of Performance:** Planned start date: 01/01/01 Completion date: R1 ~~09/30/01~~ ***12/31/02***
7.	**NASA Technical Monitor: James Bockman** M/S: 488 Phone: 757-864-9339 NASA Competency/Other Technical Coordinator (*above branch level*): M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 15RAA Revision: 6 Date of Revision: 9/22/04
Title: Advanced Space Systems (Performance Analysis)

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

The NASA Langley Research Center Vehicle Analysis Branch (VAB) develops and applies computer-aided tools in the systems analysis of advanced space transportation concepts and planetary exploration spacecraft. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, operations, and mission risk analysis. Contract support is needed, primarily:
(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems,
(b) to perform analyses in selected disciplinary areas and,
(c) to provide computer software support for NASA flight projects supported by VAB.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems.

Currently, the primary computational platforms are Silicon Graphics (SGI) workstations. Sun workstations, Apple Macintosh, and IBM PC or clones also host a few engineering codes critical to the systems analysis work. Specific requirements, deliverables with dates, metrics, and furnished materials are described below.

Reporting Requirements

Monthly reports are requested for all work under this task including statements of progress, problems, and resources expended.

Exceeding Minimum Performance

The "metrics" included in the task descriptions below describe minimum acceptable performance. To exceed minimum performance, the Contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.

Revision 1: Adds Subtask 7.0 and changes GFI (see R1 below).
Revision 2: Clarifies and increases Subtask 7.0 deliverables, adds new Subtask 8.0, and extends the completion date (see R2 above and below).
Revision 3: Rescinds all changes referenced in Revisions 1 and 2 above except part of the GFI change of Revision 1. This GFI clarification is kept to comply with overall contract. Items added in Revisions 1 and 2 will be broken out as separate task orders (tentatively 28RAA and 29RAA).

Revision 4: Extends the period of performance 17 months in continuation of NASA's support requirements (see [R4] below).
Note: It is anticipated that mission support activity will increase to about twice that of the previous period throughout the 17-month extension
Revision 5: Extends the period of performance 17 months in continuation of NASA's support requirements. Removes original Task 5 (Trajectory Animation), and renumbers Task 6 (Source Control for Flight Project Support) to be Task 5 (see [R5] below).
Revision 6: Extends the period of performance 13 months to December 31, 2005 with no changes in detailed requirements (see [R6] below, Section 6)

2. **Description of the Work to be Performed:**

1.0 Maintenance of Performance Analysis Tools. The tools are designated into two groups. The first are those that support the general-purpose analysis, and those specifically designed to support the flight projects. The primary difference is that more computer software will be under strict revision control for the flight projects.
The Contractor shall:
1. maintain and ensure proper performance of the POST family of trajectory analysis tools (POST3D, POST6D, POSTII, and IPOST), support utilities (jplot, pmat, table_plot), and other VAB simulation tools referred to collectively known as the "trajectory tools." The Contractor shall fix software bugs and problems resulting from modeling errors, programming techniques, or operating system changes. All software deliverables will be consistent with the current programming language for the affected subroutine and/or program, unless a waiver is granted. The Contractor shall produce sample case outputs and demonstrate that the enhanced code is consistent with previous results using the established test suite of input/output files. On average, three bug fix per month and two operating system changes per year are expected;
2. provide programming support for trajectory performance/ flyability studies including the development of general purpose and specific computer subroutine models of guidance and control, aerodynamics, atmosphere, and propulsion system models. Programming support tasks can be described as simple (model less than 500 lines of executable FORTRAN code), moderate (model between 500 and 5000 lines of executable FORTRAN code), or complex (model over 5000 lines of executable FORTRAN code). On average, fifty simple, fifteen moderate, and three complex task per year are expected in [R5]2003. The Contractor shall provide documentation of the software formulation, inputs/ outputs, and test cases, and shall produce a user's guide/document for the above mentioned subroutine models;
3. track these changes using configuration management software (e.g., ClearCase),
4. provide static and dynamic software analyses of trajectory tools to determine sources of computational inefficiencies, recommend solutions, and implement modifications to improve efficiencies.
5. perform the above stated types of tasks for the NASA flight projects. The support of flight projects will require more stringent adherence to source control procedures, and may require

that processes be developed to meet the VAB standards as will as the project standards.

Deliverables
1. Fully functioning programs, free of known programming errors, incorporating the above described changes including source code, executables, and data files necessary to operate the trajectory tools shall be installed on VAB computers. Monthly reports outlining the changes made to the trajectory tools. (within 1 week of an identified software bug, within 1 week for a simple model (less than 500 lines of executable FORTRAN code), within 2 weeks for a moderate model (between 500 and 5000 lines of executable FORTRAN code), 1 month for a complex model (over 5000 lines of executable FORTRAN code), and within 1 month of a new operating system/ upgrade installation)
2. Documentation of the software formulation, inputs/ outputs, and test cases, user's guide for the above-mentioned subroutine models, and instruction on use of the new models. (for a simple model within 2 days, for a moderate model within 2 weeks, and for a complex task within 1 month)

Metric
1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.
2. Ability to make any previous version of POST available within one day of such a request.
3. Ability of VAB analysts to use all modified models and subroutines easily without assistance.

2.0 Trajectory Tool Transfer to VAB Customers

The Contractor shall provide for the transfer of VAB trajectory tools and documentation to customers upon request and shall respond to customer inquiries concerning installation and operation of the tools on the customer’s computer. The Contractor shall maintain a current list of customer contact points to whom tools have been transferred and shall provide a quarterly update to current users appraising them of the current version of the trajectory tools and any significant changes in these tools. The Contractor shall provide a monthly status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. Typically, such requests are received once every two weeks. The Contractor shall assist in defining, implementing, and [R5]maintaining a Web Page which provides information about POST II [R5]and facilitates code transfer following all appropriate Langley procedures.

Deliverables

1. Status report indicating how many transfers occurred in the previous month, the point of contact for each, and how long the transfer process took to complete. (monthly)
2. Delivery of software and documentation to customers. (on request)
3. Updates to current users. (quarterly)

Metric Effectiveness of transfers measured by use of transfer method acceptable to customer and by successful customer reproduction of output from sample cases which have been run on VAB computers. Timeliness of transfers measured by documentation being sent out within 2 days of receiving the request and completion of the transfer of the trajectory tools within one week, unless otherwise specified.

3.0 POST II Validation
The Contractor shall:
1. validate that the test cases supplied by Lockheed-Martin execute properly using the [R5]contractor delivered POST II;;
2. ensure that these test cases provide results consistent with the [R5]previous POST II versions as appropriate;
3. develop additional test cases as needed to include all major models (aerodynamics, mass, atmosphere, etc.) and mission types.(ascent, orbital transfer, entry, etc.) for the single and multiple vehicle option. Compare these cases [R5]using current and previous POST II versions;
4. determine sources of computational inefficiencies, recommend solutions, and suggest modifications to implement that would improve efficiencies of the POST II software. When suggestions/implementations are agreed to, effect their implementation into the POST II code. Provide monthly status reports and document inputs/ outputs and test cases used to validate the changes.

Deliverables
1. Documentation indicating that the test cases supplied by Lockheed Martin execute properly when new POST II versions are provided (no later than 3 weeks after code delivery).
2. Documentation indicating [R5]results from the comparison between current [R5]and previous POST II test cases (no later than 1.5 months after code delivery).

Metric
1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.

4.0 Verification of changes to models in [R5]~~3DOF and 6DOF~~ POST II
The Contractor shall:

1. confirm the government changes to POST II code to when new capabilities, models, and variables are added to the R5~~3DOF and 6DOF~~ POST II software.
2. provide programming support to resolve any issues identified with the implementation of these changes.
3. demonstrate that the enhanced code is consistent with previous results using the established test suite of input/output files.

Deliverables
1. Installation on VAB computers of fully functioning programs, free of known programming errors, which provide these capabilities, including source code, executables, and data files necessary to operate them (within two months of delivery of government changes).
2. Evaluation of POST II changes using test cases identified in task 3 shall be provided no later than 2 weeks after delivery of government changes.

Metric
1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.

R5~~5.0 Trajectory Animation~~

5.0 Source Control for Flight Project Support

The Contractor shall maintain all VAB-involved flight project related software under formal source control. This includes the trajectory models, the Monte Carlo related software, input and output.

Deliverables:

1. Incorporation of specified computer software and documentation into VAB specified source control software within 2 days.
2. Retrieval of any source control software or documentation within 1 day. This retrieval includes the regeneration of previous executables.

Metric:
1. Thoroughness of the effort as measured by inclusion of all requirements described above.

3. **Government Furnished Items:**

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	1) Access to SGI workstations, personal computers (Apple and PC's) R1 with specialized software, the POST family of trajectory tools (POSTII, POST3D, POST6D, IPOST, jplot, mat, mat2.24 table_plot). 2) Current VAB visualization software. 3) Current suite of test cases for POST II. 4) Data necessary to generate ascent/entry trajectories. 5) Source Control software
4.	**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.
5.	**Security clearance required for performance of work:** Secret clearance is required for tasks 1, 3, and 4 as the tools, modifications, and supporting software are being used with projects classified as SECRET.
6.	**Period of Performance:** Planned start date: R5 ~~1/1/01~~ R6 ~~5/15/03~~ ***11/30/04*** Completion date: R4 ~~12/31/01~~ R5 ~~5/15/03~~ R6 ~~10/15/04~~ ***12/31/05***
7.	**NASA Technical Monitor:** Scott A. Striepe M/S: 365 Phone: 757-864-4512 NASA Competency/Other Technical Coordinator: M/S: Phone:

Task Order Number: 15RBK Revision: 4 Date of Revision: 05/09/02

Title: Standardization of Wind Tunnel Parameters and Computation Algorithms for Wind Tunnel Balance Measurements and Calculations.

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

The Contractor shall gather information and document the parameters calculated for balance measurements and wind tunnel flow parameters at major LaRC Wind Tunnel Enterprise facilities. The final goal is to develop a standard set of these parameters that is adopted at all major LaRC facilities. Currently there is no standard for providing final reduced aerodynamic data to the customers of LaRC wind tunnels. This causes confusion and criticism from LaRC customers when comparing wind tunnel data between facilities. An obvious part of this problem is that the parameter names are not standardized at LaRC. Another subtle part of the problem is that calculation algorithms and measurement procedures are not standardized, which leads to the following:

1.) Parameters are computed differently in different facilities and given the same name
2.) The same computations are performed in different facilities or in off-line and on-line data-reduction codes and are called by different names.
3.) Differences in tare procedures/algorithms or coordinate transformation algorithms yield different answers between data reduction codes.

In addition to these differences, the detailed documentation of the computations and algorithms, and in some cases even units, does not exist.

The goal of this work is to first develop a solid set of documentation of the following:

1.) Calculated balance and wind tunnel parameters that are delivered at major LaRC wind tunnels.
2.) The computation algorithms and procedures that are used to derive these parameters.

Then a standard set of these parameters and algorithms will be defined that can be adopted at LaRC wind tunnel facilities. Also, as part of this effort the documented information will be converted to html format and presented on a web page.

Revision 1: Adds NTF requirement, annotates completed status of items, and resets the completion date (see R1 below).

Revision 2: Adds work for software and plotting development of Standard Parameters, and resets completion date (see R2 below).

Revision 3: Adds work for modifying DESL to accommodate up to 256 character file names (see R3 below).

Revision 4: Extends the completion date three and one half months (see R4 below).

2. Description of the Work to be Performed: List all Subtasks, Deliverables and/or Products, Schedule(s), Performance Metrics (for surveillance), and Performance Standards (for award fee

determination).

2a. The Contractor shall investigate and document the wind tunnel flow and balance data parameters calculated at the following LaRC wind tunnels:

a. 14- x 22- Foot Subsonic Tunnel
b. 16-Foot Transonic Tunnel
c. National Transonic Facility
d. Unitary Plan Wind Tunnel
e. Low Turbulence Pressure Tunnel

2b. **For information only purposes:** The following non-traditional facility may be added to the above list later with a lower priority than the other tunnels as the need is determined:

~~8-Foot High Temperature Tunnel~~
Transonic Dynamics Tunnel

2c. The contractor shall make a detailed investigation of the off-line data reduction software for the 14x22 Subsonic Wind Tunnel to document the algorithms used to calculate tunnel and balance related parameters.

R1 2d. The contractor shall make a detailed investigation of the off-line data reduction software for the National Transonic Facility (NTF) to document the algorithms used to calculate tunnel and balance related parameters.

R2 3. The contractor shall develop plotting, analysis and archive capability of standard parameters in aerocompass.

R3 4. The contractor shall modify DESL to accommodate up to 256 character file names.

Tasks:

1.) **(Completed 01/31/01)** ~~A flow chart has previously been developed for each facility that outlines the specific sequence of computations and variables used in converting measured balance quantities and measured flow conditions into final, fully corrected aerodynamic flow parameters and force and moment coefficients in the model, balance, stability and wind axis reference frames. The currently developed flow chart will be enhanced with 14x22 Subsonic Wind Tunnel information. This flow chart will outline the detailed specific sequence of computations and variables used in converting measured balance quantities and measured flow conditions into final, fully corrected aerodynamic flow parameters and force and moment coefficients) in the model, balance, stability and wind axis reference frames).~~

2.) **(Completed 01/31/01)** ~~The Contractor shall document the software algorithms and related tunnel procedures used at the 14x22 Subsonic Wind Tunnel to correct for wind tunnel~~

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Title: Standardization of Wind Tunnel Parameters and Computation Algorithms for Wind Tunnel Balance Measurements and Calculations.

~~testing effects such as:~~

- ~~a.) Weight tares~~
- ~~b.) Balance Interactions~~
- ~~c.) Wind off loads~~
- ~~d.) Sting deflections~~
- ~~e.) Base and cavity pressures~~
- ~~f.) Wall interference and blockage effects~~
- ~~g.) Coordinate system transformations.~~

3.) **(Completed 01/31/01)** ~~The Contractor shall prepare this documentation in the electronic formats of MSWord (or MSExcel) and html for display on a LaRC WTE web page.~~

Begin R1 Block

4.) **(Completed 10/12/01)** ~~A flow chart has previously been developed for each facility that outlines the specific sequence of computations and variables used in converting measured balance quantities and measured flow conditions into final, fully corrected aerodynamic flow parameters and force and moment coefficients in the model, balance, stability and wind axis reference frames. The currently developed flow chart will be enhanced with NTF Wind Tunnel information. This flow chart will outline the detailed specific sequence of computations and variables used in converting measured balance quantities and measured flow conditions into final, fully corrected aerodynamic flow parameters and force and moment coefficients (in the model, balance, stability and wind axis reference frames).~~

~~5.)~~ **(Completed 10/12/01)** ~~The Contractor shall document the software algorithms and related tunnel procedures used at the NTF Wind Tunnel to correct for wind tunnel testing effects such as:~~

- ~~h.) Weight tares~~
- ~~i.) Balance Interactions~~
- ~~j.) Wind off loads~~
- ~~k.) Sting deflections~~
- ~~l.) Base and cavity pressures~~
- ~~m.) Wall interference and blockage effects~~
- ~~n.) Coordinate system transformations.~~

~~6.)~~ **(Completed 10/12/01)** ~~The Contractor shall prepare this documentation of the NTF Wind Tunnel in the electronic formats of MSWord (or MSExcel) and html for display on a LaRC WTE web page.~~

End R1 Block

Begin R2 Block

7.) The contractor shall port a binary copy of the DESL software to the development Sun platform and support that version of DESL for a period of 1 year

8.) The contractor shall port a binary copy of the DESL software to the production Sun platform and support that version of DESL for a period of 1 year

9.) The contractor shall develop "TunnelVision", a utility to be used to translate modified DESL input files into HTML forms. The HTML forms produced by TunnelVision will be amenable to further modification, if necessary, by other host utilities to provide enhanced HTML form specifics, such as file picking. The output of 'TunnelVision' shall be stored in a template table in the aeroCOMPASS database. The aeroCOMPASS team will assist in providing SQL scripts to enable the upload of these templates. Other requirements may evolve as the development of TunnelVision matures.

End R2 Block

Begin R3 Block

10.) The contractor shall modify the DESL software to accommodate up to 256 character file names

End R3 Block

Deliverables:

~~1.)~~ **(Completed 01/31/01)**~~A web based and MSWord document detailing the algorithms used within the off-line balance-related data reduction used at 14x22. This document will include details of the algorithms and procedures used to calculate wind tunnel parameters and balance related quantities from measurements to computed coefficients. This document shall be an enhancement to the web-page documentation, which had been previously completted.~~

~~2.)~~ **(Completed 01/31/01)** ~~The contractor shall present the results of these findings in a meeting with 14x22 test engineers and the applicable data system personnel. The intent of the meeting is to gather corrective information relative to the 14x22 data reduction process, algorithms and test procedures to gather additional information to clarify the documented process.~~

Begin R1 Block

3.) **(Completed 10/12/01)** ~~A web based and MSWord document detailing the algorithms used within the on-line and off-line balance-related data reduction used at NTF. This document will include details of the algorithms and procedures used to calculate wind tunnel parameters and balance related quantities from measurements to computed coefficients. This document shall be an enhancement to the web-page documentation, which had been previously completed.~~

4.) **(Completed 10/12/01)** ~~The contractor shall present the results of these findings in a meeting with NTF test engineers and the applicable data system personnel. The intent of the meeting is to gather corrective information relative to the NTF data reduction process, algorithms and test procedures to gather additional information to clarify the documented process.~~

End [R1] Block

Begin [R2] Block

5.) DESL software ported to development Sun platform and running.

6.) DESL software ported to production Sun platform and running.

7.) "TunnelVision", utility developed translate modified DESL input files into HTML forms.

End [R2] Block

Begin [R3] Block

8.) DESL software will be able to read from and write to file names with up to 256 characters in length.

End [R3] Block

Acceptable performance:

1) Deliverables provided on schedule.

Exceeds acceptable performance:

1) Documents detailed information about procedures for measuring and computing tares, wind off zeros balance interactions, sting deflections, base pressure corrections, and additional corrections used at [R1] other facilities in addition to the 14x22 Subsonic Wind Tunnel [R1] and the National Transonic Facility.
2) Documents coordinate transformation algorithms used at an additional facility [R1] other than the currently tasked ones.
3) Documents detailed corrections implemented at the 14x22 Subsonic Wind Tunnel [R1] and the NTF.
4) Starts development of a prototype GUI or web based parameter translation interface program.

3. <u>Government Furnished Items</u>:

Data from wind tunnels of existing balance measurement parameters calculated

Data, documentation and software about computation algorithms associated with balance parameter computations.

Access to the 14x22 Subsonic Wind Tunnel on-line and off-line data reduction software source code.

[R1] Access to the NTF on-line and off-line data reduction software source code.

[R2] Access to the development production Aerocompass servers.

4. <u>Other information needed for performance of task</u>: None.

5. <u>Security clearance required for performance of work</u>: No clearance required.

	Task Order Number: 15RBK Revision: 4 Date of Revision: 05/09/02 Title: Standardization of Wind Tunnel Parameters and Computation Algorithms for Wind Tunnel Balance Measurements and Calculations.

6.	Period of Performance: Planned start date: 01/01/2001 Completion date: R1 ~~01/31/2001~~ R2 ~~10/12/2001~~ R3 ~~01/31/2002~~ R4 ~~03/15/2002~~ ***06/30/02***
7.	NASA Technical Monitor: Jeff Viken M/S: 267 Phone: 757-864-2875

Task Order Number: 15RCE Revision: C1 Date of Revision: 5/2/03

Title: **Advanced Metallic Materials Processing**

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

The purpose of this task is to develop and optimize advanced processing techniques for alloy synthesis and for fabricating structures and subelements using advanced metallic materials for aerospace applications. The majority of materials to be processed include aluminum alloys, titanium alloys and intermetallics, nickel alloys and intermetallics, shape memory alloys, and continuous and discontinuous reinforced metal matrix composites. On a limited basis, polymeric and ceramic based material systems will be submitted for processing.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

The requirements described below represent a revision of previous task order 13RCE. This revision extends the period of performance one year in continuation of NASA's support with a redefinition/clarification of requirements and change in title and number for the new period of performance.

Change 1: Adds previously omitted requirements for equipment maintenance, upgrades, and installation, and for conference travel (See C1 below).

2. **Description of the Work to be Performed:**

Overall Requirements:

The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

The work under this task will be conducted on a written NOR basis and distributed among subtasks based upon the programs for which the processing is being conducted. However, the overall description of processing activities and quantities is itemized as follows:

- Thermal Processing: Specimens shall be subjected to heat treatment schedules in air, inert, and vacuum environments at temperatures up to 2500°F (up to 25 batches of specimens).

- Mechanical Processing: Sheet specimens shall be subjected to cold and warm rolling (up to 25 specimens); Specimens shall be subjected to tensile and/or compressive straining to impart predetermined strain levels (up to 50 specimens).
- Plasma Spray: Low-pressure plasma spray deposition processing shall be used to deposit thin layers of alloys onto substrates for foil/sheet fabrication and onto fiber windings for composite monotape fabrication (up to 30 plasma spray runs).
- Consolidation: Thin foils of alloys and/or fiber-reinforced monotapes shall be layed up and consolidated using vacuum hot pressing and hot isostatic pressing to produce sheet and/or metal matrix composite laminates (up to 25 consolidation runs).
- Alloy Synthesis: Novel and advanced alloys shall be produced using casting (up to 50 runs) and ball milling (up to 25 runs).

Each of the subtasks will involve work in each of the above processing categories. The Contractor shall ensure equipment is operational prior to and after utilization, and the Contractor shall ensure equipment is within current calibration where appropriate. [C1]***Some equipment maintenance, upgrades, and installation will be required.***

Deliverables (for each subtask):

- For each NOR, processed specimens and an informal written and/or oral report of results shall be delivered to the Requester within 3 working days of completion of the tests. The report shall include description of processing procedures, calibrations, specimen dimensions, anomalies, and electronic data files for each processing run.
- Informal written monthly reports that list NORs completed during the reporting period, total cost associated with each NOR, the scheduling priorities for upcoming NORs, and any other pertinent issues
- Written informal final report summarizing the number and types of processing activities conducted, standards and procedures used, and any specialized processing techniques and procedures developed. (12/31/2003)

Performance Standards (for each subtask):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each NOR (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- NORs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

Task Order Number: 15RCE Revision: C1 Date of Revision: 5/2/03

Title: **Advanced Metallic Materials Processing**

EXCEEDS:
- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completion under cost

Subtask 2.1: Revolutionary Metallic Materials
This subtask involves alloy development and processing for applications in lightweight structure for revolutionary aircraft concepts.

Subtask 2.2: Sensory and Healing Materials
This subtask involves development and processing of alloys with the ability to sense environmental and stress conditions and change their microstructures and properties to adapt to those conditions. Self-healing capabilities are also being developed in these material systems.

Subtask 2.3: Adaptable Metallic Materials and Structures
This subtask involves development and processing of alloys with the ability to change shapes under external stimuli and modify aircraft structure into optimum configurations with respect to the current flight environment.

Subtask 2.4: Metallic Materials for Hypersonic Airframe Hot Structures
This subtask involves development and processing of alloys and metal matrix composites for applications on reusable launch vehicle airframe hot structure.

3. **Government Furnished Items**:

Materials processing equipment located in the Light Alloy Laboratory (Building 1205) and the Materials Processing and Development Laboratory (Building 1267A), including the vacuum hot press, hot isostatic press, plasma spray apparatus, and various ovens and furnaces. Materials processing equipment located in the Structures and Materials Laboratory (Building 1148) including superplastic forming facilities and resistance welding equipment.

4. **Other information needed for performance of task**: C1 ***Some travel to technical conferences is anticipated.***

5. **Security clearance required for performance of work**: None.

6. **Period of Performance**:

Planned start date: 01/01/2003 Completion date: 12/31/2003

Task Order Number: 15RCE Revision: C1 Date of Revision: 5/2/03

Title: **Advanced Metallic Materials Processing**

7.	**NASA Technical Monitor**: Dr. Stephen Hales M/S: 188A Phone: 757-864-3128 NASA Competency/Other Technical Coordinator: S&MC/Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 15RDE Revision: 5 Date of Revision: 8/17/04
Title: IDEAS Lab Enhancement

1.	**Purpose, Objective or Background of Work to be Performed:** The Crew Vehicle Integration Branch has a continuing responsibility to conduct human (specifically, although not limited to, pilot) performance studies of Flight Deck Systems Concepts. The purpose of this task is to enhance the Intermediate Design Evaluation and Simulation (IDEAS) Lab located in Building 1168 to support these activities. The primary purpose of this task is to provide for IDEAS Lab modifications required for experiments. In general, the subtasks under this revision are to be completed R1~~September 30, 2001~~ R2~~September 30, 2002~~ R3~~September 30, 2003~~ R4~~September 30, 2004~~ R5***December 31, 2005***. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see R1 above and below). Revision 2: Extends the period of performance one year in continuation of NASA's support requirements (see R2 above and below). Revision 3: Extends the period of performance one year in continuation of NASA's support requirements (see R2 above and below). Revision 4: Extends the *Description of Work to be Performed* to include additional input into the actual design of experiments (see R4 below). Revision 5: Extends the period of performance one year in continuation of NASA's support requirements (see R5 above and below).
2.	**Description of the Work to be Performed:** The contractor shall perform the following subtasks: 1. Develop simulation and displays as specified in the *Experiment Requirements Documentation* supplied by the PIs. 2. Provide the capability of modifying the simulation and/or displays developed in Subtask 1 in near real-time as required by the PI. (Note: This refers to the rapid prototyping capability of the IDEAS Lab.) 3. Maintain the hardware and software developed in Subtask 1 pre-, during, and post-experimental runs as specified in the *Experiment Requirements Documentation* supplied by the PI. 4. Provide for the capability of having others start the hardware and software developed in Subtask 3. 5. Report to the task monitor by experiment the estimated cost of Subtasks 1 – 4 and R4 10 – 12. 6. Report to the task monitor by experiment the cost of Subtasks 1 – 5 and R4 10 – 12. 7. Update the operational manual and code documentation with the additions made in Subtasks 1 – 4 and R4 10 – 12. 8. Continue implementing the configuration management software and hardware plan for the IDEAS Lab developed in the previous Task Order.

9. Continue maintaining the documentation of the IDEAS Lab software in accordance with the LMS Policy Manual to support ISO 9001 Software Project Management Plan requirements.
10. R4Generate detailed questionnaires (both layout and content) for experiments detailed in Subtask 1 in conjunction with the PI(s).
11. R4Detail and categorize written and verbal comment data from experiments detailed in Subtask 1 in conjunction with the PI(s).
12. R4Determine initial settings for new hardware and software implementations.
13. R4Supply knowledgeable personnel in the areas of the simulation for pictures, videos, and demonstrations.

Deliverables:
(1) Models developed.
(2) Software developed.
(3) Documentation for operation and use of software.
(4) Report of estimated costs by experiment from Subtask 5.
(5) Report of costs by experiment from Subtask 6.
(6) R4Questionnaires from Subtask 10.
(7) R4Comment data analysis from Subtask 11.
(8) R4Initial settings from Subtask 12.

Schedule:
(a) Subtasks 1–4 shall be delivered in the timeframe indicated in the *Experiment Requirements Documentation*.
(b) Subtask 5 shall be delivered within 2 weeks after the *Experiment Requirements Documentation* is received by the contractor.
(c) Subtask 6 shall be delivered within 4 weeks after the experiment is completed.
(d) Subtasks 7–9 shall be completed by R1~~September 30, 2001~~ R2~~September 30, 2002~~ R3~~September 30, 2003~~ R4~~September 30, 2004~~ R5September 30, 2005.
(e) R4Subtask 10 shall be delivered within 6 weeks after the Experiment Requirements Documentation is received by the contractor.
(f) R4Subtask 11 shall be delivered within 6 weeks after the experiment is completed.
(g) R4Subtask 12 shall be delivered within 4 weeks after the new hardware and software are integrated into the current IDEAS Lab setup.
(h) R4Subtask 13 shall be delivered within 2 weeks after a request is received by the contractor.

Metrics and Standards:
a. Time to deliver the simulation and displays as specified in *Experiment Requirements Documentation* supplied by the PIs.
[Subtask 1]
MEETS if no slippage from the PI requirement.

EXCEEDS if completed 1 month early from the PI requirement.

b. Availability of rapid prototyping capability.
[Subtask 2]
MEETS if 70% of the time rapid prototyping capability is available within 3 days of when a PI asks for that capability.
EXCEEDS if 90% of the time rapid prototyping capability is available within 3 days of when a PI asks for that capability.

c. Functionality of the hardware and software developed in Subtask 1 pre-, during, and post-experimental runs.
[Subtask 3]
MEETS if 70% of the time functionality of the hardware and software developed in Subtask 1 pre- and during experimental runs is available as dictated by the experiment schedule.
EXCEEDS if 90% of the time functionality of the hardware and software developed in Subtask 1 pre-, during, and post-experimental runs is available as dictated by the experiment schedule.

d. Ability of having others start the hardware and software developed in Subtask 3.
[Subtask 4]
MEETS if 2 people can start the hardware and software.
EXCEEDS if directions are available for the PI, Technical Monitor, or contracting personnel related to this task to start the hardware and software.

e. Delivery time of cost estimate report.
[Subtask 5]
MEETS if report is received 2 weeks after the *Experiment Requirements Documentation* is received by the contractor.
EXCEEDS if report is received less than 2 weeks after the *Experiment Requirements Documentation* is received by the contractor.

f. Delivery time of cost report.
[Subtask 6]
MEETS if report is received 4 weeks after an experiment is completed.
EXCEEDS if report is received 2 weeks after an experiment is completed.

g. Delivery time to update the operational manual and code documentation with the additions made in Subtasks 1–4.
[Subtask 7]
MEETS if update is completed 2 months after an experiment is completed.
EXCEEDS if update is completed 1 month after an experiment is completed.

h. Time to change the hardware and software configuration of the IDEAS Lab.
[Subtasks 8 and 9]
MEETS if time to change hardware and software configuration is 2 days.
EXCEEDS if time to change hardware and software configuration is 1 day.

i. [R4]Delivery time of questionnaire layout.

	[Subtask 10] MEETS if questionnaire layout is received 6 weeks after the *Experiment Requirements Documentation* is received by the contractor. EXCEEDS if questionnaire layout is received 4 weeks after the *Experiment Requirements Documentation* is received by the contractor. j. [R4]Delivery time of comment data. [Subtask 11] MEETS if comment data is received 6 weeks after an experiment is completed. EXCEEDS if comment data is received 4 weeks after an experiment is completed. k. [R4]Initial settings for new hardware and software implementations. [Subtask 12] MEETS if initial settings are received 4 weeks after the new hardware and software are integrated into the current IDEAS Lab setup. EXCEEDS if initial settings are received 3 weeks after the new hardware and software are integrated into the current IDEAS Lab setup. l. [R4]Availability of person knowledgeable about the simulation for pictures, videos, and demonstrations. [Subtask 13] MEETS if availability is 2 weeks after a request is received by the contractor. EXCEEDS if availability is 1 week after a request is received by the contractor.
3.	**Government Furnished Items:** 1. IDEAS Lab (Silicon Graphics Workstations, side stick controllers, peripheral hardware, lab space for facility configuration and operation) 2. VAPS software tool 3. FLSIM software tool 4. *Experiment Requirements Documentation* supplied by the PIs. 5. [R4]Written and verbal comment data supplied by the PI(s). 6. [R4]Hardware (e.g., laptop or tablet PC), with appropriate software and hardware development tools, for development of electronic questionnaires.
4.	**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.
5.	**Security clearance required for performance of work:** All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines.
6.	**Period of Performance:** **Planned start date:** January 2, 2001 **Completion date:** [R1]~~September 30, 2001~~

	R2~~September 30, 2002~~ R3~~September 30, 2003~~ R4~~September 30, 2004~~ R5***December 31, 2005***
7.	**NASA Technical Monitor:** Anna C. Trujillo M/S: 152 Phone: 757-864-8047 NASA Competency/Other Technical Coordinator (*above branch level*): R5~~Norma Campbell~~ M/S: R5~~406~~ Phone: R5~~757-864-1131~~

Task Order Number: 15RFH Revision 7 Date of Revision: August 5, 2003

Title: **Engineering and Development of SAGE III Interface Adapter Module and Associated Required Testing.**

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

The objective of this task is to develop, demonstrate and maintain the [R4] Design Unit and Flight Unit Interface Adapter Module (IAM) electronics based on the current Stratospheric Aerosol and Gas Experiment III (SAGE III) interface design as described in the SAGE III Interface Design Specification (IDS), the Hexapod requirements, the proposed ExPA requirements, and the proposed Contamination Monitor Package (CMP) requirements. The electronics will consist of four (4) components: Power Supplies, Engineering Data Circuit, Communication Electronics, and Contingency Thermal circuit.

The SAGE III will measure vertical profiles of O3, NO2, H2O, OClO, temperature, neutral air density, and aerosols from the cloud tops in the troposphere through the stratosphere, and into the mesosphere for O3 using solar and lunar occultation measurement techniques. SAGE III continues the SAM/SAM II/SAGE/SAGE II lineage of UV/VIS radiometers used for monitoring stratospheric aerosols and gases with a grating spectrometer and a Charge Coupled Device (CCD) linear array detector providing measurements in nine channels between 280 nm and 1550 nm. Presently manifested on board the polar-orbiting Meteor-3M satellite and the International Space Station (ISS) the SAGE III instruments will provide global, long-term measurements of atmospheric composition in the period between 2000 and 2006.

The SAGE III/ISS instrument is currently at Langley Research Center under going functional and operational testing. Because the interface of the SAGE III instrument to the Meteor-3M satellite was developed as the primary interface design, a special adapter module must be used to interface the SAGE III instrument, the Hexapod (an auxiliary pointing platform used for the ISS mission) and the ISS ExPRESS Pallet Adapter (ExPA). This adapter will also provide the interface to the CMP which will be flown as part of the ISS SAGE III payload. The CMP measures the deposition of molecular contamination on any platform to which the SAGE III instrument is attached. The deposition measured will be processed within the CMP electronics. The Systems Engineering Competency (SEC), Electrical System Branch (ESB) is leading the development of the Interface Adapter Module (IAM) and will evaluate its performance against the SAGE III, Hexapod, and ISS requirements.

Revision 1: Adds travel requirements (see [R1] below)

Revision 2: Adds performance metrics, new requirements, and some minor clarifications, including changing to decimal section formatting. Because of scheduling considerations, by COTR Technical Direction (email from l.d.wall@larc.nasa.gov, 5/17/01), Contractor was authorized to shift emphasis temporarily to begin the new work specified herein in advance of formal modification. (See [R2] below for changes.)

Revision 3: Removes the re-assembly monitoring of the SAGE III Meteor instrument (2.1.9). Adds four weeks travel for the Test Operator to Baikonur, Kazakhstan. And adjusts delivery dates for the IAM due to ExPRESS Pallet induced delays. (See [R3] below for changes.)

Revision 4: Removes the delivery of the Communications Board (2.1.4). Removes supplying flight cables. Removes environmental tests. Renames the Engineering Model to Design Unit.

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Adds modifying SAGE III and Hexapod simulators to include MIL-STD-1553B interface and supporting software. Delivery dates adjusted due to ExP slip. Technical Monitor changed. (See R4 above and below for changes.)

Revision 5: Annotates which tasks have been completed, terminated, or closed out due to Project Closeout, adds new requirements for Project Closeout, and documents change in Technical Monitor (see R5 below).

Revision 6: Extends the period of performance through September 30, 2003 in continuation of NASA's support with remaining previous requirements deleted, new requirements added as 2.1.13 and 2.1.14, and a new Technical Monitor for the extended period of performance (see R6 below).

Revision 7: Extends the period of performance through September 30, 2004 due to Hexapod delivery delays and NASA's ongoing SAGE III ISS maintenance support requirements (see R7 below).

2. **Description of the Work to be Performed:**

2.1. The Contractor shall perform the following requirements:

2.1.1. R5 Closed due to Project Closeout ~~Build and test the R4Design Unit R2 IAM Power Supplies, Engineering Data circuit, R4Communications Electronics, and Contingency Thermal circuit. The IAM top-level design and functional description will be supplied by Systems Engineering Competency (SEC), Electronic Systems Branch (ESB). The Contractor shall evaluate the design implementation and determine the best approach to develop the IAM electronics based on the SAGE III, Hexapod, Express Pallet Adapter, and CMP requirements.~~

- ~~R2 PERFORMANCE METRIC: The Contractor shall develop a delivery schedule and transmit weekly progress of activities to the SAGE III office. Transmission of weekly activity can be performed through telephone conversation or through e-mail transmissions. Final compilation of weekly transmission/log of activities in electronic/paper form is a deliverable.~~

2.1.2. R5 Closed due to Project Closeout ~~Manage and maintain a bonded stores for flight parts and supplies for the ISS IAM. This bonded stores is managed separately from the SAGE III bonded stores until the IAM is integrated with the SAGE III/Hexapod instrument on the ExPA.~~

- ~~R2 PERFORMANCE METRIC: The Contractor shall keep records of all components, parts, hardware, and software purchased and used for the design and construction of the flight and R4Design Unit IAMs in conformance with the Contractors bonded process and transmit weekly activities to the SAGE III office. Transmission of weekly activity can be performed through telephone conversation or through e-mail transmissions. Final compilation of weekly transmission/log of activities in electronic/paper form is a deliverable.~~

2.1.3. R5 Closed due to Project Closeout ~~Build and integrate the R4Design Unit IAM and verify, by functional test, the operation of the IAM to SAGE III interface using the SEC simulators and SAGE III Instrument Simulation Unit (ISU).~~ R5 [Canceled ~~The IAM to Hexapod~~

Task Order Number: 15RFH Revision 7 Date of Revision: August 5, 2003
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~~interface and IAM to Express Pallet Adapter interface shall be verified using the SEC developed simulator and the European Space Agency (ESA) Hexapod simulator. This includes the design and development of any special purpose test equipment and interconnects/cables required to support IAM verification.~~] R4~~The Contractor shall be responsible for all environmental testing including Electromagnetic Interference (EMI), vibration, and thermal-vacuum testing, including authoring test procedures.~~ The Contractor shall be responsible for integration and test with the SAGE III and Hexapod flight payloads.

2.1.4. R4~~Design, develop, and implement, as necessary, the VHDL code for the Field Programmable Gate Array (FPGA) that is part of the Communications Electronic Circuit. All changes shall be verified with the SAGE III Data Storage Unit (DSU) simulator and or the flight DSU (if available) along with the Express Pallet Controller or an acceptable simulator.~~

2.1.5. R6~~Serve as an operator of the instruments during R2 testing. 12/30/02 R2 Instrument testing occurs at the storage facility (LaRC Bldg. 1250) and at integration sites and serve as backup to the test and integration operations in Russia. The Government will provide training for operation of all SAGE III instruments, and the Contractor must be able to run all supporting ground support equipment (GSE).~~

Begin R5 block addition

~~The Contractor shall work as an Assistant to the Test Manager/Test Engineer *except there will be no implied nor direct supervisory controls by NASA*. The duties shall include: performing all the necessary activities to close out the SAGE III Project such as the following:~~

- ~~Performing the Semi-annual Instrument Full Functional Test, Semi-annual Hexapod Calibration and Functional Test and Sunlook Test.~~
- ~~Providing inputs for all test reports, Non-Conformance Failure Reports (NFR) Closeout and Disposition, Test Procedures and Troubleshooting Tests.~~

~~Other activities include:~~

- ~~The recollection and verification of all necessary documentation, software and hardware for Configuration Management Archival and for Bonded Store storage~~
- ~~Reviewing and providing input to test and/or troubleshooting procedures~~
- ~~Preparation of hardware for "Clean Room" environment.~~

End R5 block addition

Begin R2 block

2.1.6. R5 Completed

2.1.7. R5 Completed

2.1.8. R5 Completed

2.1.9. R3 Deleted

2.1.10. R5 Completed **End R2 block**

**Begin R4 block addition*

2.1.11. R5 Closed due to Project Closeout ~~Install DDC corporation MIL-STD-1553B PCMCIA~~

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~~cards in SEC supplied SAGE III and Hexapod Simulators and develop software used to verify the IAM MIL-STD-1553B interface.~~

2.1.12. R5 Closed due to Project Closeout ~~Prepare 4 DC-to-DC converters on a printed circuit boards provided 9/15/02 by NASA/Langley for bonding stiffer plates per NASA/Goddard procedure, "Adhesive Bonding Rework of Interpoint MTR5xxxx DC-DC Converter." Bond a stiffer plate to each prepared converter. Ship immediately after curing the bonding material.~~

End R4 block addition

Begin R6 block addition

2.1.13 Hexapod acceptance testing, delivery, and maintenance support

The Contractor shall provide test engineering and evaluation support of the ESA-provided Hexapod pointing system. The proficient operation and safe handling of the Hexapod flight unit and the Ground Support Equipment (GSE) is of paramount importance. Acceptance Testing of the flight unit will formally begin after the delivery of the Hexapod and GSE to NASA Langley. Prior to delivery the test engineer is responsible for observing functional tests performed by the manufacturer at Alenia facilities in Italy and assist in post delivery testing by Alenia personnel at NASA Langley. The Contractor shall support periodic Hexapod maintenance activities at NASA Langley.

2.1.14 SAGE III ISS instrument maintenance support

The Contractor shall provide test engineering support of periodic SAGE III ISS instrument maintenance testing. Maintenance activities shall occur on a quarterly basis with more extensive maintenance being performed on a semi-annual basis.

End R6 block addition

2.2 Deliverables

2.2.1. R5 Closed due to Project Closeout ~~Power Supply, R4Communication Electronics, Engineering Data, and R4Contingency Power circuit boards, and interconnects/cables integrated into flight and R4Design Unit enclosure.~~

2.2.2. R5 Closed due to Project Closeout ~~R4Flight andGround test interconnect cables between IAM, SAGE III ICE box, Hexapod Electronics unit, Contamination Monitoring Package, and ExPRESS Pallet Adapter.~~

2.2.3. R5 Completed

2.2.4. R5 Closed due to Project Closeout ~~Demonstration of the electronics with the SAGE III ISU and SEC simulators.~~

2.2.5. R4~~Test procedures to verify that the IAM meets EMI, Thermal-vacuum and vibration as SAGE III/ISS/Hexapod IDS requirements stipulate.~~

2.2.6. R5 Closed due to Project Closeout ~~Test results showing that the IAM to Express Pallet and Hexapod Interfaces function as SAGE III/ISS/Hexapod IDS requirements stipulate.~~

2.2.7. R5 Completed

2.2.9. R5 Completed

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Begin R2 block
2.2.10. R5 Completed
2.2.11. R6~~Progress reports~~.
2.2.12. R5 Closed due to Project Closeout
2.2.13. R5R6~~Test procedures results and data, troubleshooting results~~.
End R2 block
2.3. Schedule
2.3.1. R5 Completed
2.3.2. R5 Completed
2.3.3. R5 Completed
2.3.4. R5 Closed due to Project Closeout ~~Environmental testing procedures R4 and testing of flight unit to start R4 15 May 200230 August 2002~~.
2.3.5. R5 Closed due to Project Closeout ~~Functional test procedures and testing of R4 flight design unit with assembled ExPRESS pallet payload completed by R4 1 August 2002 29 September 2002~~.
2.3.6. R5 Closed due to Project Closeout ~~Systems Acceptance Review and Delivery of flight unit by R4 31 August 200230 November 2002.~~
2.3.7. R5 Closed due to Project Closeout ~~User's manual, schematics, all test procedures, all test results, all test result analyses, and all supporting documentation delivered by 31 December 2002.~~
2.3.8. R6~~Support ongoing testing of flight instruments to 31 December 2002~~.
2.3.9. R5 Completed
2.3.10. R5 Closed due to Project Closeout R2 ~~MLI blankets shall be delivered by MAY 23,2001.~~
~~2.3.12~~ 2.3.11. R5 Closed due to Project Closeout R4 ~~Stiffened DSU power supplies on printed circuit boards shall be delivered by September 15, 2002.~~
2.3.12 R6Monthly status report and "quicklook" test evaluations for tests supported under 2.1.13 and 2.1.14

2.4. Performance Criteria
2.4.1. Meets
1 Deliverables provided on time,
AND,
2. R5 Closed due to Project Closeout ~~Successful review of all designs and documentation~~.
2.4.2. Exceeds
1. Contractor suggested enhancements to the R5~~IAM,~~ Tests setups, test procedures accepted by the government that result in enhanced performance, time and or cost savings, and innovative design that reflects reduction in complexity, size, mass or power.

AND/OR

2. Successful completion of scheduled milestones before due date.

3. Government Furnished Items:

Task Order Number: 15RFH Revision 7 Date of Revision: August 5, 2003
Title: **Engineering and Development of SAGE III Interface Adapter Module and Associated Required Testing.**

	3.1. The SAGE III/Meteor 3M Interface Design Specification document. 3.2. R5 Deleted ~~The SAGE III/Hexapod/Express Pallet Interface Definition Document.~~ 3.3. R5 Deleted ~~Designs for the Communications Electronics board and Power Supply board. Initial version of VHDL code.~~ 3.4. All Required electronic parts and components. 3.5. R5 Deleted ~~IAM enclosures~~. 3.6. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards. 3.7. Contractor may utilize NASA furnished fabrication facilities/resources to complete electronics hardware, including wiring/cabling. 3.8. R5 Deleted ~~Contractor may utilize NASA furnished VHDL code generation/compilation/simulation facilities/resources to develop and maintain VHDL code.~~ 3.9. R5 For the purpose of testing, the contractor will have access to Building 1250 40 ft. Clean Room Facility, their respective test preparation area, Medium Bay area and test facilities.
4.	Other information needed for performance of task: 4.1. R5 Completed See 4.5 below 4.2. The developed R2 ~~engineering model IAM and associated~~ documentation shall become the property of NASA Langley Research Center and the SAGE III Project upon completion of the task. 4.3. 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. 4.4. R2 It is evident that some of the work described above is required to be performed off-site to accommodate schedule and logistic concerns. (Paragraph F.3, NAS1-00135) 4.5 Task 2.1.13 requires travel to ESA contractor facilities in Italy in support of Hexapod acceptance. Current plans require two trips: 8 days for the first and 12 days for the second. Additional travel may be required based on technical progress by ESA.
5.	Security clearance required for performance of work: None
6.	Period of Performance: Planned start date: R5 ~~1 January 2001~~ October 1, 2002 Completion date: R6 ~~31 December 2002~~ R7 ~~30 September 2003~~ ***30 September 2004***

Task Order Number: 15RFH Revision 7 Date of Revision: August 5, 2003
Title: **Engineering and Development of SAGE III Interface Adapter Module and Associated Required Testing.**

7.	NASA Technical Monitor: R6 Michael Cisewski M/S: 420 Phone: 757-864-1861

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 16RAB Revision: ____ Date of Revision:

Title: RASC Visualization and Multimedia Communications Development Support

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

NASA LaRC has been requested to facilitate an agency wide Revolutionary Aerospace Systems and Concepts (RASC) analysis capability with the ultimate goal to synthesize scenarios and advanced concepts that could greatly enhance NASA's ability to accomplish its mission. These scenarios will have multifaceted architectures and operations involving the interaction of many advanced concepts along with complex analytical results that will require sophisticated visualization techniques to convey properly. Presentation of the material associated with RASC studies will have a heavy emphasis on multimedia in order to engage customers and to educate the public.

2. Description of the Work to be Performed:

1) The contractor shall create and convert three-dimensional models of architecture components and advanced concepts and utilize these models in creating visualizations. The visualizations shall represent segments of proposed missions and concepts and will also include innovative representations of analytical results. The contractor shall also maintain an easily accessible database of models and rendered visualizations both in electronic and videotape format.

2) The contractor shall create multimedia-enhanced versions of RASAC study products that interactively include text, images, sound and video. These enhanced study products will be available for presentations on laptop computers, the world-wide-web and via CDs.

Deliverables:

- Monthly report documenting recently generated multi-media products.
- Monthly update of electronic database containing multi-media products.

Metrics for Deliverables:
Outstanding performance is characterized by developing timely and innovative multi-media products in support of on-going ASCAC analysis. Acceptable performance is characterized by delivering the multi-media products after the driving analysis is complete. Minimal performance is characterized by delivering the above deliverables by the required dates.

3. Government Furnished Items:

The government will furnish a Unix workstation with Wavefront/Maya and a PC with Light wave Studio.

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	4. <u>Other information needed for performance of task</u>: Five 2 day trips a year from LaRC to NASA HQ shall be accommodated.
	5. <u>Security clearance required for performance of work</u>: None.
	6. <u>Period of Performance</u>: Planned start date: 1/1/01 Completion date: 12/31/01
	7. NASA Technical Monitor: Pat Troutman M/S: 328 Phone: 757-864-1954 NASA Competency/Other Technical Coordinator M/S: Phone:

Task Order Number: RBJ Revision: ____ Date of Revision:

Title: Data Quality Assurance

1. Purpose, Objective or Background of Work to be Performed: (DA06, NAS1-96014)
The demand by research customers for accurate data with known and traceable measurement uncertainties requires rigorous analysis of the data be conducted to verify and document the data quality. The data quality assessment is performed by the test engineer on all data obtained in the wind tunnels at this Center. The Contractor will be expected to provide wind tunnel data statistical quality control and measurement uncertainty analysis support for the wind tunnel facilities within the Research Facilities Branch (RFB). During the year, RFB will conduct approximately 12 tests, each of 4 weeks duration in each facility within RFB. The data collection system in these tunnels consists of a data acquisition computer and a variety of instrumentation (balance, tunnel Q, model attitude, etc) that produce signals which are converted into engineering units in the data acquisition/reduction process.

Note: The data quality assurance support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

2. Subtask Description:

1. (NOR) The Contractor shall provide wind tunnel data statistical quality control and measurement uncertainty analysis support to the facilities of the RFB.

Deliverables:
a) Training for customer test data quality assurance procedures
b) Quick-look plots for check standard testing
c) Post-test updating of check standard and customer scaling control charts upon request

Minimum acceptable performance:
a) Training for customer test data quality assurance within one week of NOR
b) Preparation of check standard quick-look plots within two weeks of test completion
c) Post-test updating of check standard and customer scaling control charts within four weeks of NOR

Exceeds acceptable performance:

Task Order Number: RBJ Revision: ____ Date of Revision:

Title: Data Quality Assurance

a) Training for customer test data quality assurance within two days of the NOR
b) Preparation of check standard quick-look plots within one week of test completion
c) Post-test updating of check standard and customer scaling control charts within two weeks of NOR
d) DQA support for non-RFB facilities
e) DQA support other than the deliverables described

2. (NOR) The Contractor shall support improvement activity for the DQA process in RFB wind tunnels. This activity shall include any relevant practices, experiments, analyses and tool development.

Deliverables:
a) Training in data quality assurance, statistical quality control, and measurement uncertainty processes and procedures
b) Documentation of procedures for DQA for customer and check standard testing
c) Maintenance of electronic logbooks for posting methodology and check standard activities to the world-wide web.
d) Documentation of Langley Management System procedures for data quality assurance for customer and check standard testing

Minimum acceptable performance:
a) Training, maintenance and documentation provided within one month of NOR

Exceeds acceptable performance:
a) Training, maintenance and documentation provided within two weeks of NOR
b)

3. Government Furnished Items:
Access to facility data acquisition computer system over the complete performance period.

4. Other information needed for performance of task:

5. Security clearance required for performance of work: None

6. Period of Performance:
Planned start date: January 2, 2001 Completion date: December 31, 2001 ??

Task Order Number: RBJ Revision: ____ Date of Revision:

Title: Data Quality Assurance

7. NASA Technical Monitor: Michael J. Hemsch
M/S: 280 Phone: 757-864-2882
NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth
M/S: 285 Phone: 757-864-8265

Task Order Number: 16RCG Revision: 3 Date of Revision: 2/1/2005
Title: Solar Sail Analysis and Test-Analysis Correlation

1.	**Purpose, Objective or Background of Work to be Performed**: The Structural Dynamics Branch (SDB) conducts research and technology development to quantify and control impact dynamics, ground operations, and structural dynamics of aerospace systems. SDB: *confirms* validity of approaches by conducting tests on full-scale structures, structural elements and scaled structural models; *conducts* research to advance the technology for improving the safety and handling performance of aircraft during all-weather ground operations, including takeoff, landing impact, and ground handling phenomena; develops fundamental understanding of crash behavior and crash-mitigating design; develops *and validates* predictive tools for crash dynamics; *conceives and confirms* new dynamic test techniques; *operates* the Structural Dynamics Research Facility, the Impact Dynamics Research Facility (IDRF), and the Aircraft Landing Dynamics Facility. Revision 1: Modifies the analysis requirements to include additional analysis tasks and extends the overall task order period of performance to October 1, 2004 (see R1 below). Revision 2: Modifies the analysis to include additional tasks and extend the overall task order period of performance to June1, 2005 (see R2 below). Revision 3: Adds requirements and extends the task order period of performance five months to September 30, 2005 (see R3 below).
2.	**Description of the Work to be Performed**: The Contractor shall perform analysis, test/analysis correlation, test/analysis planning, R2and prediction of a larger size sail for testing at Plum Brook in consultation for a solar sail test program. Specifically the Contractor shall: 1) Develop finite element models of R1~~10- and 20-meter~~ different sizes of single-quadrant and full four-quadrant solar sails and the various structural components of the sails. These components include booms, attachment cables, and other related hardware. Conduct nonlinear static and normal modes analyses of the models for load cases and boundary conditions specified by the Government. R1Conduct any additional related analyses that are required to ensure a successful flight demonstration such as ray tracing, crease analysis and structural wrinkling. 2) Correlate test and analysis results for static and modal tests of solar sails and components conducted by the government. Modify the finite element models and apply other methods if needed to achieve the best possible reasonable agreement with the test results. 3) Participate in test and analysis planning by suggesting test and analysis methods that will lead to improved test results or improved test/analysis correlation. *****Begin R3 block addition***** 4) Assist in developing technical reports for conferences as mutually agreed upon with NASA. 5) Present results of Analysis at technical meetings and reviews as mutually agreed upon with NASA. *****End R3 block addition***** **Deliverables:** 1) Finite element models (FEMs) and converged solutions

2) Correlated Finite Element Models to test results
3) [R1]Develop models to assist in determining best locations for application of sensors for testing purposes.
[R2]4) Develop a finite element model of a larger size sail and predict the dynamic behavior and static shape prior to testing at Plum Brook
4) Monthly technical progress report, including brief summary of results

*****Begin [R3] block addition*****

5) Co-Authorship in Conference Paper for SDM 2005
6) Delivery of all the models developed under this task with brief explanation of all files

*****End [R3] block addition*****

Schedule:

1) FEMs (Converged Correlated Finite Element Models) – deliver as completed; final delivery of all models due [R1]~~12/31/03~~ [R3]***as mutually agreed upon with NASA***. ~~10/1/04~~[R3]***9/30/2005***.
2) Monthly progress reports – monthly, as required.
3) [R2]Final technical report on this activity.

Performance Measurements:

Minimum Performance
The [R3]***Converged*** FEMs shall have adequate fidelity to represent the critical responses – such as displacements, forces and mode shapes. The analysis results shall agree with the test results as closely as possible (e.g., [R1]~~15~~ 10 percent or better agreement for key responses).

Exceeding Minimum Performance
Contractor would exceed the minimum performance with: suggestions of improvements to models, modeling techniques, analyses or test techniques; identification of code deficiencies with suggestions for improvements; development of improved models or analysis techniques using existing tools, or developing new tools that allow for faster turn-around, or better integration of analysis methods.

3. **Government Furnished Items**:

Test specimens

Test specimen instrumentation

Access to NASA specialized structural analysis software, including MSC/NASTRAN and MSC/PATRAN, I-DEAS.

4. **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.
5.	**Security clearance required for performance of work**: *None*
6.	**Period of Performance**: Planned start date:08/01/2003 Completion date: R1 ~~12/31/2003~~ R2 ~~10/1/2004~~ *R3* ~~6/1/2005~~ ***9/30/2005***
7.	**NASA Technical Monitor** Barmac Taleghani M/S 230 Phone: 757-864-8499 **NASA Competency/Other Technical Coordinator** S&MC/Laurie Johansen M/S 121 Phone: 757-864-1757

Task Order Number: 16RDC Revision: 5 Date of Revision: 2/28/08

Title: Development of a Distributed Computing Cluster, and Implementation of Standard UNIX Maintenance Procedures on the Computer Equipment Involved

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

The purpose of this work is to provide for the development of a distributed computing cluster, and implement standard UNIX maintenance procedures on the computer equipment involved.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, increases Subtask 2 deliverables, and adds new Subtask 3 (see [R1] below).

Revision2: Extends the period of performance and schedule one year in continuation of NASA's support requirements, modifies Subtask-1 to include new equipment, and annotates Subtask-3 as complete (see [R2] below).

Revision 3: Extends the period of performance and schedule one year in continuation of NASA's support requirements with updated Subtask-1 and Subtask-2 description to reflect changes in equipment (see [R3] below).

Revision 4: Extends the period of performance and schedule three months to March 31, 2005, in continuation of NASA's support, with no other changes in detailed requirements (see [R4] below).

Revision 5: Extends the period of performance and schedule nine months to December 31, 2005, in continuation of NASA's support, with no other changes in detailed requirements (see [R5] below).

2. **Description of the Work to be Performed:**

SUBTASK-1:

The Contractor shall maintain and improve [R3]~~a 23-node~~ [R2]~~distributed computing cluster and~~ a 19 node rack mounted Beowulf computer cluster. ~~based on the University of Wisconsin's Condor Software~~ The system will employ existing Linux/Intel workstations and the installation of new equipment as necessary.

Deliverables:

a) . [R3]Maintenance of the Beowulf cluster, installation of new software and hardware upgrades as required.
b) Monitor and tune cluster performance in response to cpu-load and memory requirements of typical batch jobs.

Schedule:

Through [R1] ~~12/31/01~~ [R2]~~12/31/02~~ [R3]~~12/31/03~~ [R4]~~12/31/04~~ [R5]~~3/31/05~~ ***12/31/05***

Metrics:

(Satisfactory) – Maintain current cluster functionality with 95% uptime R3~~, and provide template interface scripts for users.~~
(Exceeds) - Improve and customize interface, accommodate non-standard compilers and unsupported applications.

SUBTASK-2:
The Contractor shall maintain approximately 20 Unix workstations R3running Redhat Linux and approximately 5 networked PCs running Windows 2000, on existing and acquired hardware and respond to user maintenance requests and problem reports.

Deliverables:
a) Nightly incremental and bi-weekly full backups of user data and system logs to Langley's DMSS storage system R3for Unix Workstations only.
b) Application of security patches from OS vendor within 1 week of release.
c) Upgrades to commercial software as available, and scheduled upgrades to the operating system.
d) Addition/Removal of users as necessary (approximately 35 users total) with updating of NIS/NFS maps.
e) Formal system for reporting problems and rapid response (same day call-back, next day resolution) to system failures and urgent help requests.
f) R1 Clean hard-drives for proper disposal of obsolete equipment.

Schedule:
Through R1 ~~12/31/01~~ R2~~12/31/02~~ R3~~12/31/03~~ R4~~12/31/04~~ R5~~3/31/05~~ ***12/31/05***

Metrics:
(Satisfactory) – Fewer than five incidences over reporting period where same day call-back or next-day resolution is not meet.
(Exceeds) - 99% uptime during business hours, same-day resolution to all urgent requests.

Begin R1 block
SUBTASK-3: R2Complete
~~The Contractor shall perform a major version upgrade to GCB RedHat Linux computers. This includes a full OS re-installation, subsequent restoration of user files, and appropriate changes to the local configuration.~~

~~Schedule:~~
~~Through 3/31/02~~

~~Metrics:~~

Task Order Number: 16RDC Revision: 5 Date of Revision: 2/28/08

Title: Development of a Distributed Computing Cluster, and Implementation of Standard UNIX Maintenance Procedures on the Computer Equipment Involved

	~~(Satisfactory) – Conversion of one machine per week.~~ ~~(Exceeds) – Conversion of two machines per week.~~ **End R1 block**
3.	**Government Furnished Items**: System maintenance will occur on government equipment, with a single terminal dedicated to System Administration tasks. No other equipment or office space will be provided.
4.	**Other information needed for performance of task**: Contractor should be familiar with NASA LaRC Center Procedures related to IT security, including: CP-5517, CP-5518, CP-5519, CP-5549, and CP-5550.
5.	**Security clearance required for performance of work**: There will be no exposure to classified information, and no requirement for a security clearance. The Contractor should have personnel capable of obtaining after-hours access to LaRC.
6.	**Period of Performance**: Planned start date: 1/1/2001 Completion date: R1 ~~12/31/2001~~ R2 ~~12/31/2002~~ R3 ~~12/31/2003~~ R4 ~~12/31/2004~~ R5 ~~3/31/2005~~ ***12/31/2005***
7.	**NASA Technical Monitor:** David Cox M/S: 161 Phone: 757-864-6658

Task Order Number: 16RFF Revision: 8 Date of Revision: 2/24/05

Title: Test Hardware for Vibration Tests of Gossamer Structures.

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

Provide Engineering design and development of test hardware in support of Langley's Ultra-Lightweight and Inflatable Structures (UIS) research team currently funded under the [R3]Resilient Materials and Structures Program and the Solar Sail Technology Working Group tasks. The specific objectives of the work to be performed under the present task are to [R3]support the design of various scale model solar sail testbeds, design test fixtures to support these structures in air and vacuum conditions, and support the test activities. An additional objective is to provide continuing design and development of test fixtures for various thin-film membranes and [R3]radiometric antennas.

Note: *The design, development, and test support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask.* [R1]*In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)*

REVISION 1 (See [R1])

This revision adds a task (2.2.6) for the development of prototype actuators for the control and adjustment of membranes under study as part of the task 16RFF. Work under this revision seeks the development of working mechanism prototype(s) for later application as load/control interfaces between test object membrane(s) and support frame under development by other vendors. Adds reporting requirement to NOR note. Revises schedule. Other minor clarifications and corrections. Adds an attachments section.

REVISION 2 (See [R2])

Extends the period of performance one year in continuation of NASA's support requirements, and redefines schedule and some requirements for the new period of performance.

REVISION 3 (See [R3])

Extends the period of performance one year to 12/31/03 in continuation of NASA's support with updated and clarified requirements.

REVISION 4 (See [R4])

Adds requirements as new Subtasks 2.2.7 and 2.2.8.

REVISION 5 (See [R5])

Extends the period of performance one year to 12/31/04, adds requirements to Subtasks 2.2.1-2.2.3, 2.2.5-2.2.8, adds new Subtask 2.2.9, and deletes Subtask 2.2.4. The deliverables due dates are updated to reflect the new work and the extended period of performance. Engineering support will be provided to the Resilient Materials and

Structures Program and to Solar Sails Technology Working Group tasks. The specific objectives of the work to be performed under Revision 5 are to support the design and analysis of various scale model solar sail testbeds, design test fixtures to support these structures in air and in vacuum conditions, and support test activities. An additional objective is to provide for the continuing design and development of test fixtures for various thin-film membranes and radiometric antennas.

REVISION 6 (See [R6])

Adds new requirements as Subtask 2.2.10.

REVISION 7 (See [R7])

Closes Subtasks 2.2.2, 2.2.6, 2.2.8, and 2.2.10. Adds new requirements as Subtask 2.2.11. Updates Subtasks 2.2.1, 2.2.3, 2.2.5, 2.2.7, and 2.2.9 and extends the task order period of performance one year to 12/31/2005 to reflect continued NASA support. Engineering support will be provided to the Resilient Materials and Structures Program and to Solar Sails Technology Working Group tasks. The specific objectives of the work to be performed under Revision 7 are to support the design and analysis of various scale model solar sail testbeds, design test fixtures to support these structures in air and in vacuum conditions, and support test activities at LaRC and Plum Brook. An additional objective is to provide for the continuing design and development of test fixtures for various thin-film membranes and radiometric antennas.

REVISION 8 (See [R8])

Closes significant elements of subtask 2.2.7. Remainder element will be completed/delivered by 3/18/2005 for closure of subtask 2.2.7. This revision is a response to reduced funding available for completion of all activities pending on Task Order 16RFF.

2. **Description of the Work to be Performed:**

2.1 The Contractor will design and oversee the fabrication of R&D scale models of a solar sail and an inflatable solar array and fixtures and instrumentation-mounting hardware for vibration testing of these structures. The Contractor will also support continuing design and development of test fixtures for various thin-film membranes and [R3]radiometric antennas. 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 fixture assemblies, coordinate the integration of these assemblies into the component test apparatus and/or structural test-beds and participate in the testing of the specimens.

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 2.2.1, 2.2.2, 2.2.3, 2.2.4, and the following criteria:

2.1.1. Ability to meet delivery schedules for all mechanical 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.

2.1.2. Manufacturability of designed components per Contractor-generated engineering detail drawings

2.1.3. 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.

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

2.2.1 **(NOR item)** Design and develop a [R3]deployable prototype 10-12m solar-sail- structure [R3]with SRS membranes in consultation with cognizant NASA personnel to be used by the Ultra-lightweight and Rigidizable Structures (UIS) research team. The prototype structure shall be conducive to perform engineering research studies, including deployment dynamics, model correlation, and validation of photogrammetry measurement systems/methods. [R5]Support the engineering design and development of the Prototype III deployment boom/sails for the Able and L’Garde solar sail arrangements.
[R3]~~2/1/2002~~ [R5]~~2/1/2003~~ [R7]~~12/31/2004~~ 12/31/2005

The Contractor is to develop prototype designs for down selection by the LaRC UISRT for fabrication. The Contractor oversee fabrication the selected design, accompanying gravity off-loading support mechanisms, and fixtures and instrumentation-mounting hardware for vibration testing in the 16m vacuum chamber (both in air and in vacuum).

PERFORMANCE METRIC:

2.2.1.1 The prototype structure shall simulate (within funding constraints for material and fabrication resources established by the IUS team) the geometry and functionality of a candidate solar sail structure at a reduced scale size suitable for testing in the 16 m vacuum chamber. The design will be developed in consultation with the LaRC IUSRT.

2.2.1.2 The gravity off-loading devices shall provide simulated near free-free boundary conditions for the structure within the physical size constraints of the 16m vacuum chamber.

2.2.1.3 The structure off-loading device interfaces shall be designed such that the resulting boundary condition can be determined within 10% accuracy.

2.2.1.4 The support and instrumentation hardware shall provide clear line-of-sight to the supported test article surfaces for opto-electronic remote sensing vibration measurement of the structure during both deployment and post-deployment phases of the tests.

2.2.2. R7 Closed ~~(NOR) Support continuing design and development of fixtures for vibration testing of a 3m-diameter tensioned membrane "hexapod" test article R3 and other structures (government furnished equipment (GFE)) in the laboratory and in the vacuum chambers in Building 1293B. R2 12/31/2002 R5 12/31/2003 12/31/2004~~

2.2.3 (NOR) Support continuing design and development of fixtures for vibration testing of tensioned membranes (government furnished equipment (GFE)) in the laboratory and in the vacuum chambers in Building 1293B. R5 Support the engineering design and development of the Phase III Type remote control mechanisms and structures for membrane actuation in a vacuum, 8' & 16' chambers. Test fixture designs will accommodate 40-inch membrane specimens and others as required.
R3 ~~12/31/2002~~ R5 ~~12/31/2003~~ R7 ~~12/31/2004~~ 12/31/2005

The Contractor is to develop designs for, and oversee fabrication of fixtures and instrumentation-mounting hardware for vibration testing thin-film membranes in the laboratory (i.e., in air) and in either the 8-ft or 16m vacuum chamber (i.e., in vacuum). The fixtures shall provide attachment points to allow the membrane to be tensioned in selectable tension cases. The selectable cases include 1) at its corners (resulting in wrinkling) and 2) uniformly (eliminating wrinkling).

PERFORMANCE METRIC:

2.2.3.1 The hardware shall provide clear line-of-sight to the supported test article surfaces for opto-electronic remote sensing vibration measurement on the membrane.

2.2.3.2 The mounting hardware shall provide mounting interfaces provisions for small electro-dynamic shakers and sensors (minimum of one with growth potential to two shakers/sensors) to measure the vibration forces applied by the shakers.

2.2.3.3 The hardware shall permit remote electronic adjustment of the membrane tension and shall provide the capability to add sensors to measure the applied membrane tension.

2.2.4 R5 (Deleted) ~~(NOR) Support continuing design and development of fixtures for vibration testing of a 4.8m-diameter, inflation-rigidized, polyimide thin-film microwave antenna test article in the laboratory and in the vacuum chambers in Building 1293B. R3 12/31/2002 12/31/2003~~

2.2.5 (NOR) Support test activities of Deliverables 2.2.1 – 2.2.3

R5 Support mechanical design activities, fabrication/integration and testing of fixtures and instrumentation mounting hardware required for performing vibration tests on solar sails, tensioned membranes, and other related articles. R2~~12/31/2002~~ R5~~12/31/2003~~ R7~~12/31/2004~~ 12/31/2005

The Contractor is to aid in the integration of test fixtures and test specimen for testing activities and participate in the testing of the specimens.

PERFORMANCE METRIC:

2.2.5.1 The GFE article is successfully integrated to the test hardware per produced designs.

2.2.5.2 Resulting test set-up provided required full unobstructed line-of sight clearance for detection of designated surface targets/features by test cameras.

2.2.5.3 Test shakers provide full planned excitation input at pre-selected interface points during tests in atmospheric and vacuum conditions.

R1 2.2.6 R7 ***Closed*** ~~(NOR) Develop and deliver R3 a revised 2nd generation Engineering Prototype of Membrane Actuator device for adjustment and control of GFE membranes on GFE support frame. Design shall provide the functional requirements per R3 revised NASA specifications. R5 Support the engineering design of Generation III components to support the testing of a new actuator and the integration of the actuator into the three-meter diameter tensioned membrane "hexapod test article." Redesign the exiting actuator if appropriate to enhance the in-plane dynamic characteristics or create a new type actuator if necessary to meet the new design specifications furnished by NASA.~~
R3~~12/31/2002~~ R5~~12/31/2003 12/31/2004~~

Begin R4 block addition

2.2.7 (NOR) Support the planning and conducting of ground tests of gossamer test articles and related equipment.

The Contractor shall support structural characterization tests of 10-m solar sail hardware from L'Garde and AEC-ABLE at LaRC R8~~and of 20-m solar sail hardware from L'Garde and AEC-ABLE at the Plum Brook facility in Sandusky, Ohio~~. The Contractor shall support structural characterization tests of breadboard sensing and data acquisition equipment for the Optical Diagnostic System (ODS) on 10-m R7 and 20M solar sail hardware from L'Garde and AEC-ABLE at LaRC. R8~~The Contractor shall support structural characterization tests of prototype sensing and data acquisition equipment for the Optical Diagnostic System (ODS) on 20-m solar sail hardware from L'Garde and AEC-ABLE at the Plum Brook facility in Sandusky, Ohio~~. The Contractor shall operate NASA-supplied instrumentation and measurement systems in the above tests, such as photogrammetry and videogrammetry systems, laser vibrometry systems, coherent laser radar systems, accelerometers, load cells, thermocouples, and data acquisition systems. R5 Provide the support noted above to new configurations in the Langley vacuum chamber as well as configuration for the Plum Brook facility in Sandusky, OH. R7~~12/31/2004~~ R8~~12/31/2005~~ ***3/18/05***

PERFORMANCE METRIC:

1. The structural characteristics (shape, dynamics, membrane loads, boom loads, etc.) of both sets of 10-m solar sail hardware are successfully measured in the ground tests at LaRC.
2. R8~~The structural characteristics (shape, dynamics, membrane loads, boom loads, etc.) of both sets of 20-m solar sail hardware are successfully measured in the ground tests at plum Brook~~.
3. The performance of breadboard instrumentation for the Optical Diagnostic System (ODS) is successfully validated on both sets of 10-m solar sail hardware in the ground tests at LaRC.
4. R8~~The performance of prototype instrumentation for the Optical Diagnostic System (ODS) is successfully validated on both sets of 20-m solar sail hardware in the ground tests at Plum Brook~~.
5. NASA-supplied measurement systems and instrumentation was successfully utilized in the above tests.

2.2.8 R7Closed ~~(NOR) Conduct photogrammetric simulations and photogrammetric data analyses for gossamer spacecraft structures using state-of-the-art tools such as the Vision Measurement System (VMS) software developed by Drs. Mark Shortis and Stuart Robson. The Contractor shall provide photogrammetry analysis support for the "Optical Diagnostic System (ODS) for Solar Sails" project. The objective of ODS is to develop an integrated, unobtrusive approach for measuring and monitoring the structural characterizes of solar sails in space. The baseline approach is using multiple video cameras and photogrammetry. The Contractor shall perform photogrammetric analytical simulations of candidate camera systems and camera configurations. Parametric studies will be conducted to determine the sensitivity of design variables leading to development of an optimal configuration. The Contractor shall support ground tests of breadboard and prototype hardware for the ODS including pre-test simulations and analysis of test data. Provide the support noted above to new configurations in the Langley vacuum chamber as will as configuration for the Plum Brook facility in Sandusky, OH. 12/31/2004~~
End R4block addition

Begin R5 block addition
2.2.9 Provide support for mechanical design and testing for all components required to support the Able & L'Garde Solar R720-Meter Sail structures deployment both at the Langley 16m and Plum Brook 30m facilities. R7~~12/31/2004~~ 12/31/2005

PERFORMANCE METRIC:

1. Engineering requirements for all mechanical components to be used in these deployment tests are established in collaboration with NASA, AEC-ABLE, and L'Garde solar sail personnel.

2. Delivery schedules for all mechanical assemblies are met.
3. Correct operation of all mechanical assemblies is validated with proof tests prior to use in the solar sail deployment tests.
4. All mechanical assemblies perform as expected during the solar sail deployment tests.
5. Lessons learned in the Langley 16m program are used to advantage to design the more-challenging Plum Brook 30m test program assemblies.

End R5 block addition

Begin R6 block addition

2.2.10 R7Closed ~~Provide electrical engineering design and testing support for the Able & L'Garde Solar Sail structures deployment in the Langley 16m vacuum chamber. 12/31/2004~~

End R6 block addition

Begin R7 block addition

2.2.11 Provide engineering design and testing support for the 1/3 Meter and other antenna structures deployment in the Langley 16m vacuum chamber. 12/31/2005

PERFORMANCE METRIC:

1. Delivery schedules for all mechanical assemblies are met.
2. Correct operation of all mechanical assemblies is validated with proof tests prior to use in the antenna deployment tests.
3. All mechanical assemblies perform as expected during the antenna performance tests.

End R7 block addition

3. Government Furnished Items:

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

4. Other information needed for performance of task:

4.1 One or two trips to R3a vendor facility. Each trip is a single day to confer with the manufactures of the solar sail membranes and inflatable columns.

R4 4.2 Some off-site test support required.

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date:		Completion date:	
	R2~~Jan. 2, 2001~~		R2~~December 31, 2001~~
	R3~~Jan. 1, 2002~~		R3 ~~December 31, 2002~~
	R5~~Jan 1, 2003~~		R5~~December 31, 2003~~
	R7~~Jan 1, 2004~~		R7~~December 31, 2004~~
	R7Jan 1, 2005		December 31, 2005

7	**NASA Technical Monitor:** William M. Berrios M/S: 432 Phone: 757-864-7183 **NASA Directorate/Other Technical Coordinator**: Richard S. Pappa M/S: 230 Directorate: RTD/SDB Phone: 757-864-4321

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order		
	Task Order Number: 17RAD Revision: 1 Date of Revision: 9/18/01 Title: Simulation Studies of Advanced Aircraft Configurations	

1.	Purpose, Objective or Background of Work to be Performed: The Contractor shall conduct batch simulation studies to define the sensitivity of key handling qualities and maneuvering characteristics of advanced aircraft configurations and the impact on the performance and the survivability of the aircraft concept. It is anticipated that the results will be used in follow-on studies and/or other related studies such as those that involve vehicle design trades and optimization, etc. The Contractor will perform this work on site in the classified offices at the Langley Research Center, Hampton, Virginia. Revision 1: Extends the period of performance three months in continuation of NASA's support requirements (see [R1] above).
2.	Description of the Work to be Performed: Specific objectives or work elements designated to the Contractor will be further defined in the classified statement of work, which will be provided by the NASA Technical Monitor. The Contractor shall be fully responsible for developing subtask plans and recommending the appropriate analysis and experimental investigations. The Contractor shall perform the following requirements/subtasks: Verify the modifications to the selected simulation model to incorporate parametric variations of selected vehicle design characteristics. Plan and conduct maneuver sensitivity studies. Deliverables and performance metrics are contained in a classified addendum to this statement of work.
3.	Government Furnished Items: a) Existing simulation databases, code, and documentation b) Access to simulation model implemented
4.	Other information needed for performance of task: It is anticipated that the Contractor will need to make one trip to a government site.
5.	Security clearance required for performance of work: Due to the nature of the work, the Contractor shall have a Secret security clearance and must request the classified "statement-of-work" through the CO in order to receive it through secure NASA channels. Additionally, due to the nature of the proposed work, the Contractor shall perform this task on site at the NASA Langley Research Center.
6.	Period of Performance: Planned start date: 2/15/01 Completion date: [R1] ~~9/1/01~~ ***11/30/01***

Task Order Number: 17RAD Revision: 1 Date of Revision: 9/18/01

Title: Simulation Studies of Advanced Aircraft Configurations

7.	NASA Technical Monitor JR Elliott, ASCAC M/S 411 Phone: 757-864-7123 E-Mail : j.r.elliott@larc.nasa.gov

Task Order Number: 17RBJ Revision: 1 Date of Revision: 9/6/01

Title: Research Facilities Branch Test Support [R1] (16-Foot Tunnel and Jet Exit Facility)

1. Purpose, Objective or Background of Work to be Performed: (DA09, NAS1-96014)

   The Research Facilities Branch (RFB) is responsible for the operation of and testing in a variety of different wind tunnels and facilities at Langley Research Center. During the year, the branch will conduct approximately 12 tests, each of 4 weeks duration, in each wind tunnel. The Contractor will be expected to support approximately 5 tests in the 16-Foot Transonic Tunnel and the Jet Exit Facility, [R1] ***but beginning in September required test support is expected to double (Subtask 1 below)***. Support activities include review and documentation of wind tunnel model check out, assembly, and installation, setup and documentation of the test data acquisition software and hardware, performance and documentation of instrumentation setup and calibration, aerodynamic data and facility flow data analysis, and documentation of the complete test process through run logs and notes.

   Note: The test and data acquisition support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. (See NOR designated item(s) below.)

Revision 1: Increases Subtask 1 test activity beginning in September '01 and changes title (see [R1] above).

2. Description of the Work to be Performed:

The Contractor shall perform the following subtasks:

1. (NOR) Conduct and document pre- and post-test activities and data reduction and analysis processes for each test supported. The Contractor shall provide a daily oral status report and consultation to the RFB Test Project Engineer (TPE) on the progress of each of the individual test activities and processes to be supported. The components which may be supported are listed below:

   • Wind tunnel or facility model check out, assembly, and installation
   • Derivation of balance/sting deflection constants
   • Perform uncertainty analysis of data from wind tunnel test
   • Data acquisition process setup, monitoring, and operation
   • Flow visualization test techniques setup and operation

- Test plan development
- Shift support
- Perform pre-test uncertainty prediction

Deliverables:

Oral reports and written documentation for the supported test activities.

Minimum Acceptable Performance for activities to be supported:

a) Test setup including data reduction constants documented prior to test scheduled start date

b) Derivation of balance/sting deflection constants prior to scheduled test start

c) Complete documentation of test process and procedures in run logs and shift notes by the end of test

d) Wind tunnel or facility data uncertainty analysis complete within 1 week of end of test

e) Test plan 3 weeks prior to test

Exceeds Acceptable Performance:

a) Support activity completed prior to scheduled date for minimum acceptable performance

b) Support activity completed solely by the Contractor

2. (NOR) Support the development and implementation of improved dynamic data acquisition system for the RFB tunnels.

Deliverables:

a) Hardware and software recommendations for a new dynamic data acquisition and analysis system per requirements.

b) Implementation of the new dynamic data acquisition and analysis system

Minimum Acceptable Performance for activities to be supported:

a) Documentation of recommendations and a written plan for system implementation 2 months after receipt of requirements.

b) Demonstration of all capabilities of new system 5 months after delivery of hardware and software.

Task Order Number: 17RBJ Revision: 1 Date of Revision: 9/6/01

Title: Research Facilities Branch Test Support [R1] (16-Foot Tunnel and Jet Exit Facility)

Exceeds Acceptable Performance:

a) Reports and documentation provided prior to scheduled date for minimum acceptable performance.

b) Implementation activity completed solely by the Contractor.

3. Government Furnished Items:

Checkout area, wind tunnel model hardware and documentation, access to wind tunnel support hardware and documentation, wind tunnel test instrumentation and documentation, data acquisition computer system and documentation, terminal to access data acquisition computer, uncertainty analysis software and documentation.

4. Other information needed for performance of task:

Any hardware or software recommended by the Contractor for purchase or use during the performance of this contract must be Y 2000 compliant.

5. Security clearance required for performance of work:

Work on classified projects may be required.

6. Period of Performance:

Planned start date: 01/01/01 Completion date: 11/30/01

7. NASA Technical Monitor: E. Ann Bare
M/S: 280 Phone: 757-864-3036
NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth
M/S: 285 Phone: 757-864-8265

Task Order Number: 17RCE Revision: 1 Date of Revision: 11/30/04

Title: Metals and Thermal Structures Research and Technology Development

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

The objective of this task is: (1) to conduct research and technology development for advanced metallic materials synthesis and processing to enable the fabrication of efficient, high-performance concepts for aerospace applications; and (2) to conduct research and technology development that evaluates concepts, quantifies behavior, durability, and damage tolerance, and validates performance of advanced materials and structures for applications in extreme environments. The Contractor will be expected to perform the following general requirements as applicable to specific subtasks:

- conduct thermal-structural analyses and design studies, CAD design, and analysis of test specimens, and support for testing of advanced TPS (Thermal Protection System) systems, hot structures and cryogenic tanks for use on advanced space transportation and high-speed aircraft in support of Langley Tasks.
- perform specialized environmental fatigue tests, conduct fractography of advanced materials and airframe components, and maintain fractographic analysis laboratory.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with no changes to detailed requirements (see [R1] below, Section 6).

*****The requirements described below represent a continuation of previous task order 04RCE, Subtasks 1-4.*****

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor for Sub-Tasks #1-3 and to the Sub-Task Technical Monitor for subtask #4.

SUBTASK 1: (NOR) Conduct Thermal -Structural Studies of Advanced Space Transportation and High-Speed Aircraft Integrated Thermal-Structural Systems, and Develop Theoretical and Algorithmic/Non-Optimum Structural Weights

1. The Contractor shall conduct thermal-structural analyses and design studies of advanced cryogenic tank, hot structure, and TPS systems in support of advanced concept development and design/analysis methods development/validation with application to advanced space transportation and high-speed aircraft in support of Langley programs. The Contractor shall identify load requirements and will provide initial loads estimates. The analysis shall include aerodynamic, acoustic, thermal, and mechanical loading conditions representative of advanced space transportation or high-speed aircraft as appropriate. Various design options for vehicle concept, structural arrangement, material systems, and integrated wall concepts for cryotanks, wings, other primary structures and TPS will be considered. Thermal and structural analyses are required to size and compare integrated TPS/cryotank systems and to determine response and deflections of the aerosurfaces under load. Analysis will also be required to support design of specific test panels and to support development/ validation of new design/analysis methods.

Deliverables: Finite element models and results suitable for presentation. Short written reports of design studies, analyses and weight trades of various concept studies.

Performance Measurements:
Minimum Performance
The finite element models shall accurately represent the system being investigated and be of sufficient resolution to predict the responses of interest. The trade study results shall accurately represent the various thermal-structural concepts.

Exceeding Minimum Performance
Contractor would exceed the minimum performance with: suggestions of design improvements based on their analyses and design studies; development of improved analysis techniques using existing tools, or developing new tools that allows for faster turn-around, or better integration of analysis methods; performing surveys and documenting similar work found in the literature that allow better use of prior technology; or perform studies in a more rapid manner than original time estimates.

2. (NOR) The Contractor shall participate in structural concept, arrangement and design definitions for airframe structural systems. Detailed itemized weight statements shall be developed for individual airframe system options being considered in the trade studies. Output from Finite Element and other structural models, as well as other analytical methods will be integrated as inputs into the itemized weight statements. Knowledge and application of existing weight estimation methodology (including finite element-based, CAD-based, algorithmic, etc.) will be used to develop weight estimates for non-modeled structural items. Methodology for developing total airframe weights based on a limited number of point sizings (at discrete locations) shall be developed and applied to the airframe concepts being considered in the trade studies.

Deliverables: Detailed weight statements for integrated airframe concepts, algorithms for estimating weights of non-modeled structural features, and written reports of analytical results.

Performance Measurements:
Minimum Performance
Development of itemized weight statements and theoretical/algorithmic weight estimates using established analytical weights methods. Integration of outputs from current structural/TPS sizing codes into the detailed weight statements.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance by: suggesting improvements to structural concepts based on their analyses and design studies; developing weight estimation algorithms for new (non-standard) airframe structural concepts; developing improved weight estimation techniques using existing tools; developing new weight estimation algorithms, tools or interfaces that allow for faster turn-around, or better integration of analysis methods; performing surveys and documenting similar work found in the literature that allow better use of prior technology; or perform studies in a more rapid manner than original time estimates.

SUBTASK 2: CAD Design for Advanced Structures Concepts, Test Hardware, and Metallic Materials Processing Equipment

1. (NOR) The Contractor shall develop designs and hand and/or CAD drawings of NASA-defined structural concepts as required. Drawings may include trade study concepts, structural layouts, and components to be fabricated to demonstrate salient features of a concepts. The Contractor shall be responsible for coordinating the

successful fabrication of the designed components through the LaRC fabrication system.

Deliverables: Drawings of designs suitable for presentation or fabrication. Successful implementation of selected designs into hardware.

Performance Measurements:
Minimum Performance
The designs shall clearly illustrate the salient features of the concepts and those intended for fabrication shall be adequate for a competent fabricator to be able to fabricate the concept.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables.

2. (NOR) The Contractor shall develop designs and CAD drawings of the required fixtures based on the requirements for each specific test. Specific items that may be designed include: concepts and drawings for cryo/elevated temperature chambers, load introduction and specimen support fixtures for thermal-structural tests, and preparation jigs for specimen handling and assembly . The Contractor shall be responsible for coordinating the successful fabrication of the designed fixtures through the LaRC fabrication system. The Contractor designer shall provide advice to the NASA technician staff to support final assembly of test hardware.

Deliverables: CAD drawings of fixture designs. Successful implementation of selected designs into hardware.

Performance Measurements:
Minimum Performance
The design for the test fixtures shall be adequate for a competent machinist to be able to fabricate the test fixture. The assembled fixtures shall be delivered to appropriate testing lab in a timely manner.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables

3. (NOR) The Contractor shall develop designs and CAD drawings of required hardware to support/enhance metals processing equipment and capabilities. Specific

items that may be designed include: concepts and drawings for materials handling and positioning, and support equipment for direct metals deposition and free-form fabrication efforts. The Contractor shall be responsible for coordinating the successful fabrication of the designed hardware through the LaRC fabrication system. The Contractor designer shall provide advice to the NASA or contractor technician staff to meet the requirements for the advanced capabilities.

Deliverables: CAD drawings of equipment designs. Successful implementation of selected designs into hardware.

Performance Measurements:
Minimum Performance
The design for the equipment shall be adequate for a competent machinist to be able to fabricate the design. The fabricated equipment shall be delivered to appropriate processing lab in a timely manner.

Exceeding Minimum Performance
The Contractor would exceed the minimum performance with suggestions of design improvements or finding more rapid means to complete deliverables

SUBTASK 3: Thermal-Structural Test Support

1. (NOR) The Contractor shall, as specified in individual NOR's, perform pre-test analyses, write and/or modify test plans (including a test request form if required by specific facility) for structural and/or thermal-structural test specimens to be tested in test facilities, determine instrumentation layouts to specified test requirements, expedite specimen preparation, assist in final test preparations, track the test series, and perform post-test analysis/test correlation. The NASA technical monitor shall been given periodic reports of progress of the test support activity.

Deliverables: The Contractor shall deliver the analyses, test plans, and instrumentation layouts in electronic and printed form.
The Contractor shall deliver the test specimens and hardware to the appropriate testing laboratory and support the test series as specified in the NOR.
The Contractor shall deliver progress reports documenting the in electronic form.

Performance Measurements:
Meets- Completes documents for the analyses, test plans, and instrumentation layouts. Monitors progress of preparation of test articles for testing, execution of the test plan,

and removal of the test article.
Exceeds- All subtask elements are completed and all deliverables are met ahead of schedule

SUBTASK 4: Study sensory alloys**,** corrosion fatigue and fracture with detailed fractograhic analyses of advanced materials and aircraft components (Subtask POC: Dr. Steve Smith)

1. (NOR) Contractor shall conduct environmental fatigue tests to simulate the effects of corrosion on small fatigue cracks propagating from rivet holes. Approximately 50 fatigue tests per year shall be conducted on specimens supplied by the Government. The tests shall be conducted under test conditions: (1) as received, (2) pre-corroded and (2) under an aqueous condition yet to be determined. Detailed fractography of the tested specimens shall be performed and fractographic records shall be maintained to document the crack length and load cycle based on marker band analysis. The Contractor shall report monthly on the progress of this testing.

2. Contractor shall perform detailed fractographic examinations of airframe components supplied by the Government. The airframe components will contain corrosion and or cracks. The examinations will include detailed metallographic and scanning electron microscope (SEM) fractographic analysis. Approximately 10 to 20 components per year will be sectioned and examined in detail for evidence of fatigue cracking and corrosion. This will involve the careful dismantling of the structure and preparation of fractographic specimens. Approximately 1000 specimens per year will be prepared and examined for evidence of corrosion and cracking using microscopy. Detailed records will document the location and morphology of each damaged region. A Contractor Report shall be issued upon the completion of work on each panel.

3. The Contractor shall perform special stress/strain tests for sensory alloy development. Approximately 50 load/displacement test per year shall be performed. It is anticipated that the Contractor may need special training for unique tension/compression test methods. The government will supply all specimens.

4. The Contractor shall maintain the fractographic laboratory and coordinate all activities associated with the MTSB fractographic facility. The Contractor shall maintain a monthly laboratory equipment maintenance log. Duties will include familiarizing and certifying up to five researchers who wish to perform SEM studies.

Deliverables: (due at completion of each test, unless noted)

Task Order Number: 17RCE Revision: 1 Date of Revision: 11/30/04

Title: Metals and Thermal Structures Research and Technology Development

- laboratory maintenance log shall be kept by Contractor
- informal written and oral reports after completion of each analysis
- formal written Contractor Report at end of task (each panel examination and fatigue test series)

Performance Standards:
MEETS:

- perform minimum quantity of fracture analysis (1000 specimens per year)
- perform minimum quantity of fatigue tests (100 fatigue specimens per year)
- adherence to schedule and cost
- adherence to test procedures
- test data reports and laboratory maintenance log
- final written Contractor Report meets NASA editorial standards.

EXCEEDS: completion ahead of schedule

3. **Government Furnished Items:**
The Contractor shall be supplied access to UNIX workstations and associated CAD/CAE software. The Contractor shall use existing specialized fatigue testing equipment, optical microscopes, SEM (scanning electron microscopy) equipment, and associated supplies located in the Fatigue and Fracture Laboratory in Building 1205.

4. **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.

5. **Security clearance required for performance of work:** None.

6. **Period of Performance:**
Planned start date: January 1, R1 ~~2004~~ ***2005*** Completion date: December 31, R1 ~~2004~~ ***2005***

7. **NASA Technical Monitor:** Lynn M. Bowman
M/S 396 Phone: 757-864-5426
NASA Directorate/Other Technical Coordinator: Laurie Johansen
M/S 121 Phone: 757-864-1757

	Task Order Number: 17RDI Revision: 5 Date of Revision: 11/10/04 Title: Electromagnetics Research Facilities

1.	**Purpose, Objective or Background of Work to be Performed:** Several [R5]***Research and Technology Directorate (R&T)*** electromagnetic test facilities serve as focal points for government, industry, and university personnel for performing research. The facilities involved in this task are the Electromagnetics [R5]***and Sensors*** Research Branch's (ESB) Low Frequency Antenna Test Facility (LFATF), Compact Range Pilot Test Facility (CRPTF) , the Experimental Test Range (ETR), and the Electromagnetic Properties Measurements Laboratory (EPML). These facilities are used over the 0.1 to 40 GHz frequency range to measure electromagnetic scattering and antenna performance plus the EPML has the capability for conducting measurements to determine the dielectric properties of materials from 0.045 to 50 GHz and from 75 to 110 GHz. The purpose of this task is to provide the technical [R3]engineering support required for conducting this research. Revision 1: Schedule and completion dates extended for NASA's convenience and GFI revised for contract compliance (see [R1] below). Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and updates and/or clarifies the requirements for the new period of performance (see [R2] below). Revision 3: Extends the period of performance and schedule one year in continuation of NASA's support requirements and adds some clarifications (see [R3] above and below). Revision 4: Extends the period of performance and schedule one year to December 31, 2004 in continuation of NASA's support requirements, redefines some requirements for the new period of performance, and updates GFI (see [R4] below). Revision 5: Extends the period of performance 12 months to December 31, 2005, in continuation of NASA's support with updated and additional requirements, other updated info, and new technical monitor appointed in May '04 (see [R5] above and below).
2.	**Description of the Work to be Performed:** **2.1 Low Frequency Antenna Test Facility** - This task will provide technical [R5]***and administrative*** support for facility operations approximately [R2]~~75~~ 80% of the time. The Contractor shall provide technical support for the operation of the Low Frequency Antenna Test Facility which includes the coordination of equipment and personnel to accomplish all test requirements. *****Begin [R5] block addition***** The Contractor shall provide time and manpower estimates to accomplish internal and external customer requests. The Contractor shall review space act or interagency agreements with the view of technical merit and feasibility. *****End [R5] block addition***** Deliverables:

- technical support for facility operations
-test reports (as required by customers)
-conference papers
-problem/failure/action reports (as needed)
- [R5]***estimates needed for pricing work to NASA administration***.

Metrics:
Minimum acceptable performance:
-readiness of facility to support planned tests at least 50% of the time until [R1] ~~10/31/01~~ [R2]~~12/31/01~~ [R3]~~12/31/02~~ [R4]~~12/31/03~~ [R5]~~12/31/04~~ ***12/31/05***.
-skill improvements for present and future requirements
-timeliness of reports, [R5]***estimates***, and documentation
Exceeds minimum performance:
-recommendations for improving efficiency, capability, cost, and quality.
-propose new activities that will benefit the government in achieving the goals of the tasks included herein

2.2 Compact Range Pilot Test Facility - This task will provide technical [R5]***and administrative*** support for facility operations approximately [R2]~~75~~ 80% of the time.

The Contractor shall be responsible for providing technical support for the operation of the Compact Range Pilot Test Facility (CRPTF) which includes the coordination of equipment and personnel to accomplish all test requirements. It is anticipated that electromagnetic scattering [R4]and occasional antenna radiation measurements will be performed in the CRPTF.
*****Begin [R5] block addition*****
The Contractor shall provide time and manpower estimates to accomplish internal and external customer requests.
The Contractor shall review space act or interagency agreements with the view of technical merit and feasibility.
*****End [R5] block addition*****

Deliverables:
- [R3]technical support for facility operations
- test reports (for all radar cross section (RCS) tests; otherwise, as required by customers)
- problem/failure/action reports (as needed)
- conference technical papers
- [R5]***estimates needed for pricing work to NASA administration***.

Metrics:
Minimum acceptable performance:
- readiness of facilities to support planned tests at least 75 percent of the time until R1~~10/31/01~~ R2~~12/31/01~~ R3~~12/31/02~~ R4~~12/31/~~03 R5~~12/31/04~~ ***12/31/05***
- skill improvements for present and future requirements
- timeliness of reports and documentation

Exceeds minimum performance:
- recommendations for improving efficiency, capability, cost, and quality.
- propose new activities that will benefit the government in achieving the goals of the tasks included herein

2.3 Experimental Test Range - The Contractor shall be responsible for technical support for the Experimental Test Range (ETR). This task will provide technical support for facility operations approximately R2~~25~~ 20% of the time.

*****Begin R5 block addition*****

The Contractor shall provide time and manpower estimates to accomplish internal and external customer requests.
The Contractor shall review space act or interagency agreements with the view of technical merit and feasibility.

*****End R5 block addition*****

Deliverables:
-R5~~design modification of a R2large model for the ETR string support system model for survivability program tests~~
- preparation of facility following completion of the Construction (CoF) upgrade that is expected to be completed in the R5~~fall of 2004~~ ***winter of 2005.***
- R5***estimates needed for pricing work to NASA administration***.

R3~~-design of large RCS calibration models~~

Metrics:
Minimum acceptable performance:
- readiness of facility to support planned tests until R1~~10/31/01~~ R2~~12/31/01~~ R3~~12/31/02~~ R5~~12/31/03~~ ***12/31/05***
- R4installation of NASA provided radar/measurement system upon the completion of the CoF.

2.4 Special Access Program Laboratory Support - The Contractor shall be responsible for providing technical support to ongoing laboratory experiments ERB is involved with at NASA

Langley Research Center. This task will require a 50% level of effort.

2.5 Electromagnetic Properties Measurements Laboratory -The Contractor shall be responsible for providing the technical support for the operation of the Electromagnetic Properties Measurements Laboratory (EPML) which includes coordination of equipment and personnel to accomplish all test requirements. This task will provide technical support for facility operations approximately R2~~15~~ R5~~20~~ ***5***% of the time. R5~~The EPML anticipates making R225 to 30 several sample tests and material measurements annually , involving various test models and material configurations plus impedance and/or transmission loss measurements of a number of inflatable waveguide test articles. The EPML consists of three Hewlett Packard 8510C network analyzers and a small compact range with R2an HP8510C based measurement system. In addition,~~ The Contractor shall provide consultative and programmatic support for special access programs (as identified) that require coordinated planning with other government agencies and industry (as needed) for laboratory measurements.

Deliverables:
- test reports (as required by customers, includes informal data reports of raw and processed data for material samples for each entry)
- problem/failures/action reports (as needed)
operation compatible with other test requirements
- test requirements, planning reports, and schedules for special access programs (as properly identified) shall be reported to the ERB management and technical personnel (as properly identified) R1~~10/31/01~~ R2~~12/31/01~~ R3~~12/31/02~~ R4~~12/31/~~03 R5~~12/31/04~~ ***12/31/05***.

Metrics:
Minimum acceptable performance:
-readiness of the EPML for the support of testing
-timeliness of reports and other documentation for special access programs (as properly identified) R1~~10/31/01~~ R2~~21/31/01~~ R3~~12/31/02~~ R4~~12/31/~~03 R5~~12/31/04~~ ***12/31/05.***
-Maintain readiness of EPML.

Exceeds minimum performance:
-recommendations for improved efficiency, capability, cost, and quality
-proposed new activities or uses of the laboratory that will benefit the government in achieving the goals of the tasks included herein R1~~10/31/01~~ R2~~12/31/01~~ R3~~12/31/02~~ R4~~12/31/~~03 R5~~12/31/04~~ ***12/31/05.***

*****Begin R5 block addition*****
2.6 Secure IT systems and secure area maintenance- The Contractor shall be responsible for completing all programmatic maintenance on IT systems within controlled areas within the

	electromagnetics and sensors branch. The Contractor shall be responsible for administrative plans for security within the Electromagnetics and sensors branch. Deliverables: -routine system maintenance on secure IT systems -All required forms and plans for physical security within the Electromagnetics and Sensors branch. Metrics: Timeliness of forms and plans delivered to the security office. All IT maintenance accomplished within 30 days of assignment. Exceeds minimum performance: -IT maintenance accomplished within 7 working days of assignment. - Forms and plans turned into the security office within 7 working days of assignment. - Recommendations for improved efficiency, capability, and cost to secure systems. *****End R5 block addition*****
3.	**Government Furnished Items:** Access to test facilities, including use of instrumentation for model support and positioning and data collection, office space, R1specialized computers, test equipment, solvent reservoirs, solvents, cleaning agents, and related items will be made available to the Contractor from existing laboratory resources to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. With the exception of subtask 3.4 all work will be performed in NASA LaRC Buildings 1299, and 1299F on a non-interference basis.
4.	**Other information needed for performance of task:** Occasional one to two day travel per month in support of subtasks 3.3, 3.4 and 3.5 will be required.
5.	**Security clearance required for performance of work:** Secret clearance with LBI (R3Limited Background Information)
6.	**Period of Performance:** **Planned start date:** January 1, 2001 **Completion date:** R1 ~~October 31,2001~~ R2 ~~December 31, 2001~~ R3 ~~December 31, 2002~~ R4 ~~December 31, 2003~~ R5 ~~December 31, 2004~~

	Task Order Number: 17RDI Revision: 5 Date of Revision: 11/10/04 Title: Electromagnetics Research Facilities

	December 31, 2005
7.	**NASA Technical Monitor:** R5***Berkley A. Langford Jr.*** M/S: 490 Phone: 757-864-***1846***

Task Order Number: 17RFI Revision: 3 Date of Revision: 3/5/2003

Title: DACOM I, DACOM II, and DLH Support for the TRACE-P Expedition

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

The NASA Global Tropospheric Experiment (GTE) Program is sponsoring an airborne atmospheric science mission to the North Pacific region during February to April 2001. This measurement campaign, named TRAnsport and Chemical Evolution over the Pacific (TRACE-P), will involve the deployment of the NASA Dryden DC-8 and NASA Wallops P-3 aircraft that will be instrumented by principal investigator (PI) groups from several universities and government agencies. Primary objectives of TRACE-P are to investigate the Asian outflow and the chemical conversion of these gas species as they are transported across the Pacific.

The Sensor Systems Branch of the Systems Engineering Competency has an important role in TRACE-P by providing measurements of key gas species on both the DC-8 and P-3 aircraft. On the DC-8, high accuracy, fast response, *in situ* measurements of CO, CH_4 and N_2O will be provided by the Differential Absorption CO Measurement I (DACOM I) while high quality H_2O(v) measurements will be provided by the Diode Laser Hygrometer (DLH). On the P-3 in-situ CO and CH_4 measurements will be provided by DACOM II. The DACOM I and DLH instrument systems are scheduled to be in the field at either the DC-8 integration site (NASA Dryden) or based from intensive operations sites at Hong Kong and Tokyo. DACOM II is scheduled to be in the field at either the P-3 integration site NASA Wallops) or at the above intensive operations sites. Personnel are required to support TRACE-P by shipping the instruments to the integration sites, aircraft integration, flight testing, in-flight operation and maintenance, shipping the instruments back to Langley, laboratory reorganization, and post mission instrument calibration and data handling.

DACOM I and II have 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.

Revision 1 (12/7/2001) Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by adding Subtasks 11 through 14 and adding travel requirement (see [R1] below).
Revision 2 (6/10/2002) Adds Subtasks 15 through 19 (see [R2] below).
Revision 3 (3/5/2003) Adds/updates requirements in Subtasks 15, 17, and 19, adds new Subtasks 20 and 21, and extends the period of performance through April 30, 2003 (see [R3] below)

2. **Description of the Work to be Performed:**

Subtask 1.0: Shipment of DLH to the DC-8 integration site. The contractor shall develop procedures to ship this instrument 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 arrange for shipment of DLH to the integration within 5 working days. The contractor shall arrange for shipment of DLH to the integration site.

Deliverables
1. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DLH packed to meet scheduled ship date of January 20, 2001.
2. Shipping list complete and up-to-date on day of shipment.

Exceeds:

1. Shipping list complete and up-to-date at least two days prior to shipment.

Subtask 2.0: Shipment of DACOM II to the integration site. The contractor shall develop procedures to ship this instrument 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 arrange for shipment of DACOM II to the integration site.

Deliverables
1. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DACOM II packed to meet scheduled ship date of January 11, 2001.
3. Shipping list complete and up-to-date on day of shipment.

Exceeds:

1. Shipping list complete and up-to-date at least two days prior to shipment.

Subtask 3.0: Integrate and preflight test DACOM I and DLH on NASA DC-8. This requires the contractor to unpack, assemble and install DACOM I and DLH on the NASA DC-8. The contractor shall verify the DACOM I and DLH 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 I 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 I and DLH test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM I and DLH are ready, i.e. verified operational via Government-approved procedures to meet scheduled science flights (detailed in Attachment A) barring optics failure.
2. Delivery of DACOM I and DLH data files to PI within 24 hours of each test.

Exceeds:

1. DACOM I and DLH are ready one week prior to first scheduled science flight (detailed in Attachment A) barring optics failure.

Subtask 4.0: Integrate and preflight test DACOM II on the NASA P-3. This requires the contractor to unpack, assemble and install DACOM II on the NASA P-3. The contractor shall verify the DACOM II operation using the procedures developed under previous SAERS task GL25.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM II subsystems (according to above procedures), including anomalous behavior and / or failures.

4. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on subsystems.

5. DACOM II test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM II is ready, i.e. verified operational via Government-approved procedures to meet scheduled science flights (detailed in Attachment A) barring optics failure.
3. Delivery of DACOM II data files to PI within 24 hours of each test.

Exceeds:

1.DACOM II is ready one week prior to first scheduled science flight (detailed in Attachment A) barring optics failure.

Subtask 5.0: Operate, according to previously developed procedures, and maintain DACOM I and DLH subsystems during the TRACE P mission, i.e. test and science flights.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM I 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 I 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 I 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 I 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 6.0: Operate, according to previously developed procedures, and maintain DACOM II subsystems during the TRACE P mission (i.e. test and science flights).

Deliverables

1. Log entries summarizing procedural verification of operation and performance of DACOM II (according to above procedures) prior to each flight, including anomalous behavior and/or failures.

2. Log entries summarizing procedural operation and performance of DACOM II

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 II 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. Delivery of DACOM II 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.

Subtask 7.0: Coordinate off-loading of DACOM I and DLH with DC-8 support personnel and shipment of equipment to Langley with GTE 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:

1. Equipment packed and shipping list complete and up-to-date two days prior to shipment.

Subtask 8.0: Coordinate off-loading of DACOM II with P-3 support personnel and shipment of equipment to Langley with GTE 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:

1. Equipment packed and shipping list complete and up-to-date two days prior to shipment.

Subtask 9.0: After return from deployment, unpack DACOM I, DLH, and DACOM II and supporting equipment, reorganize laboratory, conduct equipment inventory, and calibrate instruments.

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.

Subtask 10.0: Investigate new measurement applications for the Diode Laser Hygrometer

(DLH).

Contractor shall modify the DLH such that it can measure the water vapor content within sealed-glass enclosures.

Deliverables

1. DLH that is modified for measuring water vapor inside glass enclosures.
2. Demonstration of modified DLH capabilities.
3. Data files and/or strip charts generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. Data files and/or strip charts delivered within 1 week of instrument demonstration.

Exceeds:

1. Data files and/or strip charts delivered within 24 hours of instrument demonstration.

Begin [R1] block requirements redefinition
Subtask 11.0: Preparation of poster presentation for NIST Conference (presently scheduled for April 23, 2002) that describes DLH sealed-enclosure measurement system and measurement capability.

Deliverables

1. Poster material that describes the modified DLH instrument and documents the measurements made on sealed enclosures. (This display material will also be used for a report that documents these measurements.)
2. Setup poster at NIST conference.

Performance Standards and Evaluation Criteria

Meets:
Poster display items completed two days prior to conference.

Exceeds:
Hardware demonstration that illustrates aspects of the sealed-enclosure measurements included

in poster display.

Subtask 12.0: TRACE-P data reduction and archival

Deliverables

1. TRACE-P DACOM I and II data reduced.
2. DACOM I and II data submitted to GTE archive.

Performance Standards and Evaluation Criteria

Meets:
DACOM I and II data archived prior to Feb. 1, 2002.

Exceeds:
DACOM I and II data archived prior to Jan. 15, 2002.

Subtask 13.0: Experimental investigation of DLH accuracy.

Deliverables

1. Physically set-up experiments and participate in measurements to investigate and improve DLH accuracy.
2. Prepare data for analysis of DLH accuracy.

Performance Standards and Evaluation Criteria

Meets:
Provide experimental data to NASA TM within 1 week of measurements.

Exceeds:
Provide experimental data to NASA TM within 3 days of measurements.

Subtask 14.0: Demonstration of DLH on P-3 aircraft.

Deliverables

1. Results of laboratory experiments to determine optimum P-3 installation location.
2. Adapt DLH for installation on P-3 aircraft.
3. Installation of DLH demonstration instrument on P-3.
4. Experimental DLH data on the P-3.

Performance Standards and Evaluation Criteria

Meets:
Provide P-3 experimental data to NASA TM within 1 month of measurements.

Exceeds:
Provide P-3 experimental data to NASA TM within 1 week of measurements.
End [R1] block requirements redefinition

Begin [R2] block addition
Subtask 15.0 Downsize DACOM I Gas Channel Electronics.

Deliverables

1. Fabricate and test 4 gas channel electronics units and 1 power supply unit per the DACOM II gas channel electronics.
2. [R3]***Incorporate laser power interrupt circuits into gas channel electronics units and fabricate two laser alignment tools using large area pyro-electric detectors.***

Performance Standards and Evaluation Criteria

Meets:
Provide all 4-gas channel electronics units before Jan. 1, 2003.
[R3]***Provide power supply by April 30, 2003.***
[R3]***Provide laser power interrupts and alignment tools by Dec. 9, 2002.***

Exceeds:
Provide at least 1 unit prior to Oct. 1, 2002.
[R3]***Provide power supply by April 15, 2003.***

[R3]***Provide laser power interrupts and alignment tools by Dec. 2, 2002.***

Subtask 16.0: Analysis of the GFCR (Gas Filter Correlation Radiometer) to provide total column CO measurements from the DC8

Deliverables

1. Theoretical calculations using GFCR instrument model to determine feasibility of making high specificity, high accuracy total column CO measurements in a solar reflection mode from an airborne platform such as the NASA DC-8.

Performance Standards and Evaluation Criteria

Meets:
Calculations provided to NASA TM by Dec. 31, 2002.

Exceeds:
Calculations provided to the NASA TM by Oct. 1, 2002.

Subtask 17.0: Develop, characterize and test detector gain balancing technique to improve N_2O sensitivity of DACOM.

Deliverables

1. [R3]***Develop in Labview software the gain balancing technique and simulate its operation with off-the-shelf laboratory equipment.***
Performance Standards and Evaluation Criteria

Meets:
[R3]***Demonstrate simulation to NASA TM by March 15, 2003.***
.

Exceeds:
[R3]***Demonstrate simulation to NASA TM by March 1, 2003.***

Subtask 18.0: Modify DACOM data acquisition software to be Lab Windows based.
Deliverables

1. Operational documented software demonstrated to TM.

Performance Standards and Evaluation Criteria

Meets:
Successful software demonstration by November 1, 2002.

Exceeds:
Software has capability to type in comments during data acquisition.

Subtask 19.0: Three-channel DACOM I operational in laboratory.

Deliverables

1. Demonstrate 3-channel DACOM measurements to TM. Contractor not accountable for failure of lasers or detectors. NASA to specify and configure optics.

Performance Standards and Evaluation Criteria

Meets:
Demonstration of DACOM by ~~October 15, 2002~~ ***Jan. 7, 2003***.

Exceeds:
Demonstration of DACOM by ~~October 15, 2002~~ ***Dec. 13, 2002***.
End R2 block addition
*****Begin R3 block addition*****

Subtask 20.0: Demonstrate new data acquisition software on DC-8 aircraft

1. Operational documented software demonstrated to TM.

Performance Standards and Evaluation Criteria
Meets:
Successful software demonstration by Jan. 7, 2003.

Exceeds:
Successful software demonstration by Dec. 20, 2002.

Subtask 21.0: Develop software capability using Labview and National Instruments A/D and D/A boards to modulate a DACOM laser, demodulate harmonics of the differential absorption signal, and control an optical shutter.

Deliverables

1. Demonstrate software by simulation with laboratory instrumentation.

Performance Standards and Evaluation Criteria

Meets:
Software demodulates 2f, 4f and 6f harmonic components.

Exceeds:
Software demodulates all harmonics from 1f to 6f.
*****End [R3] block addition*****

3. **Government Furnished Items**:

1. The DACOM I, DLH, and DACOM II 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 and Wallops 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 GTE site URL:
http://www.gte.larc.nasa.gov/
There will be 2 operators with DACOM I and DLH during all local flights from intensive operation sites and either one or two operators during transit flights between intensive sites. (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.

[R1] Three days of travel required to NIST Conference in Gaithersburg, MD. Several trips to NASA Wallops may be required to develop and demo the DLH on the P-3.

Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC

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.

5. Security clearance required for performance of work:

None required.

6. Period of Performance:

Planned start date: January 2, 2001 Completion date: R1 ~~December 31, 2002~~

R3 ***April 30, 2003***

7. NASA Technical Monitor: Glen Sachse

M/S: 472 Phone: 757-864-1566

NASA Competency/Other Technical Coordinator: Systems Engineering Competency (*above branch level*): *name (This is the management interface between COTR and TM for efficiency in PBC, technical focus, timely funding, modifications, scheduling, and award fee evaluations--selected by Competency/Office.)*

M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 18RAC Revision: ____ Date of Revision:

Title: Automated Package Delivery Aircraft Concepts

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

The Revolutionary Aerospace Concepts Team is interested in developing a set of vehicle concepts that will meet the projected demand for automated package delivery in the future. These models will be used to evaluate NASA's technology concepts.

2. Description of the Work to be Performed:

The contractor shall develop vehicle concepts for the automated package delivery system. Concepts that are envisioned include very large airborne warehouses, short takeoff and landing feeder aircraft, and highly modular spanloader concepts. The contractor shall model enough of the conventional aircraft in the current system for accurate comparison of performance. Technology studies will include applying technology to the conventional aircraft as a baseline in the future, and deriving technology requirements that will make the advanced concepts attractive options in the future. The mission requirements will be provided by the government. There will be several scenarios requiring different levels of automation, performance and control characteristics. The performance will be to deliver documented performance models electronically and on paper. The contractor may compare the results of the models to historical data. The contractor may develop three-dimensional models and evaluate the aerodynamics and structures of the concepts. The contractor will provide monthly reports and status of the concepts. Concepts should be delivered as they become available is encouraged so as to continue concept advocacy and planning.

Deliverables:

Large airborne warehouse concept computer based model in FLOPS or ACSYNT including a list of references for all data used to validate the model. (3/31/01)

Feeder aircraft concept computer based model in FLOPS or ACSYNT including a list of references for all data used to validate the model. (5/31/01)

Modular spanloader concept computer based model in FLOPS or ACSYNT including a list of references for all data used to validate the model. (6/30/01)

Informal status reports of concept and model development. (bimonthly)

Metrics:

Meeting the above list of deliverables defines acceptable performance.

Task Order Number: 18RAC Revision: ____ Date of Revision:

Title: Automated Package Delivery Aircraft Concepts

Exceptional performance will entail additional effort such as: developing computational aerodynamic models of the concepts; performing stability and control analysis of the concepts; identifying the key technologies that will enable these concepts to be desirable; or other analyses to be determined.

3. Government Furnished Items:

The system requirements will be furnished by the government.

4. 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.

5. Security clearance required for performance of work:

None.

6. Period of Performance:

Planned start date: 1/2/01 Completion date: 6/30/01

7. NASA Technical Monitor: Paul Gelhausen
M/S: 248 Phone: 757-864-2290

NASA Competency/Other Technical Coordinator:
M/S: Phone:

Task Order Number: 18RBG Revision: 3 Date of Revision: 10/17/02

Title: DOPPLER GLOBAL VELOCIMETRY (DGV)

1. Purpose, Objective or Background of Work to be Performed: (GH01, NAS1-96013)

Doppler Global Velocimetry is a class of flow velocity measurement technologies. It is capable of measuring three-component velocities within a plane, line, or point. The objective of the work to be performed is the development of hardware and software needed to transfer DGV technology from the laboratory to routine operational systems in wind tunnels.

Revision 1: Reschedules/reprioritizes existing work, adds new requirements as Subtask 2.3, and extends the completion date (see R1 below).
Revision 2: Expands subtasks, extends the period of performance, and notes the completion and/or cancellation of requirements due to current funding priorities (see R2 below).
Revision 3: Expands subtasks, extends the period of performance one year, and notes the completion and/or cancellation of requirements due to Program cancellation (see R3 below).

2. The Contractor shall perform the following requirements:

2.1 *Doppler Global Velocimetry*

1) R3***Completed***
2) R2Completed
3) R3***Cancelled***
4) R2Cancelled

*****Begin R3 block expansion*****

5) Provide the following system upgrades / calibrations:
   a) Calibrate the Iodine vapor cells (8) for 514.5 nm. Deliverables: Calibration data sets and lookup tables.
   b) Develop phase lock technology for DGV (laser and/or camera). Deliverables: electronics and/or control software and documentation.
   c) Develop four scene / one camera data acquisition software. Deliverables: Software and documentation.
   d) Develop data acquisition computer -> data processing computer network. Deliverables: Software, procedures, and documentation.
6) Conduct comparative DGV testing in the following facilities:
   a) 2-inch pipe flow jet (AMDB DGV Laboratory)
   b) Diagnostic Development Laboratory (AMDB)

*****End R3 block expansion*****

Schedule:
1) R3***Completed***
2) R2Completed
3) R3***Cancelled***

4) R2Cancelled

*****Begin R3 block expansion*****

5) a) Eight cell calibrations – 4/03
   b) Laboratory demonstration – 5/03
   c) Beta version – 4/03, Final version – 6/03, Documentation – 10/03
   d) Beta version – 4/03, Final version – 6/03, Documentation – 10/03
6) a) 2-inch pipe flow measurements – 7/03, Data CDs – 8/03
   b) DDL demonstration – 10/03, Data CDs – 11/03

*****End R3 block expansion*****

Standards (meets, exceeds):

1) Standards to meet specifications
   a) Delivery of all deliverables at the contracted cost for Subtask 2.1.
   b) Delivery of the primary deliverables at the schedule listed above for Subtask 2.1. Final documentation to be delivered by R1~~September 30, 2001~~ R2~~June 30, 2002.~~ R3~~October 31, 2002~~ ***October 31, 2003***.
2) Standards to exceed specifications. Meeting either of the two standards listed below will constitute exceeding the minimum acceptable performance for Subtask 2.1.
   a) Develop user training documentation/help files for the proper operation of the deliverables at the contracted cost at the delivery schedule listed above for Subtask 2.1.
   b) 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.

2.2 *Point Doppler Velocimetry*

1) R3***System redesigned from avalanche-photodiode to photomultiplier***
2) Conduct laboratory testing of the PDV to determine system performance characteristics and conduct an error analysis of the system. Deliverables: Test data sets to be analyzed by NASA.
3) Validate system performance by comparative testing in a 2-inch pipe flow. Deliverables: Comparative data sets.
4) Obtain temporal velocity records from a rotating wheel and the pipe flow to determine the limitations of PDV for temporal analysis. Deliverables: Test data sets.

*****Begin R3 block expansion*****

5) Develop signal integration electronics to obtain a continuous output from the PDV photomultipliers. Deliverables: Prototype and final circuits.
6) PDV data acquisition / data processing software. Deliverables: Software and

documentation.

7) Control software for mechanical scan rig. Deliverables: Software and documentation.

****End R3 block expansion*****

Schedule:

1) Redesign R3***Completed***. Final system, 3 receiver systems – R1~~9/01~~ R2~~5/02~~ R3~~10/02~~ ***10/03***.
2) Laboratory testing of the PDV. R3***Completed***.
3) 2-inch pipe flow testing. Phase 1 R3***Completed***. ***Phase 2 with new system modifications – 4/03***.
4) Temporal velocity records – R2~~10/01~~ R3~~10/02~~ ***4/03***

*****Begin R3 block expansion*****

5) Signal integration electronics – prototype – 3/03, final – 7/03.
6) PDV data acquisition / data processing software – 2/03
7) Scan control software – 1/03

*****End R3 block expansion*****

Standards (meets, exceeds):

1) Standards to meet specifications
   a) Delivery of all deliverables at the contracted cost for subtask 2.2.
   b) Delivery of the primary deliverables at the schedule listed above for subtask 2.2. Final documentation to be delivered by R1~~October 31, 2001~~ R2~~January 31/2002~~ R3~~October 31, 2002~~ ***October 31, 2003.***
2) Standards to exceed specifications. Meeting one of the three standards listed below will constitute exceeding the minimum acceptable performance for subtask 2.2.
   a) Compare statistical and temporal results of the PDV in the 2-inch pipe flow with hot wire anemometer measurements.
   b) Conduct proof-of-principle test of the PDV in the R3***Diagnostic Development Laboratory***.
   c) 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.

Begin R1 block

2.3 <u>Develop software for the manipulation and analysis of processed Projection Moire Interferometry (PMI) data images</u>.R2 Some requirements completed and the remainder have been cancelled.

End R1 block

3.	Government Furnished Items: All hardware components needed to construct the above systems will be government supplied. In addition, test facilities, office space, specialized test equipment, and specialized computer systems will be government supplied as needed.
4.	Other information needed for performance of task: Documentation on Doppler Global Velocimetry is available on the NASA Langley Report Server. All safety procedures for laboratory operation of laser systems are available on the NASA Langley LMS site.
5.	Security clearance required for performance of work: All tasks are unclassified.
6.	Period of Performance: Planned start date: 1/2/02 Completion date: R1 ~~10/31/01~~ R2 ~~6/30/02~~ R3 ~~10/31/02~~ ***10/31/03***
7.	NASA Technical Monitor: James F. Meyers M/S: 493 Phone: 757-864-4598 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 18RCE Revision: 2 Date of Revision: 2/15/05

Title: **Analysis, Testing, and Surface Preparation of Advanced Materials**

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

The purpose of this task is to conduct mechanical testing and microstructural analyses on materials systems, with the primary focus being advanced metallic materials. The objective is to establish processing-microstructure-property relationships for the material systems for aerospace applications. In addition, this task includes activities for chemically cleaning and surface modification of metallic materials for subsequent processing and/or analysis.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated items below.)

The requirements described represent an update of previous task order 14RCE. This revision extends the period of performance one year in continuation of NASA's support with a change in the title and number for the new period of performance.

Revision 1: Extends the period of performance and schedule three months to April 1, 2005, with increases in most total required tests and/or specimens (see [R1] below).
Revision 2: Extends the period of performance and schedule six months to October 1, 2005, with increases in most total required tests and/or specimens (see [R1] below).

2. **Description of the Work to be Performed:**

Overall Requirement: The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

Subtask 2.1 Microstructural Analysis

The Contractor shall prepare specimens and perform routine and advanced laboratory analyses on a written NOR basis. The Government will provide the materials which will primarily be metallic-based, although other materials may be included on a limited basis. Preparation techniques will include sectioning, mounting, mechanical and chemical or electrochemical polishing of specimens suitable for optical metallography, x-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analysis. The contractor shall ensure equipment is operational prior to and after analyses. The contractor shall ensure equipment is within current calibration, where appropriate. Specific analyses and quantities are detailed below:

- Utilize a variety of optical microscopes in conjunction with SEM with energy- and wavelength-dispersive spectrometry (EDS and WDS) systems and a microtexture analysis system to analyze the chemistry, morphology, and orientation of individual grains and/or particles and of the bulk microstructure (up to R1 ~~100~~ R2 ~~150~~ ***300***).
- Utilize TEM to assess the fine-scale microstructural features, chemistry, and phase content of specimens (up to R1 ~~40~~ 50).
- Conduct bulk quantitative compositional analysis using methods such as atomic absorption, inductively coupled plasma analysis, and other wet-chemistry techniques (up to 20).
- Utilize XRD to analyze bulk phase content, texture and residual stresses (up to R1 ~~40~~ R2 ~~60~~ ***100***).
- Conduct material analyses using differential scanning calorimetry (DSC) and differential thermal analysis (DTA) to identify thermodynamic and kinetic events in metallic materials (up to R1 ~~25~~ R2 ~~35~~ ***60***).
- Conduct failure analyses on test coupons and structural components to determine the origin of and reasons for failure (up to R1 ~~30~~ 40).
- Conduct hardness and microhardness tests on metallic materials (up to R1 ~~30~~ 40).

Deliverables (for 2.1):

- For each NOR, brief informal statement (written or oral) of types of analyses to be conducted and estimated time for completion to the Requester within 5 working days after receipt of the NOR.
- For each NOR, informal written and oral report of results to the Requester within 5 working days after completion of the analysis. The report shall include description of analyses and interpretation of results. The report shall include any photomicrographs, compositional analyses, x-ray and electron diffraction data relevant to the microstructural characterization performed.
- Informal written monthly reports that list NORs completed during the reporting period, costs, the scheduling priorities for upcoming NORs, and any other pertinent issues
- Written informal final report summarizing the number and types of analyses conducted, standards and procedures used, and any specialized analysis techniques and procedures developed. (R1 ~~12/31/2004~~ R12 ~~4/1/2005~~ ***10/1/2005***)

Performance Standards (for 2.1):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- NORs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- NORs completed by requested due date
- Cost

EXCEEDS:

- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completion under cost

Subtask 2.2: Mechanical Testing

The Contractor shall conduct mechanical tests and data analysis on a written NOR basis to determine the mechanical behavior of materials from cryogenic to elevated temperatures, with the majority of tests being conducted at room temperature. The Government will supply the specimens machined from aluminum, titanium, and nickel based alloys and composites, although other materials may be included on a limited basis. Product forms may include, but not be limited to, foils, sheets, plates, rods, forgings, and extrusions. The contractor shall ensure equipment is operational prior to and after tests. The contractor shall ensure equipment is within calibration. Specific tests and quantities are detailed below:

- Tensile and compression tests to measure strength, modulus, and elongation (up to R1~~400~~ R2~~550~~ ***700***).
- Fracture toughness tests using J-integral analysis of R-curves generated from compact tension, center-crack tension, and other specimen configurations (up to R1~~50~~ R2~~60~~ ***80***).
- Fatigue crack growth tests using compact tension specimens, center crack tension specimens, and other appropriate test specimen configurations (up to R1~~30~~ R2~~40~~ ***50***).
- S-N fatigue tests on notched and un-notched test specimens (up to R1~~50~~ R2~~60~~ ***80***).
- General and stress corrosion tests in salt solutions (up to 40).

Deliverables (for 2.2):

- For each NOR, tested specimens (with fracture surfaces intact and preserved) and an informal written and/or oral report of results to the Requester within 3 working days of completion of the tests. The report shall include description of test procedures, calibrations, specimen dimensions, test anomalies, and electronic data files for each test.
- Informal written monthly reports that list NORs completed during the reporting period,

costs, the scheduling priorities for upcoming NORs, and any other pertinent issues

- Written informal final report summarizing the number and types of tests conducted, standards and procedures used, and any specialized test techniques and procedures developed. ([R1] ~~12/31/2004~~ [R2] ~~4/1/2005~~ ***10/1/2005***)

Performance Standards (for 2.2):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- NORs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:

- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completed under cost

Subtask 2.3: Surface Preparation

The Contractor shall conduct surface preparation of metallic materials on a written NOR basis. The materials will comprise primarily aluminum, titanium, and nickel based alloys, although other materials may be included on a limited basis. Product forms may include, but not be restricted to, foils, sheets, plates, rods, forgings and extrusions. NOR tasks will include chemical or electrochemical cleaning, etching, milling and plating. The Government will supply the specimens (up to [R2] ~~800~~ ***1200***) limited to 36 inches by 12 inches in dimension, but usually on the order of 1 inch by 4 inches in size. The Contractor shall be responsible for maintaining chemical cleaning baths and monitoring, neutralizing, and coordinating disposal of hazardous materials. The contractor shall ensure equipment is operational prior to and after surface preparation activities. The contractor shall ensure equipment is within current calibration, where appropriate.

Deliverables (for 2.3):

- For each NOR, an informal written and/or oral report of the results to the Requester within 3 working days after completion of the work. The report shall include description of the surface preparation procedures, results, and anomalies.
- Informal written monthly reports that list NORs completed during the reporting period, the scheduling priorities for upcoming NORs, and any other pertinent issues
- Written informal final report summarizing the number and types of surface preparation activities conducted, standards and procedures used, and any specialized techniques and

procedures developed. (R1 ~~12/31/2004~~ R2 ~~4/1/2005~~ ***10/1/2005***)

Performance Standards (for 2.3):

MEETS

- Quality of data generated for each test request (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- NORs completed by requested due date (accounting for complexity and competing requests).
- Quality of reports (meets NASA standards)
- Cost

EXCEEDS

- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completion under cost.

Subtask 2.4: Laboratory Chemical Inventory

The Contractor shall maintain chemical supplies for the Surface Preparation Laboratory and the Light Alloy Laboratory. This subtask shall include maintaining a catalog of the appropriate materials safety data sheets (MSDS's) and the Chemical Materials Tracking System (CMTS).

Deliverables (for 2.4):

- MSDS catalog (throughout period of performance)
- CMTS website input (throughout period of performance)
- Written informal final report summarizing the chemical supply inventory and the CMTS and MSDS activity. (R1 ~~12/31/2004~~ R2 ~~4/1/2005~~ ***10/1/2005***)

Performance Standards (for 2.4):

MEETS

- CMTS data meets NASA standards
- MSDS catalog remains up-to-date

3. **Government Furnished Items:**

Surface preparation equipment located in Metals Cleaning Laboratory (Building 1229A) including deionized water supply, chemical cleaning and rinse tanks, anodizing equipment, electroplating equipment and supplies, acids, bases, precleaners, neutralizing chemicals, supplies, and related safety equipment.

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Title: **Analysis, Testing, and Surface Preparation of Advanced Materials**

	Mechanical test equipment located in the Light Alloy Laboratory (Building 1205) and the High-Temperature Test Laboratory (Building 1205), including cryogenic and elevated temperature chambers, test machines, strain and displacement measurement instrumentation, and System 4000/5000 and Fracture Testing Associates data acquisition systems. Metallurgical analysis equipment located in the Light Alloy Laboratory (Building 1205), including optical microscopes, SEM's, TEM's, x-ray diffraction systems, hardness and microhardness test machines, DTA and DSC systems, ICP system, and specimen preparation apparatus and supplies.
4.	**Other information needed for performance of task**: None.
5.	**Security clearance required for performance of work:** None.
6.	**Period of Performance:** Planned start date: 01/01/2004 Completion date: R1 ~~12/31/2004~~ R2 ~~4/1/2005~~ ***10/1/2005***
7.	**NASA Technical Monitor:** Keith Bird M/S: 188A Phone: 757-864-3512 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

SWALES (NAS1-00135) Performance Based Contracting (PBC) Task Order	
Task Order Number: 18RDI Revision: 5 Date of Revision: 11/9/04 Title: Computational Electromagnetics Research	

1.	**<u>Purpose, Objective or Background of Work to be Performed</u>**: The objective of this task is to develop analytical techniques, computational methods and computer codes which would enhance the electromagnetic analysis and design capabilities of the Electromagnetics Research Branch (ERB). Change 1: Adjusts schedule to agree with Contractor's 6/25/01 approved Task Plan and corrects Task Order number in heading. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance. Revision 2: Extends the period of performance one year in continuation of NASA's support with redefined and/or updated requirements. (For details of Revision 2, see Bold Italic Font and [R2] below. For details of original, Change 1, and Revision 1 SOWs see ETOS *doc* files *18RDI, 18RDI001, and 18RDI01*, respectively.) Revision 3: Extends the period of performance to August 31, 2004 in continuation of NASA's support with additional requirements as new Subtasks 2.5 and 2.6 for the new period of performance, and updates other info (see [R3] below). Revision 4: Subtask 2.5 is discontinued with partial completion. Under subtask 2.5, a partially verified single-layer computer code has been delivered. Due to changing government requirements, the scope of Subtask 2.6 has been narrowed to focus the effort on performing computer simulations and optimizing designs for the SAR-RSW configuration solely, and to extend the period of performance to Dec. 31, 2004. This revision also documents the Technical Monitor change and extends the overall period of performance to Dec. 31, 2004.(see [R4] below) Revision 5: Extends the period of performance 12 months to December 31, 2005, in continuation of NASA's support with no changes in detailed requirements (see [R5] below)
2.	**<u>Description of the Work to be Performed</u>**: The Contractor shall conduct the following subtasks to develop enhancements to the computational electromagnetics capabilities of the Electromagnetic Research Branch: **Begin [R2] block requirements redefinition/update** 2.1 The Contractor shall develop a computer code using the Method of Moments (MoM) to estimate EM scattering from a thick flat material slab of arbitary shape using the volume formulation. The Contractor shall validate the numerical accuracy of the code through comparison with the results obtained from the surface formulation. The Contractor shall develop a procedure for extending the technique to curve material substrate. Deliverables: Verified computer code for determining the EM scattering from thick flat material slab, with supporting documentation. Written report which describes the

technique and verification test results. Oral presentation, which describes the extension of the technique to curve material slab.

Schedule: Verified computer code and documentation completed May 30, 2003.
Oral presentation on extension to curve material slab completed July 31, 2003.

Metrics: Assessment of progress toward meeting the standards will be determined through technical interchange meetings and quarterly written progress reports.

Standards: (meets): Delivery of code and documentation on schedule with a minimum of two verification test cases, and delivery of oral presentation on schedule describing extension to curve slab.
(exceeds): Delivery of codes and documentation on schedule with a curve material slab test cases.

2.2
The Contractor shall perform a study of various commercial off-the-shelf (COTS) propagation modeling tools to simulate (1) aircraft cabin propagation characteristics, (2) antenna radiation in an aircraft cabin. This effort will provide a preliminary assessment for the capability of these softwares to accurately predict aircraft cabin path loss. The Contractor shall develop simulation capabilities to predict antenna radiation characterisitcs in an aircraft cabin. The Contractor shall perform numerical studies in sufficient detail to establish the potentials of these commercial softwares with in-house developed simulation technique for the purpose .

Deliverables: Documentation that describes limitations and advantages of the commercial available softwares. Also comparison of results obtained from the use of these softwares with the NASA's measured data.
Oral presentation describing the use of these codes for estimation of electromagnetic interference due to various PEDs (personal electronic devices).

Schedule: Studies and Documentation completed Nov. 30, 2003.
Oral presentation completed Dec. 31, 2003.

Metrics: Assessment of progress toward meeting the standards will be determined through technical interchange meetings and quarterly written progress reports.

Standards: (meets): Delivery of simulation code and documentation on schedule with minimum of two verification cases and delivery of oral presentation on schedule.
(exceeds): Delivery of code with application to PED.

2.3
The Contractor shall develop the geometrical modelling and meshing techniques using COSMOS/GEOSTAR to model material rectangular slabs that are loaded with metal rods, wires and various other shapes. The Contractor shall also develop modelling techniques to develop models of various periodically loaded material.

Deliverables: Verified COSMOS/GEOSTAR code for modelling and meshing periodically loaded rectangular material slabs, with supporting documentation.
Written report which describes the technique and test results.
Oral presentation which describes the extension to model complex material.

Schedule: Documented code and written report completed March 30, 2003.
Oral presentation completed April 30, 2003.

Metrics: Assessment of progress toward meeting the standards will be determined through technical interchange meetings and quarterly written progress reports.

Standards: (meets): Delivery of code, written report and oral presentation on schedule with a minimum of two verification test cases.
(exceeds): Delivery of verified complex geometry modelling and meshing and supporting documentation, with numerical results from a minimum of two verification test cases.

2.4
The Contractor shall develop a technique and computer codes using Genetic Alogorithms (GA) to design material layers for low reflectivity (less than –50dB) or maximum transmitivity for various medium such as rectangular waveguide, free-space. The Contractor shall demonstrate use of these multilayer material for truncation of computational domain in the Finite Element Methodology. The Contractor shall validate the numerical accuracy of the code through

comparison with data obtained from analytical formulations. The Contractor shall develop a procedure for extending the technique to realistic materials.

Deliverables: Verified computer code for multi-layer material, with supporting documentation.
Written report which describes the technique and verification test results.
Oral presentation which describes the extension of the technique to multiple layers.

Schedule: Documented code and written report completed Dec. 31, 2003
Oral presentation completed December 31, 2003

Metrics: Assessment of progress toward meeting the standards will be determined through technical interchange meetings and quarterly written progress reports.

Standards: (meets): Delivery of code, written report and oral presentation on schedule with a minimum of two verification test cases.
(exceeds): Delivery of verified multi-layer modification of code and supporting documentation, with numerical results from a minimum of two verification test cases with an accuracy of 99% or better.

End R2 block requirements redefinition/update
Begin R3block addition

2.5 R4Discontinued

2.6
The Contractor shall R4use government-owned commercial software to develop computer models and perform analysis for the prediction of the performance characteristics of reduced surface wave antenna elements for a large, lightweight, space-based remote sensing array antenna. R4The shorted annular ring reduced surface wave (SAR-RSW) antenna configuration shall be investigated for the purpose of optimizing designs for various geometries and material selections. The designs for these antennas using conventional materials are found in the literature. R4~~The purpose of this task is to develop simulation techniques which can be used to vary design parameters to investigate effects on performance.~~ This will be used to attempt to design configurations which are compatible with lightweight, flexible materials while keeping the desirable performance characteristics.

Task Order Number: 18RDI Revision: 5 Date of Revision: 11/9/04

Title: Computational Electromagnetics Research

	Deliverables: Written report which describes the R4 antenna designs and modelling results. R4 ~~Computer models and computer software developed in performance of the task.~~ Schedule: Written report completed R4 ~~August~~ R5 ~~December 31, 2004~~ ***December 31, 2005***. Metrics: Assessment of progress toward meeting the standards will be determined through technical interchange meetings R4 ~~and bimonthly written progress reports~~. Standards: (meets): Delivery of R4 ~~computer models, computer software, and~~ written ***final*** report on schedule. **End R3 block addition**
	3. <u>Government Furnished Items</u>: The Government will provide office space, facilities, government data, access to government specialized computer equipment, access to existing ERB specialized software codes and specialized commercial software on an as-needed basis to accomplish the task objectives.
	4. <u>Other information needed for performance of task</u>: The Contractor shall obtain advanced Government approval for any disclosure of results and the interpretation thereof.
	5. <u>Security clearance required for performance of work</u>: None
	6. <u>Period of Performance</u>: Planned start date: R1 ~~02/15/01~~ R2 ~~01/01/02~~ R3 ~~01/01/03~~ 1/1/04 Completion date: R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~8/31/04~~ R5 ~~12/31/04~~ ***12/31/05***
	7. NASA Technical Monitor: R4 Robin L. Cravey M/S: 490 Phone: 757-864-1819 NASA Competency/Other Technical Coordinator: AirSC/ M/S: Phone:

Task Order Number: 18RFH Revision 4 Date of Revision: January 27, 2005

Title: R2 **General Aviation Data Acquisition System**

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

Begin R2 Section 1 redefinition

The Electronic Systems Branch (ESB) at NASA Langley Research Center is responsible for acquiring and recording the data on Langley's R3 fleet of General Aviation Research Aircraft utilizing a Data Acquisition System (DAS) developed by ESB.

The overall objective of this task is to operate, maintain and upgrade the Data Acquisition System (DAS) and validate data acquired by the DAS.

End R2 Section 1 redefinition

Revision Record:

Revision 1: Extends the period of performance through December 31, 2002 in continuation of NASA's support requirements and redefines some requirements for the new period of performance by showing Subtask 3 as completed and adding new Subtask 4. (See R1 below.)

Revision 2: Extends the period of performance through December 31, 2003, in continuation of NASA's support with updated title, background, GFI, and other info section, redefined requirements, and new Technical Monitor for the extended period of performance (see R2 above and below).

Revision 3: Extends the period of performance one year in continuation of NASA's support, updates some requirements for the new period of performance, and updates other info (see R3 above and below).

Change 1: (see R3.1 below).

Revision 4: Deletes anticipated flight quantities in subtask 1 and all of subtask 2, clarifies/updates subtask 4 and Section 4, and extends the period of performance ten months to December 31, 2005 (see R4 below).

2. Description of the Work to be Performed:

Begin R2 block requirements redefinition

Subtask 1.

The Contractor shall maintain and operate the government provided Data Acquisition System (DAS) on the R3 fleet of General Aviation aircraft. This will include providing an operator for the DAS during all system integration tests, environmental ground tests and all research flights on the R3 fleet of General Aviation aircraft. The Contractor shall also operate the DAS during research flights while on deployments at remote sites. R4 ~~It is anticipated there will be approximately 35 research flights locally and 10 research flights at remote locations.~~ The Contractor shall verify the DAS is performing as requested before each research flight.

1. 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. 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. The Contractor shall maintain configuration control management for all of the DAS flight spares equipment.

2. The Contractor shall modify, integrate, qualify, and validate the DAS as required to support changes/upgrades for scheduled research flights to meet FY03, FY04, R3 and FY05 mission goals, this could include supporting missions at sights other than Langley Research Center. The Contractor shall present integration designs, including a list of required Government Furnished Equipment (GFE), test plans and schedule for the upgrades to the R3 fleet of General Aviation R3 aircraft. The Contractor shall generate configuration change request, data recording list changes, design drawings, experimental work orders, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.

3. 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 General Aviation System Manager when critical flight schedules conflict with accomplishing these calibrations.

4. 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. Configuration Change Request, Data Recording List changes, design drawings, Experimental System Work Requests and Aircraft Work Orders needed to integrate the upgrade or modifications.
6. Monthly written status reports.

7. Calibrated sensors in response to the Data Recording list.
8. A short abbreviated report following each validation test and each research flight.
9. Notification, in writing, of any failures or anomalies.

Performance Standards and Evaluation Criteria
Meets:
1. Parameters have been verified though DAS and ADAPS 1 day before the ICF of a requested flight-test series.
2. An operational DAS, capable of recording parameters 1 day before the ICF of a requested flight test series.
3. Recorded data media delivered to ADAPS two working hours following any test or research flight conducted out of Langley Research Center.
4. 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.
5. 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.
6. DAS sensors, signal conditioning and other ground support equipment are calibrated at less than or equal to 12 months intervals.
7. 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. Parameters have been verified though DAS and ADAPS five days before the ICF of a requested flight series.
2. An operational DAS, capable of recording parameters five days before the ICF of a requested flight test series.
3. Recorded data media delivered to ADAPS one working hour following any test or research flight.
4. Data, acquired by DAS during as research flight, verified within 4 working hours following each research flight. Any anomalies with the data shall be immediately reported to the TM.
5. 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.

Subtask 2 R4 ***Deleted***

Subtask 3 R1 Completed.

Begin R1 block new subtask addition

Subtask 4
The Contractor shall serve as the Chemical Material Tracking System (CMTS) Auditor/Inventory Manager R3 ~~for Building 1202~~ R2 ~~and~~ for the rooms in which R4 ***the Electronic Systems Branch of the Systems Engineering Directorate occupy*** in Building 1244. This effort is to assist in the regulatory compliance and pollution prevention through enhanced inventory control. The Contractor shall be responsible for 1) recommending to the Government materials the Government should procure to maintain the required inventory and 2) maintaining an inventory of chemicals and hazardous materials located in the facility. The Contractor shall make entries and maintain the inventory using Langley Research Center's CMTS system. R2 The Contractor shall make provision for onsite contingency backup of this support during normal working hours.

__Deliverables:__

1. R3 ~~Inventory and complete an updated list of all chemicals and hazardous materials in Building 1202 (with the exception Pearl Young Theater, Aerodyner, and janitorial supply rooms) and the rooms mentioned in Building 1244 by March 1, 2002~~ R2 ~~March 14, 2003.~~
2. Quarterly maintenance and updates maintained through the calendar year ending ~~December 31, 2002~~ R2 ~~December 31, 2003~~ R3.1 ~~December 31, 2004~~, R4 ~~February28, 2005~~ ***December 31, 2005.***

End R2 block requirements redefinition

__**Performance Standards and Evaluation Criteria**__

__**Meets:**__

1. Deliverables completed on schedule.

__**Exceeds:**__

1. Deliverables completed on schedule.
2. Suggestions (accepted by the Government) for enhancing the CMTS activity.

End R1 block new subtask addition

3. __**Government Furnished Items**__:

Begin R2 GFI update

__Access to the following__

1. Use of ADAPS is available for post flight data processing and displays.

Hardware:

1. CAIS (Common Airborne Instrumentation System) data system with documentation
2. CAIS compatible recording media
3. Assorted collection of Sensors
4. Sensor calibration data
5. Access to Flight Simulation Integration Laboratory (FSIL) for testing.
6. PCM Data Systems, Signal Conditioning Units, Signal Condition Modules
7. Smart Decommutator/Display Systems
8. Recorders: Magnetic Tape, Optical Disk, Strip Charts
9. Time Code Generators / Readers / Receivers
10. Power Subsystem; Power Supplies
11. PC based "quick-look" system for DAS validation, post-test and post-flight quick-look.

Documentation:

1. Project Requirements Document
2. All General Aviation aircraft Schedules
3. CAIS system setup documentation
4. Data System Specifications/Operation/Maintenance/Troubleshooting information.
5. Calibration database information/software.
6. Smart Decommutator/Real-time Display System Applications Software Manual.
7. List of equipment that Contractor may elect to have NASA service due to availability of expertise and facilities already existing at NASA. **End R2 GFI update**Specifications, review materials, drawings, operating manuals and other available design documentation.
8. Access to Government owned, SEC managed, CAEDE design and analysis tools.
9. Copy of available test procedures and previous test results.
10. Access to lab bench in building 1202 and standard laboratory equipment/tools (voltage supplies, RF meter, multi-meter, oscilloscopes, logic analyzers, probes, hand tools, etc.).
11. Breadboard, developmental, or flight system/hardware when available.
12. Appropriate mission assurance requirements, handbooks, plans or other controlling documentation.

4. <u>Other information needed for performance of task</u>:

Begin R2 Section 4 update

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. The schedules 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 General Aviation aircraft. No exceptions are allowed in flight hardware inspection. Inspection must be scheduled.

4. R4 ***The Contractor must be certified to NASA Standard NASA-STD 8739 in the following: Soldering, crimping, interconnecting cables harness, wiring and Electrostatic discharge (ESD)***.
5. Soldering shall be performed to NASA Standard NASA-STD 8739.3.
6. Crimping, interconnecting cables harness, and wring shall be performed to NASA Standard NASA-STD-8739.4.
7. Electro Static Discharge procedures stated in n NASA-STD-8739.7 shall be followed.
8. Wiring, crimping, installation, etc., of aircraft hardware must be performed by certified personnel.
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 General Aviation System 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, Building1250) 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.

End R2 Section 4 update

5. **Security clearance required for performance of work:** None.

6. **Period of Performance:**

Planned start date: January 2, 2001 Completion date:

R1 ~~December 31, 2001~~
R2 ~~December 31, 2002~~
R3 ~~December 31, 2003~~
R3.1 ~~December 31, 2004~~
R4 ~~February 28, 2005~~

	December 31, 2005
7.	**NASA Technical Monitor:** R2 Donna A. Gallaher M/S: 257 Phone: 757-864-1621 NASA Competency/Other Technical Coordinator (*above branch level*): *name* M/S: *nnn* Phone: 757-864-*nnnn*

	Task Order Number: 19RAC Revision: 0Chge1 Date of Revision: 6/19/01 Title: Methods for Synthesis and Sizing of BWB Concepts

1.	Purpose, Objective or Background of Work to be Performed: The Systems Analysis Branch needs the ability to perform technology studies on advanced concepts. The Blended Wing Body (BWB) is currently a concept that is representative of those concepts, but is difficult to size using conventional methods. This task is to develop automated sizing tools to be applied to the BWB concept. Change 1: Adjusts schedule and completion date to accommodate delays in GFI (see [C1] below).
2.	Description of the Work to be Performed: The Contractor shall develop geometric modeling methods to parametrically shape BWB airplanes. The geometry will include traditional and non-traditional parameters as is necessary to model airplanes from small regional transports to very large transports. The Contractor shall develop structural weight estimation methods that work with the parametric geometry models to accurately estimate the weight and balance of BWB airplane structures. The Contractor shall develop aerodynamic analysis methods that predict the lift, drag and pitching moment of the parametric geometry. The maximum lift capability shall be estimated for configurations with and without flaps. The methods will be developed into FORTRAN subroutines that can be incorporated into either FLOPS or ACSYNT at the discretion of the Contractor. Deliverables: Geometric modeling methodologies and software including: supporting documentation and references, working test cases, and validation data. ([C1] ~~6/30/01~~ ***9/30/01***) Structural weight estimation methodologies and software including: supporting documentation and references, working test cases, and validation data. ([C1] ~~9/30/01~~ ***12/31/01***) Aerodynamic analysis methodologies and software including: supporting documentation and references, working test cases, and validation data. ([C1] ~~9/30/01~~ ***12/31/01***) Metrics: Meeting the above list of deliverables defines acceptable performance. Exceptional performance will include developing methods that interface with other codes such

	as ELAPS, RAM, VORVIEW, WINGDES, or other codes that can assist in the evaluation of BWB concepts.
3.	Government Furnished Items: C1 ***Data as needed to perform the task order.*.**
4.	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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 1/2/01 Completion date: C1 ~~9/30/01~~ ***12/31/01***
7.	NASA Technical Monitor: Paul Gelhausen M/S: 248 Phone: 757-864-2290 NASA Competency/Other Technical Coordinator: M/S: Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 19RBA Revision: ____ Date of Revision:

Title: Mars Exploratory Rover Entry Configuration and Lander

1.	Purpose, Objective or Background of Work to be Performed: The purpose of this task to obtain accurate measurements of the longitudinal aerodynamic characteristics of the Mars Exploratory Rover entry configuration and lander, which are needed for the simulation of the entry, descent, and landing. .
2.	Description of the Work to be Performed: The Contractor shall perform the following requirements/subtasks:

1. Fabricate three scaled models of the Mars Exploratory Rover lander components: (1) backshell, (2) lander, and (3) airbags using drawings MER-001, MER-002, and MER-003. Model fabrication materials (such as wood, fiberglass, foam, or aluminum) must satisfy structural safety requirements for testing in the selected wind tunnel and provide a surface quality representative of the three components (smooth surface to the touch with a tolerance of +/- 1/32"). Provide balance adapter blocks to fit within each of the three components. Model diameter should be selected to provide a Reynolds number of 225,000 based on the diameter of the backshell and the free stream test conditions.

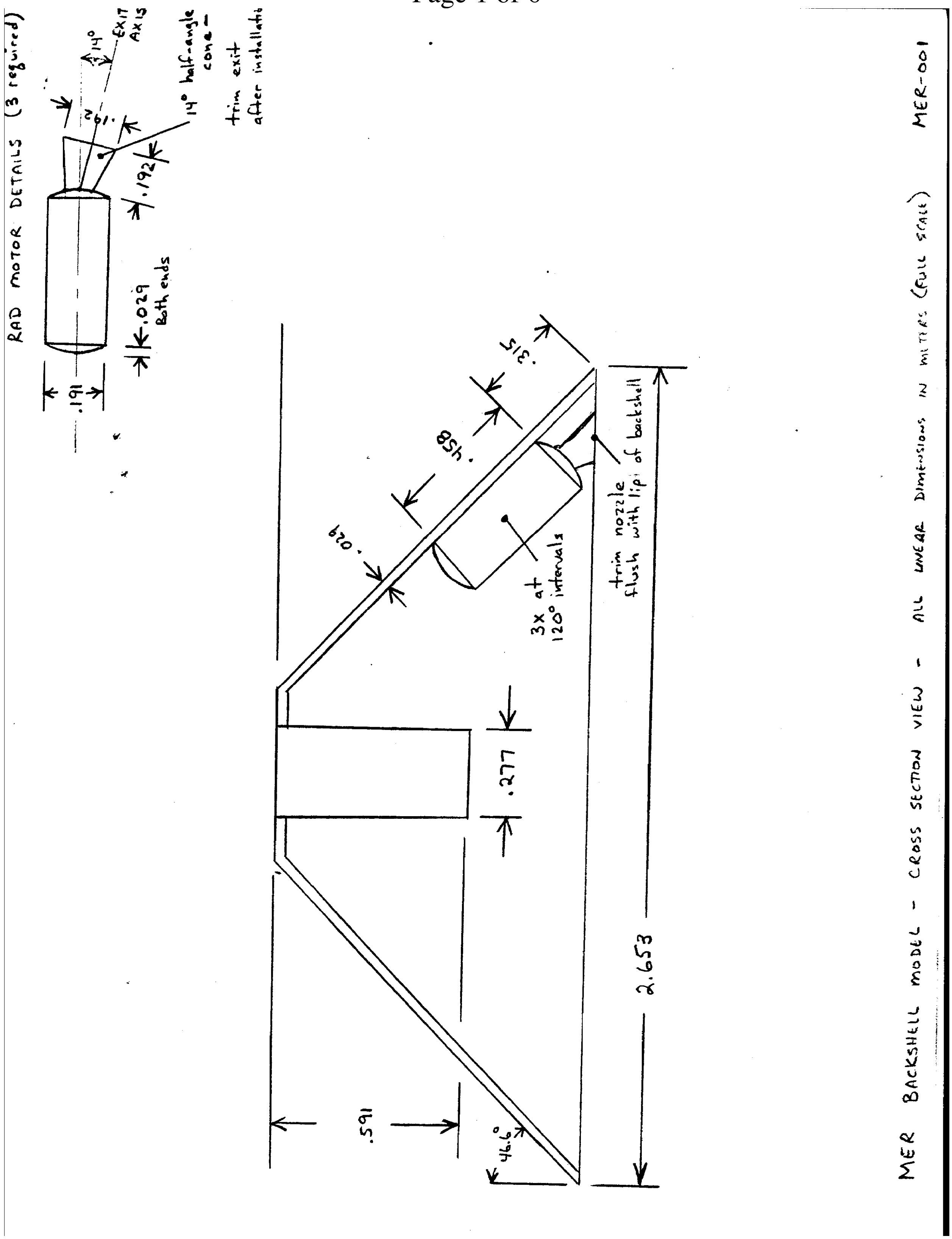
   Provide instrumentation to measure the model angle of attack, the 6 model forces and moments, two base pressures, and the tunnel test conditions (total and static pressure and static temperature). Selected instrumentation should provide a drag accuracy of +/-1% of the measurement and +/-0.2 degrees for the angle of attack.

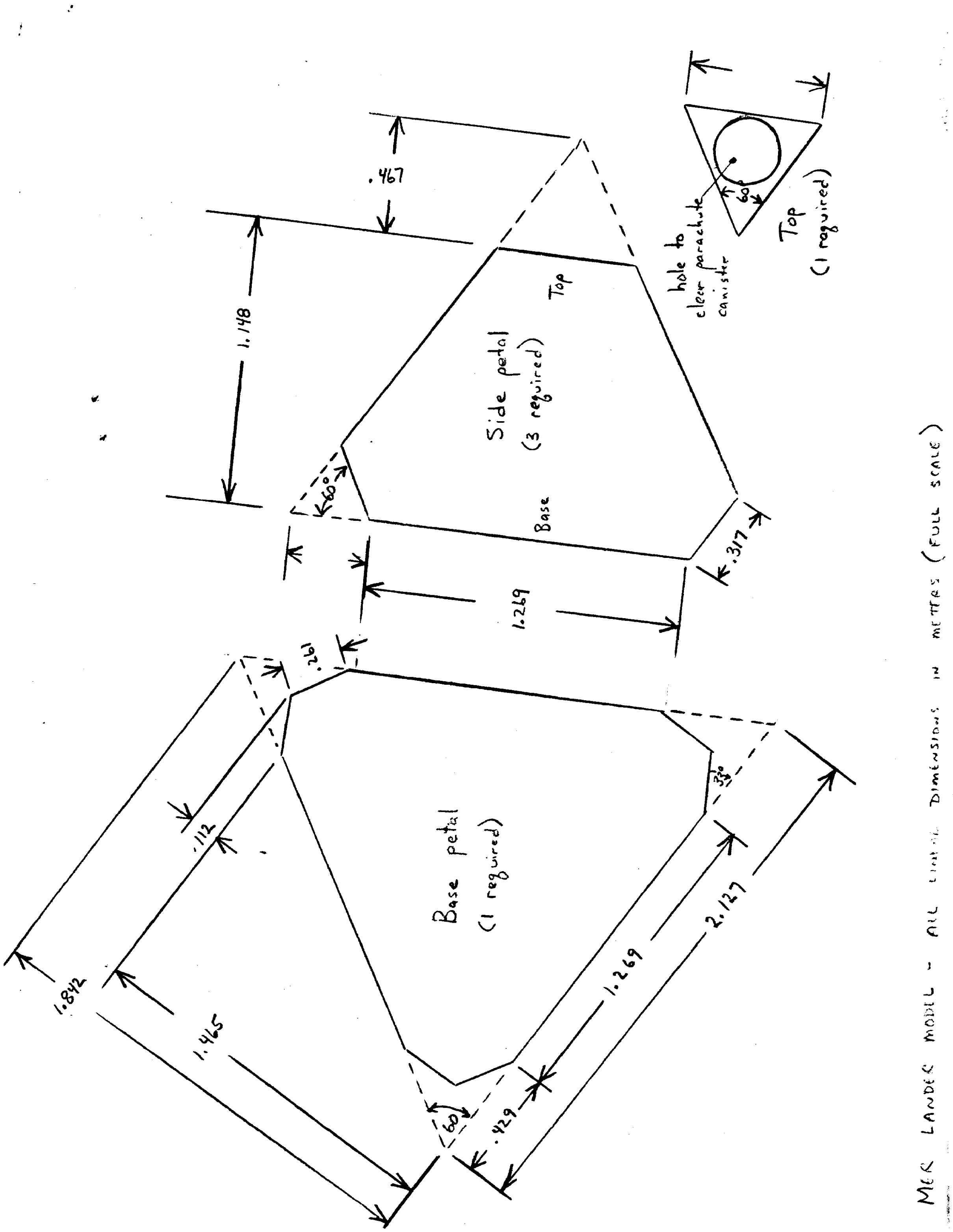
   Install the model of the backshell in the tunnel. Checkout instrumentation for the model angle of attack, the model forces and moments, the base pressures, and the test conditions.

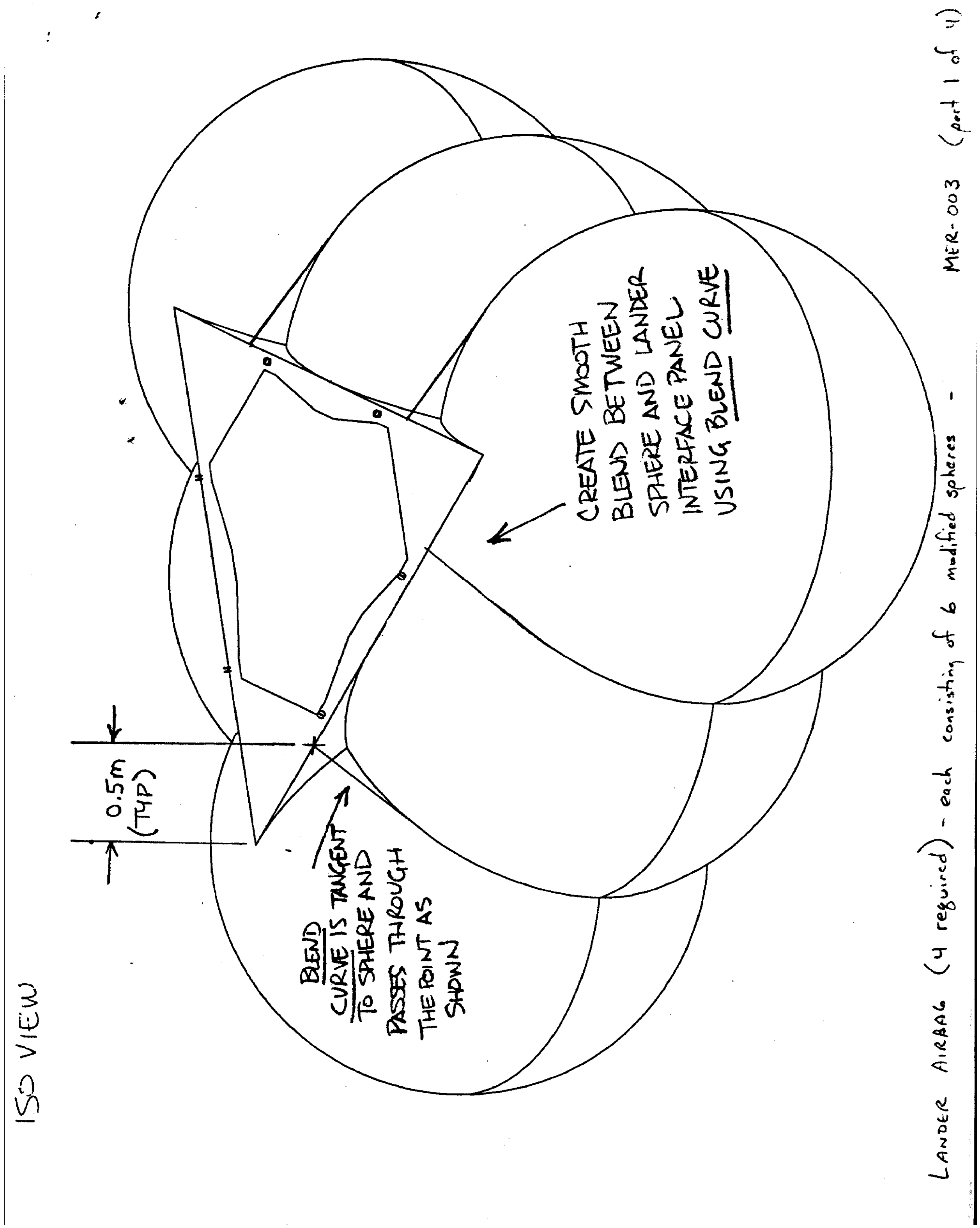
   Provide tunnel time, tunnel operator/technicians, instrumentation and data acquisition and reduction technicians, and a test engineer as required to complete the following wind tunnel tests. Test four configurations: (1) the backshell alone, (2) the lander in the backshell, (3) the lander alone, and (4) the lander with the airbags deployed. Each configuration should be tested over an angle range of –30 degrees to +30 degrees in 2 degree increments. This angle range should be repeated 5 times: (1) at the baseline dynamic pressure for a Reynolds number of 225,000, (2) at 1.4 times the baseline dynamic pressure, (3) at the baseline dynamic pressure, (4) at 0.6 times the baseline dynamic pressure, and (5) at the baseline dynamic pressure. The angle range for the elevated dynamic pressure run may be curtailed if instrumentation limits are exceeded. Each test configuration should be documented with at least two different photographs (either electronic of conventional film) of the tunnel installation.

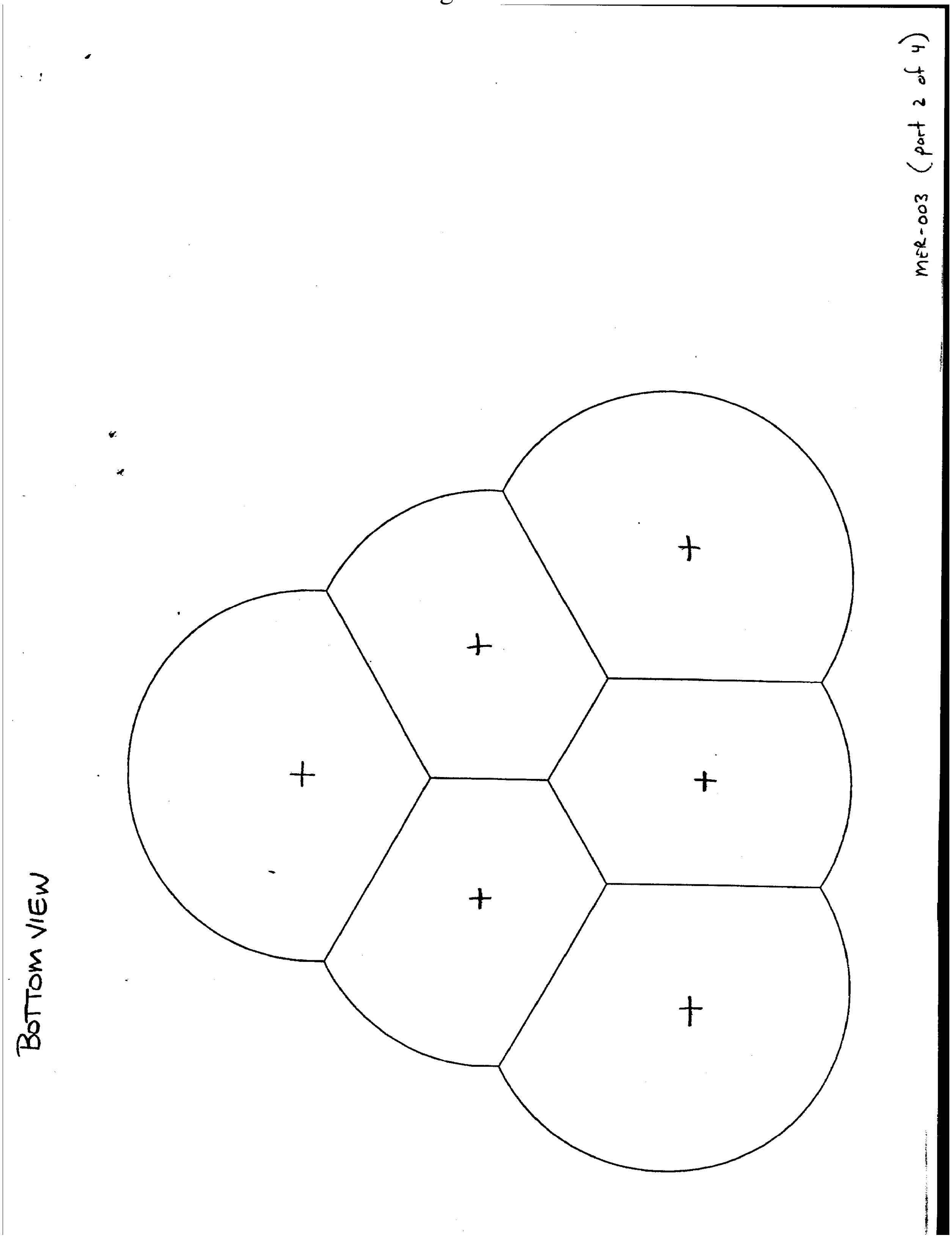
   Reduce all force and moment data to coefficient form and provide both a hard copy and electronic version of all test data.

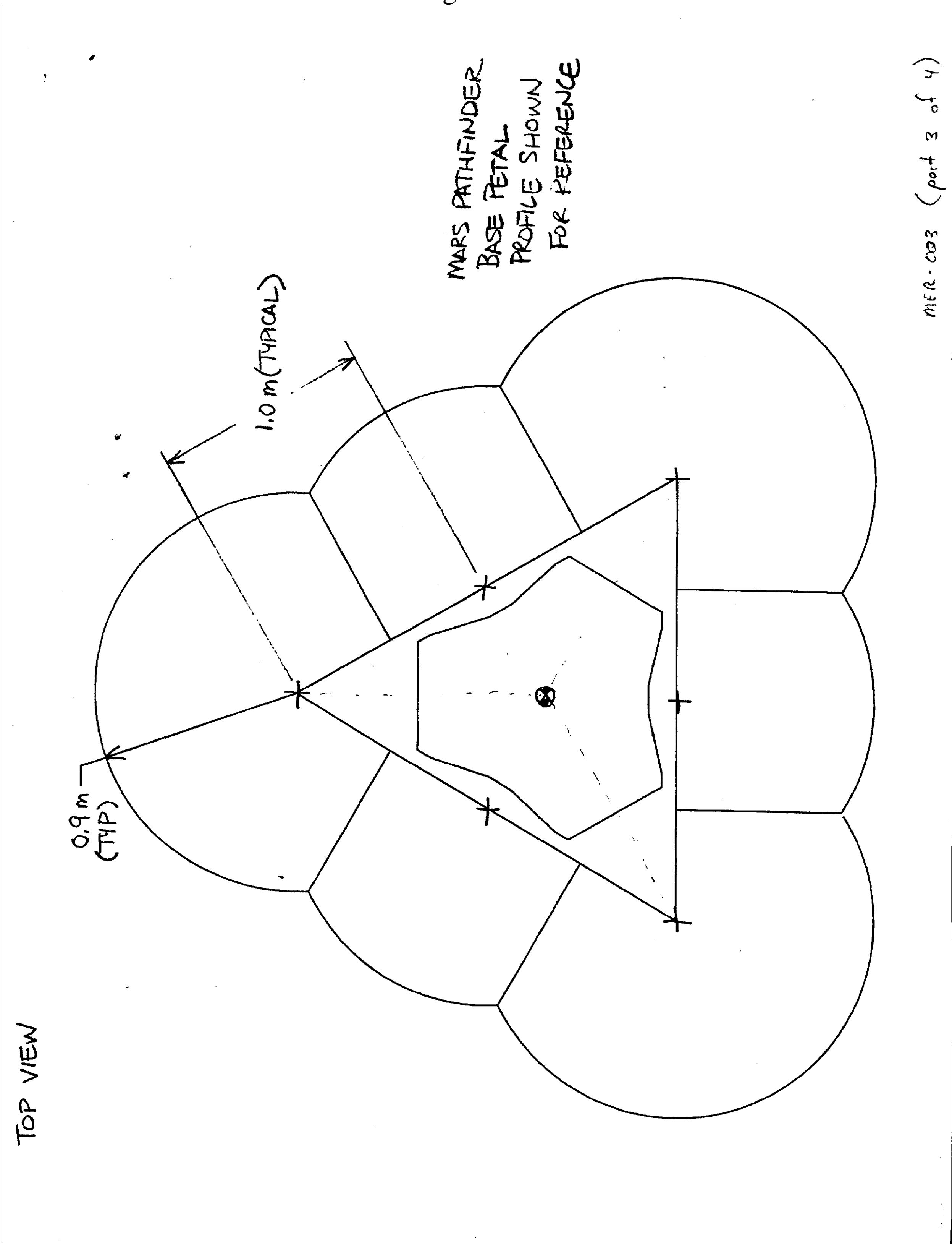
	Deliverables: 1. Three wind tunnel models and the associated balance blocks. 2. One set of photographs documenting each test configuration. 3. One hard copy and one electronic copy of the test results. Schedule: Deliver the three models, the documentary photographs, instrumentation uncertainty, and one electronic and one hardcopy of the test results to NASA by June 29, 2001 Metrics: Models fabricated according to drawings provided. Test documentation describes the procedures and analyses used. Results provided in both hard copy and electronic form. Standards (meets, exceeds): Task meets the standard of performance if three models are fabricated and tested and the results provided by the completion date. Task exceeds the standard if the same items are provided one week prior to the completion date.
3.	Government Furnished Items: *Model drawings* MER-001, MER-002, and MER-003.
4.	Other information needed for performance of task: *None.*
5.	Security clearance required for performance of work: *Unclassified. All test results are the property of the U.S. Government and are not to be released to any other party.*
6.	Period of Performance: Planned start date: May 21, 2001 Completion date: June 29, 2001
7.	NASA Technical Monitor: *Raymond E. Mineck* M/S: *286* Phone: 757-864-*2879*

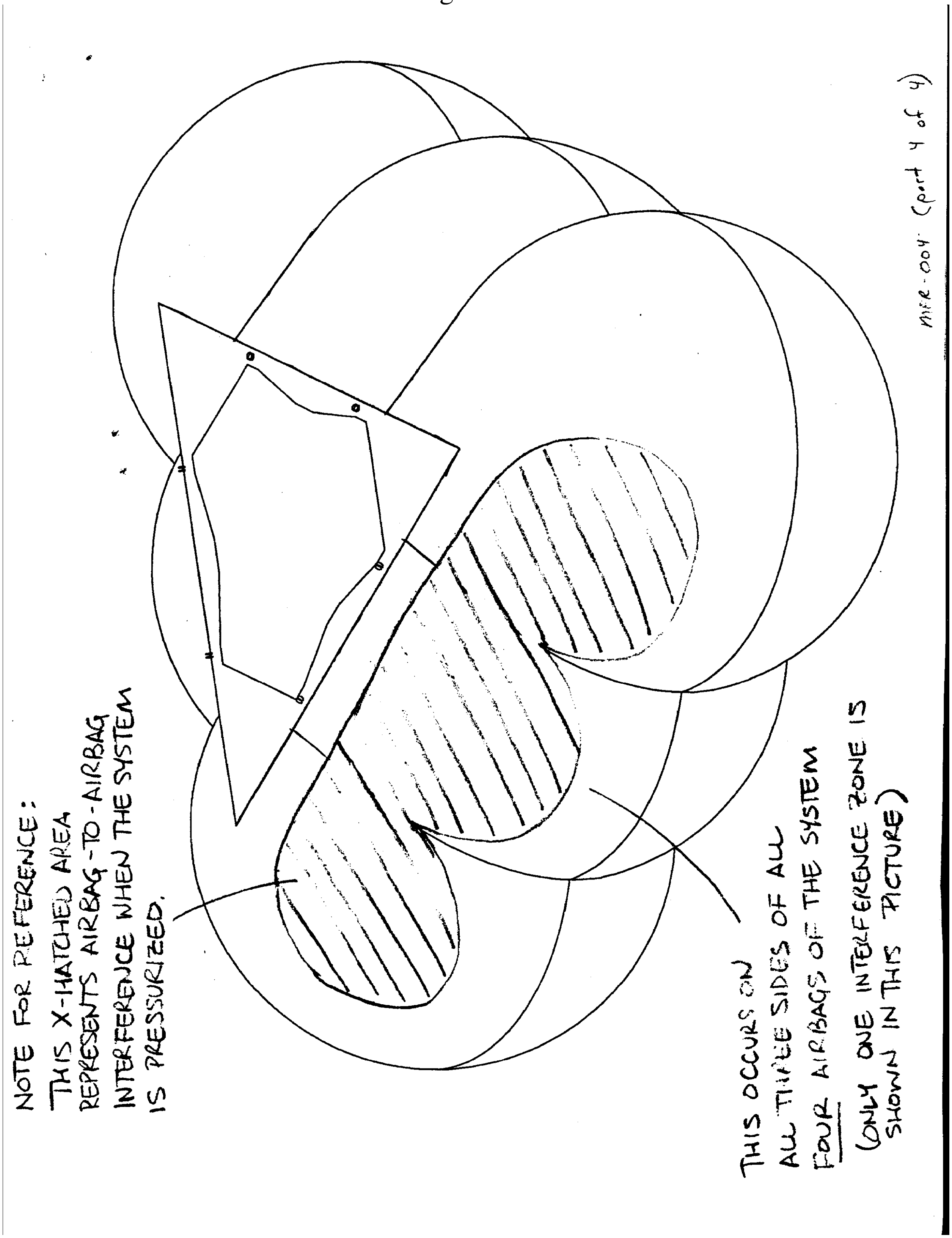

RAD MOTOR DETAILS (3 required)
14°
EXIT AXIS
.192
14° half-angle cone -
trim exit after installation
.192
.029 Both ends
.191
.315
.458
.029
3x at 120° intervals
trim nozzle flush with lip of backshell
.277
2.653
.591
46.6°
MER BACKSHELL MODEL - CROSS SECTION VIEW - ALL LINEAR DIMENSIONS IN METERS (FULL SCALE)
MER-001


.467
1.148
Side petal
(3 required)
Top
Base
1.269
.317
60°
hole to clear parachute canister
Top
(1 required)
Base petal
(1 required)
.112
1.842
1.465
2.127
1.269
.429
60
33°


ISO VIEW
0.5m (TYP)
BLEND CURVE IS TANGENT TO SPHERE AND PASSES THROUGH THE POINT AS SHOWN
CREATE SMOOTH BLEND BETWEEN SPHERE AND LANDER INTERFACE PANEL USING BLEND CURVE
LANDER AIRBAG (4 required) - each consisting of 6 modified spheres - MER-003 (part 1 of 4)


MER-003 (part 2 of 4)
BOTTOM VIEW


TOP VIEW
0.9 m (TYP)
1.0 m (TYPICAL)
MARS PATHFINDER
BASE PETAL
PROFILE SHOWN
FOR REFERENCE
MER-003 (part 3 of 4)


NOTE FOR REFERENCE:
THIS X-HATCHED AREA REPRESENTS AIRBAG-TO-AIRBAG INTERFERENCE WHEN THE SYSTEM IS PRESSURIZED.
THIS OCCURS ON ALL THREE SIDES OF ALL FOUR AIRBAGS OF THE SYSTEM
(ONLY ONE INTERFERENCE ZONE IS SHOWN IN THIS PICTURE)
MFR-004 (part 4 of 4)

Task Order Number: 19RCE Revision: 2 Date of Revision: 2/15/05

Title: **Processing of Advanced Metallic Materials**

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

The purpose of this task is to develop and optimize advanced processing techniques for alloy synthesis and for fabricating structures and subelements using advanced metallic materials for aerospace applications. The majority of materials to be processed include aluminum alloys, titanium alloys and intermetallics, nickel alloys and intermetallics, shape memory alloys, and continuous and discontinuous reinforced metal matrix composites. On a limited basis, polymeric and ceramic based material systems will be submitted for processing.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

The requirements described below represent a revision of previous task order 15RCE. This revision extends the period of performance one year in continuation of NASA's support with some redefinition/clarification of requirements and change in title and number for the new period of performance.

Revision 1: Extends the period of performance and schedule three months to April 1, 2005, with increases in most total required procedures and/or specimens (see [R1] below).
Revision 2: Extends the period of performance and schedule six months to October 1, 2005, with increases in most total required procedures and/or specimens (see [R2] below).

2. **Description of the Work to be Performed:**

Overall Requirements:

The Contractor shall address technical progress and costs at the individual subtask level in the monthly reports to the Technical Monitor.

The work under this task will be conducted on a written NOR basis and distributed among subtasks based upon the programs for which the processing is being conducted. However, the overall description of processing activities and quantities is itemized as follows:

- Thermal Processing: Specimens shall be subjected to heat treatment schedules in air, inert, and vacuum environments at temperatures up to 2500°F (up to R1 ~~25~~ R2 ~~50~~ ***100*** batches of specimens).
- Mechanical Processing: Sheet specimens shall be subjected to cold and warm rolling (up to R1 ~~25~~ 30 specimens); Specimens shall be subjected to tensile and/or compressive straining to impart predetermined strain levels (up to R1 ~~50~~ 70 specimens).
- Plasma Spray: Low-pressure plasma spray deposition processing shall be used to deposit thin layers of alloys onto substrates for foil/sheet fabrication and onto fiber windings for composite monotape fabrication (up to R1 ~~30~~ R2 ~~50~~ ***80*** plasma spray runs).
- Consolidation: Thin foils of alloys and/or fiber-reinforced monotapes shall be layed up and consolidated using vacuum hot pressing to produce sheet and/or metal matrix composite laminates (up to R1 ~~25~~ R2 ~~40~~ ***80*** consolidation runs).
- Alloy Synthesis: Novel and advanced alloys shall be produced using casting (up to 50 runs) and ball milling (up to R1 ~~25~~ R2 ~~40~~ ***60*** runs).

Each of the subtasks will involve work in each of the above processing categories. The contractor shall ensure equipment is operational prior to and after utilization, and the contractor shall ensure equipment is within current calibration where appropriate.

Deliverables (for each subtask):

- For each NOR, processed specimens and an informal written and/or oral report of results shall be delivered to the Requester within 3 working days of completion of the tests. The report shall include description of processing procedures, calibrations, specimen dimensions, anomalies, and electronic data files for each processing run.
- Informal written monthly reports that list NORs completed during the reporting period, total cost associated with each NOR, the scheduling priorities for upcoming NORs, and any other pertinent issues
- Written informal final report summarizing the number and types of processing activities conducted, standards and procedures used, and any specialized processing techniques and procedures developed. (R1 ~~12/31/2004~~ R2 ~~4/1/2005~~ ***10/1/2005***)

Performance Standards (for each subtask):

MEETS:

- Adherence to ASTM or other relevant standards
- Quality of data generated for each NOR (electronic data in ASCII format; can be downloaded into Excel spreadsheets)

- NORs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Cost

EXCEEDS:
- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completion under cost

Subtask 2.1: Lightweight Metallic Technologies
This subtask involves alloy development and processing for applications in lightweight structure for revolutionary aircraft concepts.

Subtask 2.2: Sensory and Healing Materials
This subtask involves development and processing of alloys with the ability to sense environmental and stress conditions and change their microstructures and properties to adapt to those conditions. Self-healing capabilities are also being developed in these material systems.

Subtask 2.3: Adaptive Metal Concepts
This subtask involves development and processing of alloys with the ability to change shapes under external stimuli and modify aircraft structure into optimum configurations with respect to the current flight environment.

Subtask 2.4: Metallic Materials for Hypersonic Airframe Hot Structures
This subtask involves development and processing of alloys and metal matrix composites for applications on reusable launch vehicle airframe hot structure.

Subtask 2.5: Processing of Materials for Return to Flight
This subtask involves development and processing of materials to support return to flight of the Space Transportation System in terms of investigating technologies such as materials for hot structure repair.

3. **Government Furnished Items**:

Materials processing equipment located in the Light Alloy Laboratory (Building 1205) and the Materials Processing and Development Laboratory (Building 1267A), including the vacuum hot press, hot isostatic press, plasma spray apparatus, and various ovens and furnaces. Materials

Task Order Number: 19RCE Revision: 2 Date of Revision: 2/15/05
Title: **Processing of Advanced Metallic Materials**

	processing equipment located in the Structures and Materials Laboratory (Building 1148) including superplastic forming facilities and resistance welding equipment.
4.	**Other information needed for performance of task**: None.
5.	**Security clearance required for performance of work**: None.
6.	**Period of Performance**: Planned start date: 01/01/2004 Completion date: R1 ~~12/31/2004~~ R2 ~~4/1/2005~~ ***10/1/2005***
7.	**NASA Technical Monitor**: Dr. Stephen Hales M/S: 188A Phone: 757-864-3128 NASA Competency/Other Technical Coordinator: Laurie Johansen M/S: 121 Phone: 757-864-1757

Task Order Number: 19RDP Revision: 11 Date of Revision: 1/25/05

Title: Flight Research Systems Development Support

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

The [R9]Aircraft Engineering Branch, [R9]Flight Research Services [R11]***Directorate***, has a continuing responsibility to provide capabilities to demonstrate and validate 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, experiments involving industry-supplied equipment, integrating new concepts onto the airplane, and conducting flight tests. The Transport Research [R7]Facilities (TRF) is a set of tools used in a Simulation–to-Flight concept, which incorporates common software, and processes for both ground-based simulators and the 757 aircraft. The TRF is maintained 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 consists of (1) the Airborne Research Integrated Experiment System (ARIES); (2) the Cockpit Motion Facility (CMF); (3) Research System Integration Laboratories (RSIL) located in Building 1268D; and (4) the Flight Systems Integration Laboratory (FSIL) located in Building 1244. The ARIES Lab is the LaRC B-757 with the [R7]common Transport Research System (TRS) installed onboard. The CMF includes the Research Flight Deck (RFD) simulator, the Integration Flight Deck (IFD) simulator, the Generic Flight Deck (GFD) simulator, the Motion Base, the Cockpit Translation System (the crane), and the building (B1268D). 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.

In addition to the transport Aircraft, the [R9]Aircraft Engineering Branch also has the responsibility to conduct modifications in support of new, innovative research projects to be integrated on the General Aviation Aircraft. These three aircraft are the Cessna C-206, [R7]SR 22 Cirrus and the [R7]Colombia 300 Lancair. As part of the modifications to these aircraft, a common, "baseline", set of accommodations [R7]is being developed for all flight experiments to utilize. Currently, two NASA Aviation Safety Program (AvSP) experiments have been identified as customers for the Cessna C-206 aircraft. The Aviation Weather Information (AWIN) Experiment and the Synthetic Vision Systems – General Aviation (SVS-GA) Experiment. Each of these initial experiments require similar, yet significantly diverse, configurations of the aircraft. **Begin [R7] block addition>>Another customer, the Small Aircraft Transportation System Project, has the following objectives: (1) Conceive, develop and evaluate advanced airborne systems to enable equitable, on-demand or scheduled, widely distributed, point-to-point, commercial or self-operated air mobility between thousands of local airports throughout the nation. (2) Enable the reduction of doorstep-to-destination travel times by 50% by 2007 for trips to or from rural locations using small aircraft based on 1997 levels. The Cirrus aircraft is being configured at this time to support these objectives.<<End [R7] block addition**

Begin [R9] block background redefinition

~~In addition to the transport Aircraft, the Systems Development Branch also has the responsibility to conduct modifications in support of new, innovative research projects to be integrated on the General Aviation Aircraft. These three aircraft are the Cessna C-206, Cirrus and the Lancair. As part of the modifications to these aircraft, a common, "baseline", set of accommodations will be developed for all flight experiments to utilize. Currently, two NASA Aviation Safety Program (AvSP) experiments have been identified as customers for the Cessna C-206 aircraft. The Aviation Weather Information (AWIN) Experiment and the Synthetic Vision Systems – General Aviation (SVS-GA) Experiment. Each of these initial experiments require similar, yet significantly diverse, configurations of the aircraft.~~

End [R9] block background redefinition

Revision 1: Updates ARIES experiment schedule and Subtask 4 schedule/deliverables, adds GA schedule, rewords travel requirements, and extends due date of Subtask 1 deliverable a).(For details of issued original and revision 1 SOWs see ETOS files *19RDP.doc* and *19RDP01u.doc*, respectively)
Revision 2: For NASA's convenience Subtask 1 is noted as complete and Subtask 2 is discontinued (see [R2] below).
Revision 3: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements and rolls in previous Task Order 08RFL for the new period of performance (see [R3] above and below).
Revision 4: Adds new requirements as Subtask 6 and extends the Task Order completion date to January 31, 2003 (see [R4] below.)

Revision 5: In Subtask 6, requires completed designs for NASA review and adds and/or revises schedule specification (see R5 below).
Revision 6: Adds new requirements as Subtask 7 (see R6 below).
Revision 7: Extends the period of performance one year to 1/3/04 in continuation of NASA's support with updated requirements including schedule and deliverables (see R1 above and below).
Change 1: Updates Subtask 4 schedule in response to Contractor-initiated change. (see R7.1 below)
Revision 8: Delete DAS/DPDS upgrade task as described in item 9 in subtask 5 (see R8 below).
Revision 9: Extends the period of performance to January 31, 2005 in continuation of NASA's support requirements, redefines the requirements for the new period of performance, and updates other info (see R9 above and below). *Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 19RDP, 19RDP01u, 19RDP02, 19RDP03, 19RDP04, 19RDP05, 19RDP06, 19RDP07, 19RDP071, and 19RDP08.*
Change 1: A Subtask 4 deliverable date extended to accommodate hardware performance issues (see R9.1 below).
Revision 10: Adds requirements as new Subtask 7 (see R10 and below).
Revision 11: Extends the period of performance to December 31, 2005 in continuation of NASA's support requirements (except Subtask 3 which is extended to July 31, 2005), redefines the requirements for the new period of performance, and updates other info (see R11 above and below).

2. Description of the Work to be Performed:

Summary of Subtasks
Subtask 1 ARIES Flight Management Research Systems (Completed)
*Subtask 2 ARIES Flight Controls Systems (*R3Reactivated*)*
Subtask 3 Aircraft Pallet and Electronic Systems Support
Subtask 4 CMF Motion Base Control Algorithm Development and Dynamic Analysis
Subtask 5 ARIES Data Acquisition System (DAS) and Data Processing and Display System (DPDS)
R4Subtask 6 ARIES mechanical systems design R9(completed)

The Contractor shall perform the following requirements/subtasks:
Subtask 2. ARIES Flight Controls Systems
Begin R3 block requirements redefinition
Description:
Conduct the development of the AFT Flight Deck by assisting in the design, fabrication, integration and testing of flight systems hardware and software.

Conduct operations of planned flight testing of the ARIES and assist in the direct modifications to ARIES research flight control systems as required to support ARIES flight tests.
End R3 block requirements redefinition
Subtask 3. Aircraft Pallet Support

Description:

The Contractor shall design and install research systems for installation on LaRC research aircraft. These systems may range from small self-contained packages R7to complex computer hardware and displays integrated on LaRC General Aviation aircraft to specialized multi-component pallets weighing up to 700 lbs that are installed on ARIES. Currently, R11***eleven*** pallets are installed on the B-757 aircraft as part of the baseline Transport Research System (TRS). R7New custom pallets may be required as flight experiments come to the aircraft. 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. The Contractor shall coordinate with the Aircraft Systems Branch (ASB) using Aircraft Work Orders, with electronic fabrication, and the R11***Aircraft Engineering Branch (AEB)*** using Experimental Systems Work Requests (ESWR's). The Contractor will also coordinate with the Quality Assurance office as equipment is installed on research aircraft. R7The Contractor shall perform system preflight checkouts prior to experiment flight tests. R11~~R3Prior to the 757 C-check, it is required that the Contractor assist in the break down of required pallets.~~ R7~~C-Checks occur every twenty~~

~~four months regularly and there is not a C-check due this contract period. The pallet equipment is configuration controlled and will require the Contractor to prepare and acquire all proper documentation and approvals before equipment is removed and stored.~~

The Contractor shall coordinate with staff operating the Flight Simulation Systems Laboratory (FSIL) to execute FSIL validation of experimental equipment to be installed on ARIES.

Begin R3 block requirements redefinition
Deliverables for subtasks 2 and 3:

1. Status of subtasks and technical summary delivered monthly, electronically to the Task Monitor by COB of the 10th working day of the month. Working days exclude weekends and federal holidays.
2. A short abbreviated report following each validation test and each research flight.
3. Test plan and procedure R9 for each delivered system. Test Plans include Integration test plan delivered before each specific flight experiment. Procedures include a pre-flight procedure written and delivered to technical monitor for file in Quality Assurance Office.
4. Experimental Systems Work Request documentation.

Metrics:

a) Quality of innovation, technical execution, and documentation, as determined by the customer. The quality of technical work is the predominant metric and shall determine the distinction between "excellent", "very good", and "good", "poor" performance.

b) Timeliness in meeting the deliverables schedule. Meeting all deliverables on time is to be considered consistent with "excellent" to "very good" performance.

Schedule:

ARIES Experiment Schedule best estimate (all subtasks). (All Dates Fiscal Year) R11 ***No travel is anticipated to meet objectives of the FY05 flight schedules.***

Begin R9 block update

*****Begin R11 block update*****

6/05 Complete ICF of the Return to Flight (RTF) TRS configuration (a modified Baseline TRS and Synthetic Vision Experiment equipment) on the ARIES.

7/31/05 Removal and final close out of Synthetic Vision Experiment equipment.

*****End R11 block update*****

End R9 block update

Experiment schedule for the GA aircraft: R11 ***Travel to support the following experimental flight tests is so noted***.

Begin R9 block update

*****Begin R11 block update*****

4/05 Complete COWABONGA AWIN experiment on C206

7/05 SATS - HVO III demo flight on the SR 22- travel of 3 days on site at Danville may be required.

****End R11 block update*****

End R9 block update
End R3 block requirements redefinition

Subtask 4. CMF Motion Base Control Algorithm Development and Dynamic Analysis

Begin R9block redefinition The Contractor shall provide support for algorithm changes and tuning requirements necessary to achieve controlled 2Hz to 3Hz motion cueing performance for the previously developed and delivered Phase 1 Real-Time WorkShop (RTWS) control law. The Contractor shall develop and supply a detailed Phase 1 Digital Control Law (DCL) design description document. The design description shall include a definition and description of what files makeup the various elements of the project including: the Simulink Phase 1 Control Law, Motion Base Model block diagrams and the RTWS configuration and implementation. The Contractor shall develop and supply a DCL software test plan that includes as references the completed test procedures. The software test plan shall differentiate tests that are performed in simulation versus integrated tests that are performed using control system hardware. (i.e. Model changes require retesting and parameter tuning can be retested in simulation.) The Contractor shall participate in the development and execution of hydraulic subsystem and motion base dynamic system identification and shakedown tests and procedures. The Contractor shall perform test data analysis as necessary to support system R11 ~~identification and participate in an integrated systems review~~. The Contractor shall modify the Simulink math model of the CMF motion base to include relevant Government-furnished data, to support payload and other component load analyses, and shall incorporate parameter changes resulting from system identification and integration tests. The Contractor shall investigate and begin the development of an advanced concept Phase II Control Law for higher performance closed loop control of the motion platform, which supports multiple payload configurations. The Phase II Advanced Control Law shall take advantage of the higher performance motion base and payload structures and strive to generate controlled motion cues above 5Hz. If time permits, the Contractor shall present a conference paper addressing aspects of evaluating the CMF performance. The Contractor shall coordinate efforts closely with the CMF Development Team and the CMF Controls Team Lead.

Deliverables:

Simulink Math Model analyses and updates with GFE data.
As required

Algorithm and parameter updates for Phase I Control Law required for shakedown testing..
R9.1~~May~~ 1 R11June ~~4, 2004~~ ***February 18, 2005***

Phase I Control Law test plan documents.
R11~~August 30,~~ 2004 ***February 28, 2005***

Phase I Control Law detailed software design description.

R11 ~~August 30, 2004~~ ***June 30, 2005***

Government-scheduled integrated systems review presentation.
As per updated schedules

Phase I Control Law maintenance updates.
As required

Phase II Advanced Control Concept RTWS Initial Concept and Development
December 31, R11 ~~2004~~ ***2005***

Metrics:

a) The quality of the Contractor's innovation, technical execution, and documentation, as determined by the customer. The quality of the Contractor's technical work is the predominant metric and will determine the distinction between "excellent", "very good", and "good", performance.
b) The Contractors timeliness in meeting the deliverables schedule. Meeting all deliverables on time is to be considered consistent with "excellent" to "very good" performance.

End R9 block redefinition

Begin R3 block roll-in of previous Task Order 08RFL

Subtask 5. ARIES Data Acquisition System (DAS) and Data Processing and Display System (DPDS)

The Contractor shall R3 maintain and operate the government provided Data Acquisition System (DAS) on the ARIES B-757. This will include providing an operator for the DAS during all system R3 integration tests, environmental ground tests and all research flights (NOR) on the ARIES B-757. The Contractor shall also operate the DAS during research flights while on deployments at remote sites. The Contractor shall verify the DAS is performing as requested before each research flight. It is anticipated that approximately 40 local flights and 30 remote site flights will be required and that the aircraft will be down for approximately 5 months to perform modifications and upgrades to the DAS to support flight research programs.

1. 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) and R3 Technical POC 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.

2. The Contractor shall modify, integrate, qualify, and validate the DAS as required (NOR) to support changes/upgrades for scheduled research flights to meet R11 ***FY05*** and R11 ***FY06*** 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 Shared Common Random Access Memory Network (SCRAMNet) data block software configuration changes, experimental system work requests and aircraft work orders needed to integrate the upgrade or modifications.

3. The Contractor shall provide Pulse Coded Modulated (PCM) digital data and IRIG-B time to the Data Display and Processing System (DPDS).

4. For each flight test series (NOR), the Contractor shall R3 consult with the experimenter to develop "Project

Measurement List". This list shall contain DAS parameters that will meet specifications defined in the experimenter's Requirements Document. This list will be a subset of the Data Recording List and may contain new parameters not currently in the Data Recording List. This list shall be submitted to the TM and R3Technical POC for approval before each flight test series. The parameters in the "Project Measurement List" shall be verified within R38 working hours after each research flight.

5. Using the Data Recording List, provide a measurement calibration database to the NASA Aerospace Data Acquisition and Processing Station (ADAPS) R3in a format compatible with ADAPS. 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.

*****Begin R11 block update*****

6. The Contractor shall assist in the maintenance and upgrade to the government provided Data Processing and Data Display System (DPDS) and the DAS on the ARIES B-757 in support of a newly combined system to support the Aft Flight Deck integration to ARIES. This will include providing an alternate operator for the DPDS during system check out and integration tests, environmental ground tests and troubleshooting on the ARIES B-757. The Contractor shall support changes and upgrades to the DPDS to design drawings, experimental work orders, database configuration changes, software configuration changes, experimental system work requests, fabrication work orders and aircraft work orders needed to integrate the upgrade or modifications.

*****End R11 block update*****

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 B-757 Project Manager when critical flight schedules conflict with accomplishing these calibrations.

~~8.~~ R11~~R3~~~~The Contractor shall assist in the maintenance and upgrade to the government provided Data Processing and Data Display System(DPDS) on the ARIES B-757. This will include providing an alternate operator for the DPDS during system check out and integration tests, environmental ground tests and troubleshooting on the ARIES B-757. The Contractor shall support changes and upgrades to the DPDS to design drawings, experimental work orders, database configuration changes, software configuration changes, experimental system work requests, fabrication work orders and aircraft work orders needed to integrate the upgrade or modifications.~~

Begin R7 block addition

~~9.~~ R8R3~~The~~ ~~Contractor shall assist in the maintenance and upgrade to the government provided Data Processing and Data Display System(DPDS) and the DAS on the ARIES B-757 in support of a newly combined system to support the Aft Flight Deck integration to ARIES.~~

10. The Contractor shall support changes and upgrades to the DAS, and Wire Integration Unit to support the Aircraft Condition Analysis and Management System (ACAMS) experiment. This will include preparing design drawings, experimental work orders, database configuration changes, software configuration changes, experimental system work requests, fabrication work orders and aircraft work orders needed to integrate the upgrade or modifications.

End R7 block addition

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 R3Technical POC.

6. Configuration Change Request, Data Recording List changes, design drawings, 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. R3A database that accurately reflects the Data Recording List for ADAPS, the DAS setup computer, the DAS quick look computer, and the DPDS.
8. Monthly written status reports.
9. Calibrated sensors in response to the Data Recording list.
10. A short abbreviated report following each validation test and each research flight.
11. Notification, in writing, of any failures or anomalies.
12. "Project Measurement List" for the current flight series.
13. 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. R3 "Project Measurement List" delivered to TM or R3Technical POC five working days before the flight test series.
3. Parameters described in the R3"Project Measurement 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 "Project Measurement 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 "Project Measurement List" and acquired by DAS during as research flight, verified within R38 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 and R3Technical POC, 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 R3Technical POC 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 or R3Technical POC 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 R34 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.

End R3 block roll-in of previous Task Order 08RFL

Begin R4 block addition
Subtask 6. ARIES Mechanical Systems Design- R9Completed
End R4 block addition

Begin R10 block addition
Subtask 7. Inmarsat (International Maritime Satellite Organization) Cabinet Cradle Design
Inmarsat/Pyka system includes an external, top-mounted, antenna and an electronic cabinet mounted in the forward cargo bay, near station 600. This design task concerns the cabinet in the cargo bay.

The current cabinet mounting concept attaches the cabinet at four points. Three of the points are located on the bottom of the cabinet. These three points attach to a seat track rail bolted to the floor of the forward cargo bay. The fourth point is located at the top, outboard, edge of the cabinet and is currently designed to attach directly to a ring frame of the aircraft via a turnbuckle. Complete design drawings of the cabinet will be provided by NASA, Flight Research Services Competancy, Aircraft Engineering Branch.

The purpose of this design task is to create a cradle or other mounting concept to eliminate the fourth attachment point on the aircraft ring frame. The goal is to react all mounting loads into the floor of the forward cargo bay seat tracks.

Design requirements:

1. Design must be capable of safely reacting the emergency landing loads given in the drawings.
2. Design must accommodate current Inmarsat/Pyka cabinet with no modifications to the cabinet. Rationale: The cabinet belongs to NASA Glenn and is not ours to modify.
3. Design must maintain the present location of the Inmarsat/Pyka design within 30 inches. Rationale: This is necessary to accommodate current cabling distance and performance requirements.
4. Design must maintain current orientation of the cabinet; up/down, fore/aft, left/right, must be maintained. Rationale: This is necessary to accommodate current cabling and component performance requirements.

Deliverables:

1. A complete analysis report documenting the actual loading versus capability of the cabinet cradle structure and attachments to the seat tracks.
2. A drawing package, to include fabrication, assembly and installation drawings.
3. Tabletop design review packages including cognizant engineer support for the milestone review dates listed below.
4. Updated drawing and analysis package after aircraft installation with redline changes revised.

*****Begin R11 block update*****

Schedule:

1. A CDR (Critical Design Review)-level review by March, 2005
2. Final package delivery by March, 2005

*****End R11 block update*****

Performance Standards and Evaluation Criteria

Meets:

1. CoDR, PDR, and CDR-level reviews held on schedule. CoDR-level conceptual slides delivered five days in advance of CoDR.
2. PDR-level slides, graphs, or pictures, any preliminary drawings, and preliminary analyses delivered five days in advance of PDR
3. CDR-level drawings (at or near 100 % complete) delivered five days in advance of CDR.
4. CDR-level final analyses delivered five days prior to CDR.
5. Completion of any RFA's, or outstanding issues, or incomplete drawings within 10 days of CDR.

	6. Final Package delivered, and accepted, on schedule. Exceeds: 1. Final Package delivered, and accepted, 10 days ahead schedule. 2. CDR-level drawings (electronic and paper, 100 % complete) delivered 10 days in advance of CDR. 3. CDR-level final analyses delivered 10 days prior to CDR. 4. Completion of any CDR-level RFA's, or outstanding issues, or incomplete drawings within five days of CDR **End R10 block addition**
3.	**Government Furnished Items:** Access to the following 1. R3 Use of ADAPS is available for post flight data processing and displays. **Begin R3 block roll-in of previous Task Order 08RFL** Hardware: 1. AATIS (Advanced Airborne Test Instrumentation System) data system with documentation 2. AATIS compatible recording media 3. Assorted collection of Sensors 4. Sensor calibration data 5. Access to Flight Simulation Integration Laboratory (FSIL) 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. Project Requirements Document 3. Parameter Data Management System Document 4. DAS/B-757 Schedule 5. AATIS system setup documentation 6. Data System Specifications/Operation/Maintenance/Troubleshooting information. 7. Calibration database information/software. 8. Smart Decommutator/Real-time Display System Applications Software 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. **End R3 block roll-in of previous Task Order 08RFL**
4.	**Other information needed for performance of task:** Subtask 2 - ARIES Flight Controls Systems • Receipt of NASA-funded AFD Flight Control Interface definition from Boeing. Subtask 4 - CMF Motion Base Control Algorithm Development and Dynamic Analysis • Motion Base hardware system and digital controller baseline system to support leg length PID control system tuning and control concept testing. **Begin R3 block roll-in of previous Task Order 08RFL**

Subtask 5-

1. 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 B-757 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.
2. Contractor may use NASA environmental (Environmental Test Facility, Building1250) and EMI test facilities to qualify flight hardware.
3. Contractor may utilize NASA furnished parts and components.
4. Contractor may utilize NASA printed circuit fabrication facilities/resources to obtain printed circuit boards.
5. Contractor may utilize NASA furnished fabrication facilities/resources to complete fabrication, packaging and assembly of flight hardware, including mechanical hardware and wiring.

End R3 block roll-in of previous Task Order 08RFL

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.

5. **Security clearance required for performance of work:**

NONE

6. **Period of Performance:**

Planned start date:	~~1/1/2001~~	Completion date:	~~12/31/2001~~
	R3 ~~1/1/02~~		R3 ~~12/31/02~~
	R7 ~~1/31/03~~		R4 ~~1/31/03~~
			R7 ~~1/31/04~~
	R11R9 ~~1/31/04~~		R11R9 ~~1/31/05~~
	1/31/05		***12/31/05***

7. **NASA Technical Monitor:** . Wendy Pennington
M/S: 256 Phone: 757-864-7126

NASA Competency/Other Technical Coordinator: R11 ***FRSD/AEB***
M/S: 125B Phone: 757-864-4016

R3 NASA Technical Point of contact for subtask 5: Keith Harris M/S 257 Phone: x43824

Task Order Number: 19RFM Revision: 0c2 Date of Revision: 5/25/01

Title: Pyrovalve Investigation

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

Purpose: Complete a functional evaluation of a pyrotechnically actuated valve, which was initiated under Task RF03 (SAERS).

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.

Change 1: Extends the schedule and completion date to correspond to Change 1 of Contractor's plan. (see [C1] below).
Change 2: Extends the schedule and completion date to correspond to Change 2 of Contractor's plan. (see [C2] below).

2. Description of the Work to be Performed:

Subtask 1. The contractor will duplicate the "energy required" force/time history in actuating the pyrovalve by conducting weight drop tests. The tests shall be conducted in a pyrovalve simulator with modified shear pins that duplicate the shear section in the flight valve.

Deliverables: Shear pin dimensions and force/time weight drop test data.

Metrics: Progress will be assessed on assembly and checkout of test hardware and conduct of tests to size shear pin.

Standard: Meets – Duplicating force/time histories by [C1] ~~January 31~~ [C2] ~~March 16, 2001~~ June 30, 2001.

Exceeds – Duplicating force/time histories by [C1] ~~January 31~~ [C2] ~~February 28, 2001~~ June 15, 2001.

Subtask 2. The contractor will conduct functional tests in the pyrovalve simulator to evaluate the effects of the booster charge assembly's heat loss, ignition delay, chocked flow from the initiator, booster charge retention, and chocked flow from the booster

Task Order Number: 19RFM Revision: 0c2 Date of Revision: 5/25/01

Title: Pyrovalve Investigation

charge.

Deliverables: Velocity profile of actuating ram and energy delivered for each test parameter.

Metrics: Progress will be assessed on assembly and checkout of test hardware and completion of tests on each variable.

Standard: Meets - Completion of all tests by C1 ~~March 30, 2001~~ C2 ~~April 30, 2001~~ June 30, 2001.

Exceeds - Completion of all tests by C1 ~~March 16, 2001~~ C2 ~~April 16, 2001~~ June 15, 2001

3. Government Furnished Items: The Government will supply test facilities, data acquisition systems and test hardware.

4. Other information needed for performance of task: Langley safety procedures shall be used in the handling and testing of all pyrotechnic components.

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.

5. Security clearance required for performance of work: None

6. Period of Performance:

Planned start date: January 1, 2001 Completion date: C1 ~~March 30, 2001~~ C2 ~~April 30, 2001~~ June 30, 2001

7. NASA Technical Monitor: Laurence J. Bement

M/S: 456 Phone: 757-864-7084

NASA Competency/Other Technical Coordinator (*above branch level*):

Dr. Thomas Shull,

Assistant for Flight Systems Programmatic Implementation

Systems Engineering Competency

Mail Stop 430, Phone 757-864-1837

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 20RAB Revision: ____ Date of Revision:

Title: GPS Dual RF Board Population and Testing

1. Purpose, Objective or Background of Work to be Performed: Dual RF GPS boards have in the past been purchased from GEC Plessey, but are no longer being made. Because those boards are presently being needed for various GPS applications, Langley has obtained the Gerber files and approval to build from Plessey. Four dual rf boards have been built to date as per the Plessey Gerber files. The long-term goal is to preserve the capability to build these boards in-house and advance toward modifications that will allow reaping the benefits of parallel correlation processing seen as a necessary advance in GPS Surface Reflection Measurements.

Change 1: Schedule and Period of Performance extended to accommodate long lead time in NASA procurement, various minor wording clarifications added (see [C1] above and below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. The work to be performed consists of coordinating the purchase of unpopulated dual RF GPS receiver boards, verifying the boards adherence to the guidelines in Mitel Application Note AN4855, specifying and purchasing electronic components to populate the boards, coordinating the population of the boards with the electronics fab shop, and testing the boards per a previously developed test plan. Finally, a test report is required to document the results.

   Deliverables:
   1. Parts list with vendors, costs, delivery information
   2. Test Report
   3. Four (4) populated and tested dual RF GPS boards

   Schedule:
   1. [C1] ***February 9, 2001 or 15 working days*** ~~ATP (Authorization To Proceed) + 3 weeks -~~ Completion of parts list, and ordering. - ***Completed***
   2. [C1] ***September 14, 2001*** ~~ATP + 9 weeks~~ - GPS Board population complete.
   3. [C1] ***September 14, 2001*** ~~ATP + 12 weeks~~ - GPS Board testing complete.
   4. [C1] ***September 30, 2001*** ~~ATP + 14 weeks~~ - Task complete.***with test report***

   Metrics:

   Standards (meets, exceeds):

   Meets:
   1. Monthly report
   2. Parts list with vendor, cost, and delivery information
   3. Clearly written test report

Task Order Number: 20RAB Revision: ____ Date of Revision:

Title: GPS Dual RF Board Population and Testing

Delivery of Four (4) populated and tested dual RF GPS boards by scheduled delivery date.

Exceeds:

Delivery of Four (4) populated and tested dual RF GPS boards before at least 2 weeks ahead of the scheduled delivery date.

2. Government Furnished Items:

1. Gerber file including parts listing
2. Test Plan
3. Electronic [C1] ***fabrication (through separate contract)***
4. Access to [C1] ***specialized*** lab equipment
5. Access to direct and reflected GPS signals (Bldg. 1202 rooftop antennas/amplifiers)
6. Consultation for troubleshooting
7. Mitel Application Note AN4855

4. 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.

5. Security clearance required for performance of work: none

6. Period of Performance:

Planned start date: [C1] ~~TBD~~ ***January 2, 2001*** Completion date: [C1] ~~TBD~~ ***September 30, 2001***

7. NASA Technical Monitor: George Ganoe
M/S: 328 Phone: 757-864-1940

NASA Competency Technical Coordinator: ASCAC/Rita Verlander
M/S: 327 Phone: 757-864-1944

Task Order Number: 20RBE Revision: 13 Date of Revision: 3/10/05

Title: Aeroacoustic Experiment and Analysis Support

1. **Purpose, Objective or Background of Work to be Performed:** (DF19, NAS1-96014)

The purpose is to provide experimental and analytical support to Airframe Noise and acoustic flight and windtunnel research being performed by the Aeroacoustics Branch and funded by a variety of programs (such as SHCT, QAT, Rotorcraft Base Program).

Subtask 1. [R8]The objective of this subtask is to provide support with the acquisition and reduction of aerocoustic test data. The tests are performed in the Quiet Flow Facility (QFF). They include PIV and acoustic measurements on wing/flap and landing gear models.

Subtasks 2 and 3. This support includes data analysis, software development and validation studies, data system integration, both for near real time and post-test scenarios. Technology focus is on rotors, jets, and other sound-producing devices in flight.

Subtasks 4 and 5. The objective of this subtask is to provide electrical instrument, and computer system and programming support of fundamental and programmatic research performed at the Jet Noise Laboratory (JNL) to include maintenance and operations of the Dual Stream Propulsion Model (DSPM) control system, operations of the Low Speed Aeroacoustics Wind Tunnel (LSAWT) and the Small Anechoic Jet Facility (SAJF).

Subtask 6. The wind tunnel acoustic data acquisition system has been developed to provide data acquisition capability for a wide variety of acoustic wind tunnel tests. This subtask will further enhance the reliability and capability of that system. The purpose of this task is to upgrade the wind tunnel acoustic data aquisition system to improve reliability, enhance archival capability, and provide permanent capability to convert 64/rev signals to 1024/2048/rev signal sampling clock.

Subtask 8. A test of the 12 inch diameter ADP demonstrator configured with a scarf inlet was recently completed in the Noise Research Facility. The test showed highly non-uniform inflow to the fan due to the scarf combined with the airflow through the anechoic chamber. As a result, the stall margin of the fan was reduced and the fan could not be run at full speed without unacceptable vibration. While the flow through the chamber exacerbates the inflow non-uniformity, similar noise and vibration problems were noted during full scale static engines tests with the scarf inlet at Pratt & Whitney and at Honeywell. The inflow control device was found to be ineffective at reducing the inflow distortion to acceptable levels. Wind tunnel tests of the 12 inch ADP demonstrator with the scarf inlet showed that the inflow distortion is greatly reduced by forward flight.

The purpose of the test to be performed under this task order is to modify the boundary layer downstream of the highlight to reduce the inflow distortion. The boundary layer modification is expected to reduce the thickness of the boundary layer at the fan face and to permit operation of the demonstrator near the maximum speed without stalling the fan.

The work to be performed under this task order is reduction of the acoustic data that will be collected during the test. The preparation of the model and configuration changes throughout the test will be performed under a separate task agreement. Operation of the model will be performed by the researchers, as will collection and reduction of pressure data in the ADP demonstrator. Collection of the acoustic data, including calibration of the acoustic data acquisition system, will be performed under a separate task order.

[R1]Subtask 9. The test noted Subtask 8 above showed highly non-uniform inflow to the fan due to the scarf combined with the airflow through the anechoic chamber. As a result, the stall margin of the fan was reduced and the fan could not be run at full speed without unacceptable vibration. While the flow through the chamber exacerbates the inflow non-uniformity, similar noise and vibration problems were noted during full scale static engines tests with the scarf inlet at Pratt & Whitney and at Honeywell. The inflow control device was found to be ineffective at reducing the inflow distortion to acceptable levels. Wind tunnel tests of the 12 inch ADP demonstrator with the scarf inlet showed that the inflow distortion is greatly reduced by forward flight.

The purpose of the test to be performed under this Subtask is to modify the boundary layer downstream of the highlight to reduce the inflow distortion. The boundary layer modification is expected to reduce the thickness of the boundary layer at the fan face and to permit operation of the demonstrator near the maximum speed without stalling the fan.

The work to be performed under this subtask order is flow analysis of the scarf inlet. The flow analysis is expected to provide the researchers with the insight to design flow control hardware which will be fabricated and installed on the 12 inch ADP demonstrator and whose effectiveness will be determined during a test in the Noise Research Facility.

Begin R7 block addition

The Structural Acoustics Branch (SAB) has a continuing responsibility to develop advanced liner technology to achieve community noise reduction goals under the Quiet Aircraft Technology Program. In support of this mission, it is necessary to maintain state-of-the-art facilities for investigation of advanced liner concepts. The purpose of tasks issued for SAB is to provide technical support for the development of prediction and measurement methods for conducting laboratory investigations of advanced duct liner concepts.

End R7 block addition

Revision 1: Adds Subtask 2 requirements and new Subtask 9, renumbers Subtasks to agree with Contractor's previous task plan, revises period of performance in Subtask 8, and clarifies earlier omissions (see R1 above and below).

Revision 2: Clarifies some requirements and extends completion date of Subtask 2 (see R2 below).

Revision 3: In continuation of NASA's support requirements, extends the period of performance to September 30, 2002, updates the NOR note and Subtasks 2, 3, and 8, replaces Subtask 4.3, and adds new Subtasks 6.4, 10, and 11 (see R3 below).

Revision 4: Updates the requirements of Subtasks 5.2 and 5.4 (see R2 below).

Revision 5: For NASA's continuing support requirements with some change of emphasis, this modification extends the completion date 3 months and extends Subtasks 1, 4, 5, and 8 schedules (see R5 below).

Revision 6: Rewords Subtask 2 to utilize the NOR feature and includes estimated quantity of experimental data sets, schedules earlier completion of Subtask 8 and overall task order, updates Subtask 11 requirements, and adds new Subtask 12 (see R6 below).

Revision 7: Rolls in requirements previously planned under Task Order 02RBF (new Subtasks 14-17), extends Subtasks 2, 3, 4, 5, 8, 10, 11 schedules to November 30, 2002, adds requirements to Subtask 4, adds new Subtask 18, and notes Subtasks 6, 7, 9 as completed (see R7 above and below).

Revision 8: Extends the period of performance twelve months in continuation of NASA's support requirements, redefines the requirements for the new period of performance, adds some clarifications to existing requirements, adds new subtasks, extends schedule on some existing subtasks, and removes details of and annotates recently completed subtasks (see R8 above and below). Note: For detailed requirements of completed subtasks, see ETOS SOW file *20RBE07.doc*.

Revision 9: Extends the schedule in Subtasks 8, 13-17, adds requirements to Subtask 13, and adds new Subtasks 21 and 22 (see R9 below)

Revision 10: Extends the schedule in Subtasks 1,13, 19, and 22; adjusts deliverables in Subtask 13; adds some clarification to update Subtask 19; adds requirements as new Subtask 23; annotates Subtasks 8 and 14 as complete (see R10 below).

Revision 11: Extends the overall period of performance to December 31, 2004 (12 months) and the schedules in active Subtasks 1-3, 4.5, 13, 15-22; adjusts deliverables in Subtask 13; updates/adds requirements in Subtasks 3, 4.2, 4.6, 13, 15, and 16; adds requirements as new Subtasks 24 and 25; annotates Subtasks 4.1, 20.2-20.5, and 23 as complete (see R11 below).

Revision 12: Extends the period of performance 12 months to December 31, 2005 with updated schedules and/or requirements for active Subtasks 1-4, 13, 15-19, 25, adds requirements as new Subtasks 20.7, 26-28, and annotates Subtasks 13, 20.1, 22, and 24 as completed (see R12 below).

Revision 13: Terminates Subtask 1, adds new Subtasks 29-32, updates schedules and/or requirements for active Subtasks 3, 16-19, 21, 27, and 28, adds requirements as new Subtasks 20.7, 26-28, and annotates Subtask 15 as completed (see R12 below).

2. **Description of the Work to be Performed:**

Note:

- R3 Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

- Monthly technical and financial reporting is required at the subtask level. Monthly financial reports at the subtask level will be used only for cost sharing and/or accrual determination within the user organization.

The Contractor shall perform the following subtasks:

Begin [R8] block requirements redefinition

Subtask 1. [R13](*TERMINATED – see new subtask 32 below*) Thomas F. Brooks M/S: 461 Phone: 757-864-3634

Subtask 2. David A. Conner M/S: 461 Phone: 757-864-5276

[R1] (NOR) Perform post-test data processing analysis [R6]and reporting of data acquired during experimental tests(flight and wind tunnel) conducted by Aeroacoustics Branch personnel. The Contractor shall process data that were not processed during on-site analysis and that were not processed under prior task orders, as well as perform [R8]EDAS (Electronic Data Access System) processing and additional analyses [R6] as required in NORs [R6] It is anticipated that post-test data analyses will be required for no more than eight different experimental tests during the period of performance of this subtask.

Metrics: Perform specified analyses and computation of Sound Exposure Level (SEL) , EPNL PNLT, SPL, BVISPL, etc.; computation of areas inside various SEL levels, selected narrowband spectra or ensemble-averaged spectral time history,[R3] or generation of RNM noise hemispheres, for [R6]identified test conditions. Minimum acceptable percentage of [R6]identified data runs processed in this manner is 95 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process. For the remainder of runs, identification and documentation of the reasons why these cases cannot be processed shall be provided. Greater percentage of processed and [R8]EDAS archived data runs, as well as additional noise metrics computed [R6]and processing of ancillary data sets, will be used to assess the level of performance exceeding the acceptable level~~.~~

Deliverable: [R6]Specified noise [R8]data/metrics identified for each test in both graphic and digital formats, [R8]as required, within EDAS. [R3] Noise hemispheres in RNM required format. Post-processed data archived on both optical disk [R8]and/or tape media. [R6]Written description of data reduction and analysis procedures and results.

Schedule: Subtask 2 shall be completed by [R2] ~~September 30~~ [R3] ~~December 31, 2001~~ [R7]~~September 30, 2002~~ [R8]~~November 30, 2002~~ [R11]~~September 30, 2003~~ [R12]~~September 30, 2004~~ ***September 30, 2005.***

Subtask 3. David A. Conner M/S: 461 Phone: 757-864-5276

(NOR) Provide programming and consultation support for modifications of and upgrades to the Digital Acoustic Measurement System (DAMS) , the [R12]~~Remote Acquisition and Storage System (RASS)~~***Wireless Acoustic Measurement System(WAMS),*** [R8]the Electronic Data Access System (EDAS), [R11]and the Acoustic Detection of Aircraft Model (ADAM) to include: (1) software development; (2) data analysis; and (3) system analysis. [R1]It is anticipated that several upgrades/modifications will be required as a continuous process to miniaturize and maintain state-of-the-art systems. [R13]***Key to this effort will be programming and consultation support for improvements in acoustic propagation prediction methods.***

Metric: Upgrades and modifications successfully integrated into the DAMS , RASS, [R8]EDAS, [R11]and ADAM systems.

Deliverable: Provide documentation of all programming and consultation support.

Schedule: Subtask 3 shall be completed by [R3] ~~September 30, 2001~~[R7]~~September 30, 2002~~ [R8]~~November 30, 2002~~

R11 ~~September 30, 2003~~ R12 ~~September 30, 2004~~ September 30, 2005.

Subtask 4. Martha C. Brown M/S: 166 Phone: 757-864-6277
4.1 R11(Completed)

4.2 The Contractor shall provide R8data acquisition and system administration/computer support to JNL R8on-going research. This task is necessary in order to address/ R8troubleshoot computer problems in real-time, thus minimizing the adverse impact R8of unplanned events to on-going research. Specific duties R8are difficult to anticipate very far in advance of the need and may vary, depending on the requirements R8in response to the unplanned events. Examples of R8events include, R8but are not limited to: UNIX operating system R8obsolescence/"bugs," hard drive R8inadequacies/failures, computer crashes, printers R8in need of maintenance, R8data backups, etc. R11Verify current virus protection updates to all PC's

Deliverables of this support include resolving these problems in a timely manner in order to minimize impact to on-going research. Also a brief tabulation of problems, solutions, and the associated occurrence and resolution times/dates shall be included in the monthly technical report.

As minimum acceptable performance, the Contractor shall be able to respond to a request within thirty (30) minutes of the identified problem. Completion time will depend on the nature of the problem (e.g., time to procure a part). R1Performance is exceeded R8when Contractor solutions measurably minimize the adverse impact to on-going research.

R8(Previous 4.3 completed)

4.3 (R8previous 4.4) The Contractor shall perform in-situ calibration tasks, improve calibration procedures where necessary, and identify new procedures when applicable. R8The Contractor shall also troubleshoot problems if normal calibrations fail or do not meet desired acceptance levels. All calibrations performed shall be in compliance with Langley LMS calibration R8procedures. The Contractor may collaborate with JNL's metrology representative, or any JNL personnel in accomplishing this task. R12The Contractor is also responsible for the maintenance and upgrades of the linear array of microphones in the LSAWT.

The Contractor shall deliver a completed calibration sheet including his initials, demonstrating written proof of completed task. Documentation shall be provided to the metrology representative for all new and modified calibration procedures. A brief tabulation of calibration tasks, procedure improvements, and new procedures shall be included in the monthly technical report. R12The Contractor shall provide necessary documentation and calibration record keeping regarding the linear array of microphones.

Minimum acceptable performance is achieved when Electronic Scanning Pressures (ESP) modules and R12 ~~NEFF~~ airball (broadband noise source) instrument calibration procedures are performed R8prior to each daily test. Modified calibration procedures shall be submitted to the metrology representative in R8two (2) weeks after calibration has been performed. New calibration procedures should be submitted to the metrology representative in two (2) weeks after calibration has been performed. R1Exceeded performance will be when 75 % of recommended improved and/or new procedures are approved for use by the Subtask Technical Monitor.

Begin R8 block requirements redefinition
4.4 The Contractor shall archive all data acquired in the JNL. General archiving involves transferring data from the data acquisition computer to the local storage computer, mass storage (DMSS), and tape media (DVD, DLT tapes). In preparation for the PIV test, the Contractor shall assist in developing a plan to transfer PIV data from the data acquisition computer to the post-processing and archiving computers.

Deliverables shall be in the form of preparing tape media for storage and allowing disk space for data acquisition on a daily basis.

Minimum acceptable performance will be met when data transfer from the data acquisition computer to the post-processing computer causes only minimal adverse impact to research schedule. Exceeded performance is met when data transfer causes no adverse impact to research schedule.

R8(Previous 4.5 completed)

4.5 The Contractor shall perform instrumentation configuration management in support of research performed in the LSAWT. **Begin R12 block update** This task will include, but not be limited to, ~~building a MODCOMP setup and sending list file, modifications to changing station channel assignments, configuration changes on MODCOMP and DAS computers, and troubleshooting~~ maintenance of the Paragon control system, upgrading the Paragon software to the most recent version compatible with the new PLCs, modifying the I/O to communicate with the PLCs, and writing an installation/implementation/checkout plan for the upgraded Paragon system. The Contractor shall also set up communication between the National Instrument (NI) software and other laboratory devices and computers, as well as select programming of different modules in LabView. In addition, the Contractor shall act as Software Manager for the Paragon system and the Software Configuration Manager for all of the control room software, including the Paragon, PLC, and NI systems. **End R12 block update**

Deliverables will be demonstration to the test engineer on the working details of these functions.

Minimum acceptable performance is met upon demonstration of working details of instrumentation configuration by R12~~December 30, 2003~~ December 31, 2005. Exceeded performance is met when the Contractor demonstrates working details of the instrumentation configuration before R11~~June 30, 2003~~ R12~~June 30, 2004~~June 30, 2005.

R8(Previous 4.6 completed)

4.6 The Contractor shall provide electrical engineering support for the JNL. One type of support is building circuits in support of research programs (e.g., PIV experiment). Specific details of this task will be defined by the principal investigator. Another type of support required is the recommended design and procurement of instrumentation for LSAWT. This task is needed in preparing for the facility upgrades to be scheduled in FY04. This task includes, but is not limited to, researching hardware components as well as recommendations to instrumentation patch panels, instrumentation wiring, etc.

R11~~Deliverables will be providing instrumentation upgrade findings in writing no later than May 2, 2003.~~ Circuits will be based on a set deadline defined by the principal investigator.

R11Minimum acceptable performance will be met upon delivery of such circuits by the deadline set by the principal investigator. Superior performance will be met upon delivery of circuits that cause no adverse impact to research schedules.
R8(Previous 4.7 completed)

Subtask 5. R8*(Completed)* **Martha C. Brown M/S: 166 Phone: 757-864-6277**
Subtask 6. R7(Completed) **Earl Booth M/S: 461 Phone: 757-864-3627**
Subtask 7. R7(Completed) **Odilyn L. Santa Maria M/S: 461 Phone: 757-864-5104**
Subtask 8. R10(Completed) **Lorenzo R. Clark M/S: 461 Phone: 757-864-3637**
Subtask 9. R7(Completed) **Lorenzo R. Clark M/S: 461 Phone: 757-864-3637**
Subtask 10. R8(Completed) **Doug Boyd M/S: 461 Phone: 757-864-5947**
Subtask 11. R8(Completed) **David A. Conner M/S: 461 Phone: 757-864-5276**
Subtask 12. R7(Completed) **Carl H. Gerhold M/S: 461 Phone: 757-864-5279**

Begin R7 block addition
Subtask 13. R12 (Completed) **Michael G. Jones M/S: 463 Phone: 757-864-5272**
Subtask 14. R10(Completed) **Michael G. Jones M/S: 463 Phone: 757-864-5272**
Subtask 15. R13*(Completed)* Michael G. Jones M/S: 463 Phone: 757-864-5272

Subtask 16. Michael G. Jones M/S: 463 Phone: 757-864-5252
(NOR) The Contractor shall acquire complex acoustic pressure data using the Pulse Impedance Tube(PIT). These data shall be processed such that they are suitable for usage in a time-domain analysis to be provided by the Government.

Metrics: Percentage of successfully completed RTR's will be assessed on a monthly basis.

Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response within two weeks for 80% of NOR's. The number of data sets required is expected to be R11~~between 2 and 8~~ up to 4 per month. Greater percentage of RTR within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverable: Documented data charts and annotated electronic data files within 2 weeks of request.

Schedule: Subtask 16 shall be completed by R8~~November 30, 2002~~ R9~~September 30~~ R11~~November 30, 2003~~ R12~~September 30, 2004~~ R13~~September 30, 2005~~ ***November 30, 2005***.

Subtask 17. Michael G. Jones M/S: 463 Phone: 757-864-5272
(NOR) The Contractor shall acquire flow resistance data using the Raylometer. In addition, the Contractor shall provide oversight for usage, maintenance and analysis of data for the Raylometer.

Metrics: Percentage of successfully completed RTR's will be assessed on a monthly basis.

Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response within two weeks for 80% of NOR's. The number of data sets required is expected to be between 1 and 4 per month. Greater percentage of timely responses will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverable: Documented data charts and annotated electronic data files within 2 weeks of NOR.

Schedule: Subtask 17 shall be completed by R8~~November 30, 2002~~ R9~~September 30~~ R11~~November 30, 2003~~ R13~~September 30, 2005~~ ***November 30, 2005***.

Subtask 18. Carl H. Gerhold M/S: 461 Phone: 757-864-5279
The Contractor shall provide design and material specifications, assembly and fabrication oversight for R8~~a boundary layer control device for~~ the S-Duct R8test apparatus. The Contractor shall also provide software support for the data acquisition system to be used with this apparatus. Design guidelines(sketches, dimensions, instrumentation) will be provided by the Government. Software requirements for the S-Duct include instrument and test control and R12flow rate and flow quality related data acquisition capabilities. Specific requirements(algorithms, equations, measured quantities) will be provided by the Government.

Metrics: Progress toward completion of deliverables will be assessed on a monthly basis.

Acceptable Performance Standard: Completion of deliverables by the required dates.

Exceeds Performance Standard:
1. Completion of the deliverables at least one month before the required dates.
2. Implementation of significant facility enhancements beyond those included in Government- furnished guidelines.
3. Development of software with capabilities significantly exceeding those included in Government-furnished guidelines.

Deliverables:

Status report detailing progress of S-Duct by R8~~November 30, 2002~~ R12~~September 30, 2003~~ December 31, 2004.

Schedule: Subtask 18 shall be completed by R8~~November 30, 2002~~ R11~~September 30, 2003~~ R12~~September 30, 2004~~ R13~~December 31, 2004~~ ***November 30, 2005.***
End R7 block addition

Begin R8 block addition
Subtask 19. Carl H. Gerhold M/S: 461 Phone: 757-864-5279

The purpose of this subtask is to develop, debug, and implement a data analysis program to determine the noise R10reduction of an acoustically lined, curved duct. The duct cross section will be R12~~30~~ ***15*** inches x 6 inches. The nominal air flow speed will be Mach 0.3, and the maximum flow speed will be Mach R12 ~~0.5~~ ***0.4***. The sound will be generated by an array of R12~~20~~ 16 loudspeakers, and will consist either of single pure tones or wideband random sound over a frequency range 300 Hz to R12~~10,000~~ 3500 Hz. The mode shapes in the rectangular duct will consist of modes in both the x- and y-directions of the duct cross section. The highest order mode number will be determined. The test section will have acoustically-lined walls. The R10noise reduction will be measured using two arrays of microphones, one located upstream of the test section and one located downstream of the test section. The microphones are piezoceramic and will be flush mounted on the side walls of the duct. Each array of microphones will be designed to resolve modes along both axes of the duct cross section. It is expected that each of the two arrays will consist of R12as many as 100 microphones.

System calibration:

The Contractor shall assist the lead NASA engineer to calibrate the microphones. This will consist of a complete end-to-end calibration of each microphone in order to determine the calibration factors of each microphone in the array, and a spot check to identify inoperative channels. The complete calibration will be done as part of the facility checkout and after any lengthy down time of the facility or any major change to the facility. The spot check, using one sound source and acquiring data from all microphones simultaneously, will be performed at least daily while experiments are in progress.

Data acquisition system development:

The sound in the duct will be generated using a control system that is being developed under a separate task. Data collection will commence once a steady state condition has been achieved in which the flow in the duct is on condition and sound is being generated in a desired mode shape and at a desired frequency. Data will be collected from the upstream array of microphones, a switchbox will be activated, and data will be collected from an array of microphones downstream of the test section. The time series data will be archived on DVD or optical disk, and either the time series data or the Fast Fourier Transformed (FFTed) cross-spectra will be transferred to the data analysis computer for post processing. Once data collection is complete, the test operating condition will be changed to a new point, and the control and data collection processes repeated. The parameters that are changed in a run are expected to include mode shape distribution, frequency of tone, and flow speed.

Data related to the test condition, including test, run, and point identifier, flow speed, temperature and any other pertinent information will be collected and archived in addition to acoustic data.

Acquired data will be processed using Government-developed algorithms used to determine the acoustic transmission loss in the controlled mode, and the generation of spurious modes by the duct curvature. The contractor shall develop the algorithms to perform the data retrieval, data analysis, data archiving, and analysis reporting.

Data acquisition support:

The Contractor shall provide continuing support throughout the duration of the project to acquire, analyze, and archive data and to provide graphics support for the preparation of reports and papers.

Note: R10A descoped test facility R10consisting of an acoustic driver section, a microphone array section, and two anechoic terminations is currently under construction and is expected to be operational by the fourth quarter of FY03. It is expected that the data collection system hardware will be ordered within the first quarter of FY03, and it is expected that the system components will be assembled prior to installation of all hardware in the test apparatus. It is also expected that software development will be essentially complete by the time it is installed in the test apparatus. The control R10~~and data acquisition~~ system software is expected to be fully operational by the end of the R10~~third~~ fourth quarter of FY03. R10Even though the microphone array in this test facility will be smaller than the final version, it will provide the opportunity to develop the data acquisition and data processing software can be operational by the end of the first quarter of FY05. ~~The baseline tests will be run in the first quarter of FY04. It is expected that four test duct configurations will support the testing throughout that time by operating and maintaining the control and data acquisition system.~~

Begin R12 block update

Note: As a result of the successful completion of the descoped test facility, the data acquisition system software has been developed and a procedure for collection of appropriate test information has been determined. Construction of the flow duct described in the first paragraph of this subtask has begun and is expected to be complete by December 31, 2004. It is expected that the Contractor shall oversee the transfer of the software developed in the descoped test to the flow duct facility and shall provide continuing support throughout the duration of the project to acquire, analyze, and archive data and to provide graphics support for the preparation of reports and papers.

End R12 block update

Metrics:

Minimum acceptable performance for this task is completion of the task in sufficient time that the test window start is not delayed by software development and implementation. Minimum acceptable performance for continuing support is completion of the test matrix within the test window, or, if delays occur, they are not caused by sound generation control or data acquisition problems. It is critical to minimize the settling time required for the system to reach a steady state of the desired mode shape because of the limited amount of air available for each run. Thus the ability to reach steady state operating condition of the sound generation with the required accuracy in the least time will be used to assess performance which exceeds the minimum acceptable level. The ability to add model configurations to the test matrix because the sound generation control and data acquisition processes take less time than anticipated will be used to assess performance which exceeds the minimum acceptable level. Utilization of the graphics capabilities of Labview to develop Graphical User Interface and ease operation of the control system will be used to assess performance which exceeds the minimum acceptable level.

Deliverables:

1. A working data analysis package.
2. A report including:
    A. The data reduction routines used in the analysis, the theoretical development of the algorithms used in the data analysis, and a list of the documentation necessary to support the analysis methodology used.
    B. Documentation of the control software for the microphone array positioning.
    C. Documentation of the acoustic data acquisition system, including description of parameters such as data acquisition rates, sample size, data weighting, averaging technique used, data file management, data archiving, and retrieval of the curved duct data collection.

D. Sample cases to demonstrate the validity of the data collection.

3. All specified plots in electronic as well as printed form.

Period of performance:

Start date: January 1, 2003 Completion date: R10~~September 30, 2003~~ R11~~November 30, 2003~~ R12~~September 30, 2004~~ R13~~September 30, 2005~~ ***November 30, 2005***

Subtask 20. Martha C. Brown M/S: 166 Phone: 757-864-6277

20.1 R12(Completed)

20.2-20.6 R11(Completed)
End R8 block addition

Begin R12 block addition
20.7 The Contractor shall assist in the development of the new data acquisition system for the LSAWT. Duties include the following:

- Communication between LabView computer and National Instrument(NI) devices, Precision Filters, ESP Remote Processor, Traverse, and other RS-232 devices,
- Communication between LabView computer and Paragon control system,
- Communication betreen LabView computer and PLC,
- Programming designated modules(subroutines) to view, acquire, and store acoustic and aerodynamic data,
- Provide programming expertise as required.

NASA will provide all detailed requirements, instrumentation, and hardware required to perform this task.

Minimum acceptable performance is achieved when this task is completed by November 30, 2004. Exceeded performance is achieved when this task is completed by November 19, 2004.
End R12 block addition

Begin R9 block addition
Subtask 21. Michael G. Jones M/S: 463 Phone: 757-864-5252
(NOR) The Contractor shall acquire total/static pressure data using a total pressure rake and multiple static pressure ports in the GTI. These data shall be processed such that they are suitable for usage in analysis to be conducted by the Government.

Metrics: Percentage of successfully completed RTRs will be assessed on a monthly basis.

Standard: Acceptable performance on this task shall be the timely acquisition and analysis of data. Minimum acceptable performance is response within two weeks for 80% of NORs. The number of data sets required is expected to be between 2 and 8 per month. Greater percentage of RTR within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverable: Documented data charts and annotated electronic data files within 2 weeks of request.

Schedule: Subtask 21 shall be completed by R11~~November 30, 2003~~ R12~~September2004~~ R13~~September 30, 2005~~ ***November 30, 2005***.

Subtask 22. R12(Completed) **Lorenzo R. Clark MS/461 Phone: 757-864-3637**

End R9 block addition

Begin R10 block addition
Subtask 23. R11(Completed) **David A. Conner M/S: 461 Phone: 757-864-5276**
End R10 block addition

Begin R11 block addition
Subtask 24. R12(Completed) **Carl H. Gerhold M/S: 461 Phone: 757-864-5279**

Subtask 25. Casey L. Burley M/S: 461 Phone: 757-864-3659
(NOR) Perform on-site data reduction and preliminary and post analysis of particle image velocimetry (PIV) images and resulting vector maps, acoustic data, surface pressure data, and other related measurement data. Software shall be developed or modified, as required, for data logging, archiving to stored media (DVD, CD) and processing. The PIV measurements are taken with Integrated Design Tools (IDT) software and are to be processed as well using this software. The acoustic data are primarily taken from the 33-microphone Small Aperture Directional Array (SADA). The model(s) contains 100 or more Kulite pressure transducers. A total of 3 tests are anticipated. The Contractor requirements shall include the following:

a. R12 (Cancelled)
b. R12 (Cancelled)
c. Develop and maintain the software to archive data obtained in the QFF to DVD. These data will be in the form of *netcdf* files and ascii files. R12 (December 30, 2004)
d. Archive data as they are obtained during the following experimental efforts: Hot-Wire grid turbulence test, PIV grid turbulence test, PIV simple component test, PIV landing gear test, Acoustic grid turbulence/simple component test. R12(September 30, 2005)
e. Process data from each of these tests and archive in database log file on EDAS. The following data need to be processed and delivered as scheduled:
   i. PIV grid turbulence test data (Dec. 30, 2003)
   ii. PIV simple component test data (Jan. 30, 2004)
   iii. Acoustic grid turbulence/simple component test (R12~~Jan. 30, 2004~~ December 30, 2004)
   iv. PIV landing gear test data (R12~~March 30, 2004~~ December 30, 2004)
   v. Acoustic landing gear test (R12~~Feb. 27, 2004~~ December 30, 2004)
   vi. Acoustic LTPT (Low-Turbulence Pressure Tunnel) and Boeing Gear Models test (R12~~June 30, 2004~~ December 30, 2004)
   vii. Acoustic Blown Flap + Porous Tip (R12~~July 31, 2004~~ April 1, 2005)
   viii. Acoustic Wing/Landing Gear Wake Interaction test (R12~~August 31, 2004~~ June 1, 2005)
   ix. Acoustic, pressure Turbulence/Lifting Surfaces Interactions test (R12~~Nov. 30, 2004~~ September 30, 2005)
f. Document that all data archiving procedures and processing, PIV and acoustic data processing, function in manner determined by NASA. R12 (December 30, 2004)
g. Show that the archived data locations can be determined using the searchable procedures on EDAS and that the located data are on the specified DVD. R12 (December 30, 2004)

Metric: Documentation (written) of all data archiving procedures and processing, PIV and acoustic data processing. Demonstration of searching and identifying data files and location using the database log file on EDAS. The delivery of processed results provided according to the schedule specified. Presentation of processed data that verify correctness and completeness of the data on a daily basis. The ability to provide processed data throughout the test will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Software to archive and log data in stored medium and log of data on EDAS. Documentation of all software and procedures developed. Documentation is to be in the form of comments in the software and procedures, and as user guide reports.

R12 Schedule: Subtask 25 shall be completed September 30, 2005.
End R11 block addition

Begin R12 block addition
Subtask 26. David A. McCurdy MS: 463 Phone: 757-864-3596
(NOR) Perform on-site data processing and reduction and post-test analyses and reporting of acoustic, weather, and aircraft position data acquired during acoustic flight test to be conducted at Dulles International Airport in Virginia.

The flight test is scheduled for October 2004 and is expected to last three weeks. The test schedule and duration could be impacted by external influences such as airport access problems and weather. The Contractor shall process data received from NASA digital data recording systems. A typical data flight condition lasts approximately 1 minute, although this can vary from 30 seconds to 3 minutes, depending on type of flight condition. Data from up to 20 microphone locations may be acquired for each flight condition. The maximum number of data acquisition hours in one day should not exceed six. The Contractor shall also pack data processing equipment prior to shipment by NASA, perform pretest setup and post-test teardown of that equipment, and pack up the equipment prior to departing from the test site.

On-site data processing and reduction metric: Computation of 1/3 Octave Band Sound Pressure Level time histories (0.5-sec intervals), A-weighted Sound Pressure Level time histories (0.5-sec intervals), and A-Weighted Sound Exposure Levels (SEL) for each flight condition shall be computed post-flight; the A-weighted Sound Pressure Level time histories(0.5-sec intervals), and A-weighted Sound Exposure Levels(SEL) to be available in graphic format within 24 hours of receipt of the data. Minimum acceptable percentage of data runs processed in this timeframe is 75 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process. Greater percentage of processed data runs, as well as generation of noise spectra plots, acoustic and weather data acquired by others and/or noise - measurement data from prototype wireless microphone systems in this timeframe will be used to assess the level of performance exceeding the acceptable level.

Data reduction and analyses not finished on-site are to be completed within 3 months of end of data collection at Dulles International Airport.

Data processing and reduction deliverables: 1/3 Octave Band Sound Pressure Level time history data in table format. A-weighted Sound Pressure Level time histories, and A-weighted Sound Exposure Level (SEL) data in both graphic and table formats. Raw and processed test data archived on DVDs.

Specific details of post-test analyses and reporting will be specified in NORs.

Subtask 27. Michael G. Jones M/S: 463 Phone: 757-864-5252
The Contractor shall provide design and material specifications, assembly and fabrication oversight, and software support for Flow Impedance Test Facility upgrades. These include enhancements to the Dual-Waveguide Normal Incidence Tube(DWNIT) and the Grazing Incidence Tube(GIT). Design guidelines(sketches, dimensions, instrumentation choices) and software requirements(algorithms, equations, measured quantities) will be provided by the Government. Additional upgrades include (1) design and implementation of a hardware/software system to acquire total pressure data with a 9-probe, independent-control rake and provide detailed mean flow contours of the GIT, (2) an improved boundary layer(BL) suction control system(expected to be achieved via multiple shop-vacs), (3) integration of Agilent VXI A/D's into data acquisition software for usage with the Pulse Impedance Tube(PIT), R13 ***(4) a replacement stainless steel 95-mic window, and (5) a Raylometer-to-GIT connection scheme to allow DC flow resistance measurements in the presence of grazing flow.*** The Contractor shall perform an assessment of the mean flow profiles in the Grazing Incidence Tube to demonstrate that the modified BL control system is satisfactory, and shall provide consultation regarding potential enhancements to the GIT flow system(e.g., air ejector).~~The Contractor shall maintain up-to-date documentation of the facility capabilities(User's~~

~~Guide, Facility Reports).~~ R13***The Contractor shall also conduct calibrations and tests with the DWNIT to demonstrate functionality.***

Metrics: Progress toward completion of deliverables will be assessed on a monthly basis.

Acceptable Performance Standard: Completion of deliverables by the required dates.

Exceeds Performance Standard;
1. Completion of the deliverables at least one month before the required dates.
2. Implementation of significant facility enhancements beyond those included in Government-furnished guidelines.
3. Development of software with capabilities significantly exceeding those included in Government-furnished guidelines.

Deliverables:
1. Demonstration of upgraded mean flow measurement system by October 31, 2004.
2. Demonstration of improved boundary-layer control system by March 31, 2005.
3. Revised User's Guide for Flow Impedance Test Facility by R13~~May 31, 2005~~ ***September 30, 2005***.
4. R12~~Revised~~ Facility Report (user's guide plus description of facility purposes, capabilities and usages) by R13~~September 30, 2005~~ ***November 30, 2005***. R12Replaces deliverable 4, Subtask 13 above.
5. Completion of contour map of detailed mean flow profiles by January 31, 2005.

*****Begin R13block addition*****

6. Design of replacement 95-mic window by July 31, 2005.
7. Completion of DWNIT check-out tests by April 30, 2005.
8. Completion of DWNIT user's guide by May 31, 2005.
9. Design of Raylometer-to-GIT interface by June 30, 2005.

*****End R13block addition*****

Schedule: Subtask 27 shall be completed by R13~~September 30, 2005~~ ***November 30, 2005***.

Subtask 28. Michael G. Jones M/S: *463* Phone: 757-864-5272
(NOR) The Contractor shall acquire complex acoustic pressure data suitable for educing the normal incidence acoustic impedance using the Normal Incidence Tube (NIT), the Vertical Impedance Tube (VIT), and the Dual-Waveguide Normal Incidence Tube (DWNIT).

Metrics: Percentage of successfully completed RTR's will be assessed on a monthly basis.

Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response within two weeks for 80% of NOR's. The number of data sets required is expected to be up to 4 per month. Greater percentage of RTR's within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverable: Documented data charts and annotated electronic data files within 2 weeks of request.

Schedule: Subtask 28 shall be completed by R13~~September 30, 2005~~ ***November 30, 2005***.
End R12 block addition
*****Begin R13block addition*****
Subtask 29. Michael G. Jones M/S: 463 Phone: 757-864-5272
(NOR) The Contractor shall acquire complex acoustic pressure data with the Grazing Incidence Tube (GIT) using the large-array microphone approach. In addition, the Contractor shall provide oversight for usage and maintenance

of the GIT data acquisition system.

Metrics: Percentage of successfully completed responses to requests (RTR's) will be assessed on a monthly basis.

Standard: Acceptable performance on this task shall be the timely acquisition of data. Minimum acceptable performance is response with two weeks for 80% of NOR's. The number of data sets required is expected to be up to 10 per month. Greater percentage of RTR within 2 weeks of NOR will be the basis used to assess the level of performance exceeding the acceptable level.

Deliverable: Documented data charts and annotated electronic data files within 2 weeks of request.

Schedule: Subtask 29 shall be completed by November 30, 2005.

Subtask 30. Michael G. Jones M/S: 463 Phone: 757-864-5272

The Contractor shall conduct an investigation of the effects of channel skew on local-reacting liner impedance. This investigation shall include tests with the Vertical Incidence Tube and computations with the Government-furnished prediction code (ZKTL). Measured and predicted results shall be compared to support enhancements to the ZKTL prediction code.

Metrics: Progress toward deliverables will be assessed on a monthly basis.

Standard: Completion of deliverables by the required dates.

Exceeds Performance Standard: Completion of deliverables at least one month before required date.

Deliverable: Report documenting comparison of measured and predicted results, together with suggestions for enhancements to the ZKTL code by October 31, 2005.

Schedule: Subtask 30 shall be completed by October 31, 2005.

Subtask 31. David A. Conner M/S: 461 Phone: 757-864-5276

Perform on-site data reduction and analysis of acoustic, weather, and aircraft position data acquired during acoustic flight test to be conducted at Eglin Air Force Base in Florida. The test is scheduled for Fall 2005, but could occur as early as Spring 2005 and is expected to last three to four weeks. The test duration could be impacted by external influences such as weather and aircraft mechanical problems. The Contractor shall process data received from NASA digital data recording systems. A typical data flight condition lasts approximately 3 minutes, although this can vary from 90 seconds to six minutes depending on flight condition. Data from up to 23 microphone locations may be acquired for each flight condition. The maximum number of data acquisition hours in one day should not exceed four. The Contractor shall also pack data processing equipment prior to shipment by NASA, perform pretest setup and post-test teardown of that equipment, and pack up the equipment prior to departing from the test site.

Metric: Computation of Sound Pressure Levels (SPLs) and dBA levels for each flight condition shall be computed post-flight, to be available in graphic format to all parties within 24 hours of receipt of the data. Minimum acceptable percentage of data runs processed in this timeframe is 80 percent of all "good" runs, where a good run is defined as one in which no anomalies occurred during any part of the recording process. Greater percentage of processed data runs, as well as generation of RNM input source noise spheres, processing of aircraft tracking data, and weather data acquired by NASA and others, made available in this timeframe, will be used to assess the level of performance exceeding the acceptable level.

Deliverables: SPL and dBA data in both graphic and table formats. Raw and processed test data archived on DVD media and 8mm tape.

Schedule: Subtask 31 shall be completed by October 31, 2005.

Subtask 32. Thomas F. Brooks M/S: 461 Phone: 757-864-3634
(NOR) Perform the acquisition, reduction, and post analysis of acoustic, PIV, and other related measurement data. The acoustic data are taken from the 33-microphone Small Aperture Directional Array (SADA). Several acoustic tests are anticipated: landing gear test, rods and bars test, and gear/flap interaction test. Organize and document tests, equipment, and facilities.

The Contractor requirements shall include the following:

a) Set up equipment and perform post-test tear-down for each test configuration as required. Software shall be developed as needed for configuration control, data acquisition, and data processing.
b) Calibrate instrumentation as needed.
c) Acquire test data, per NASA-provided test plan.
d) Process data for both archiving and for near real-time presentation.
e) Perform backups of all data on [R12] DVD.
f) Post-process data at appropriate test breaks.

Metric: Document validations that all data acquisition, processing, and backup systems function in manner determined by NASA on the Web based AeroCompass. Show that acquisition can be accomplished, and properly stored, for each point. Results of limited time-critical processing should be completed and displayed in short time. Present processed data that verify correctness and completeness of the data on a daily basis. The ability to provide data analysis throughout the test and in formats other than described herein to enhance physical understanding will be used to assess the level of performance exceeding the acceptable level.

Deliverables: Processed data in stored medium and in the form of charts and lists. All data fully documented with configuration, test conditions, and instrument settings defined. Present selected data in formats of publication quality. Organize and document existing data regarding the following tests:

1- Rods and Bars PIV test
2- Rods and Bars Hot Wire test
3- Grid turbulence PIV test
4- Grid turbulence Hot Wire test
5- Landing gear PIV test

Store organized information and documentation onto AeroCompass.

Schedule: The date for completion of this subtask shall be November 30, 2005 for tests performed to that date. Additional testing and extension(s) are anticipated beyond the task completion date.
*****End [R13]block addition*****

3. Government Furnished Items:

1. On-network DEC ALPHA workstations will be provided. Other special equipment, software, materials, facilities, office space, specialized lab test equipment, and task-specific commercial off the shelf equipment will be provided as required to complete task.

2 and 3. High level work stations, computers, and accompanying specialized software for processing and analyzing test data, printers, and other peripherals for use during testing and data analysis, and storage media.

4 and 5. Specialized equipment or products that are required to complete the subtask.

6. The Wind Tunnel Data Acquisition system will be used to receive these upgrades. Required hardware,

software, shipping costs will be provided by the Govt.

8. Measured acoustic signals will be provided to the contractor in the form of data files collected using a multi-channel high speed data acquisition and recording system, either NEFF 495 driven by a DEC Alpha workstation or a PC-base 64-channel high speed DataMax data recorder.

[R1]9. The grid for the finite element analysis will be generated by a separate entity such as Geolab using Government-furnished files of coordinates defining the contours of the 12 inch ADP demonstrator nacelle, centerbody, and scarf inlet, and delivered to the Contractor. The Contractor will provide consulting to Geolab related to the grid topology and size. The Government will provide access to suitable data processing equipment and software, both for analysis and for presentation of results. The Government will provide profiles of static and stagnation pressures that were measured using pressure probe rakes mounted in the aft discharge duct of the 12 inch ADP demonstrator equipped with an inlet bellmouth, for speeds encompassing the range of interest in the present experiment. In addition, other measured and calculated data, such as mass flow rate in the bypass duct and fan pressure ratio will be made available to the contractor.

[R6]Subtask 12:

a. 18-channel microphone array on a hoop with capability of rotation and translation
b. Data files acquired and stored under either: DataMax 64-channel data acquisition and recording system or NEFF 32-channel high-speed data acquisition system

Begin [R7] block addition

The Structural Acoustics Branch will provide the following:

a) Flow Impedance Test Facility(including GIT, NIT, PIT, Raylometer).
b) Design guidelines for modifications to Flow Impedance Test Facility.
c) Test specimens for testing in the PIT under Subtask 16.
d) Test specimens for testing in the Raylometer under Subtask 17.

End [R7] block addition

4. Other information needed for performance of task:

8. Complete specifications of the DataMax data recorder are available, as are all specifications for the NEFF 495 data acquisition system.

Maintain needed certification for operating lasers and other equipment. 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.

[R6]12. Microphone array calibration shall be performed at least at the beginning of the test and calibration files will be stored on the data acquisition computer to permit correction of data to proper sound level units.

Begin [R7] block addition

Documents on flow impedance facilities, impedance measurement methods and instrumentation, and liner impedance models will be made available on an as-needed basis at Langley Research Center or from other appropriate organization.

Any data, test procedures, test methods, or inventions generated, produced or implemented by the Contractor shall be the sole property of the Government. However, the Contractor shall be free to publish non-proprietary data in the public domain.

One 3-day trip to a NASA-sponsored workshop to present data acquired under this task order. The location of the workshop is TBD.

End [R7] block addition

[R9]In order to meet some urgent requirements of this task order, the Contractor may have to make various small purchases of materials and equipment such as optical disks, toner cartridges, pressure tubing, and acoustic foam.

[R10]Subtask 23. Off-site support and travel required.

5. Security clearance required for performance of work:

Security clearances are not required for any of the subtasks herein defined. However, future revisions could require clearances.

[R7]Contractor will be required to sign a nondisclosure statement prohibiting disclosure of Government or private company information to third parties, including other divisions of the Contractor's parent organization.

6. Period of Performance:

Planned start date: January 2, 2001

Completion date: [R3] ~~December 31, 2001~~

[R5]~~September 30, 2002~~

[R6]~~December 31, 2002~~

[R8]~~November 30, 2002~~

[R11]~~December 31, 2003~~

[R12]~~December 31, 2004~~

December 31, 2005

7. NASA Technical Monitor: Joe W. Posey

M/S: 461 Phone: 757-864-7686

NASA Competency/Other Technical Coordinator: [R13]***Terrie T. Seitz***

M/S: 461 Phone: 757-864-***3618***

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Statement of Work

Task Order Number: 20RDA Revision: 10 Date of Revision: 1/28/05

Title: Wind Tunnel Test Support For VDB

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

The Vehicle Dynamics Branch (VDB) conducts research to advance the state of the art in analytical and experimental characterization of vehicle stability, controllability, and control power requirements, spin characteristics, flying and handling qualities, agility, and maneuverability. Several wind tunnel test techniques are used as a part of this research. The current test techniques include: Static Force and Moment Test, Pressure Test, Power Effect Test, Tunnel Survey, Flow Visualization, and Dynamic Test including Forced Oscillation, Free-to-Roll, Dynamic Pitch, Free Spin, Rotary Balance. Additional information can be obtained on these test techniques on the VDB web page (URL http://asgsparc.larc.nasa.gov/docs/). The task pertains to working with new methods of investigating aerodynamic problems and in conducting the aerodynamic research using the current test methods.

Revision 1: Some minor word changes for clarity (bold italics), adds Subtask 7 ([R1]).
Revision 2: Removes subtask 7 and adds subtask 8 & 9. (See [R2] below.)
Revision 3: Adds Vertical Spin Tunnel subtasks 10, 11, & 12. (See ** [R3] block** below.)
Revision 4: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance with some schedule adjustment and without Sub-task 8 which is expected to be completed December 31, 2001 (see [R4] below).
Revision 5: Moves subtasks 3 and 6 to new facility support task order 31RDA. Records subtask 12 as completed. Adds two additional modifications to subtask 11 (see [R5] below).
Revision 6: Adds subtask 13 & 14. Records completion of subtask 9. (see [R6] below).
Revision 7: Extends the period of performance one year in continuation of NASA's support with requirements redefined (including new Subtask 1.a and annotations for completed Subtasks 9, 10, & 11 and Subtasks 5 & 13 moved to separate task orders) for the new period of performance (see [R7] below).
Revision 8: Added Subtask 15, Updated portions of Other Information Needed for the Task, corrected data in Subtask 14, and extended the period of performance of the task (see [R8] below).
Revision 9: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with no changes in detailed requirements and documents a change in technical monitor for the new period of performance (see [R9] below).
Revision 10: Notes Subtask 4 as complete and reduces Subtask 15 to a one-shift operation (see [R10] below).

2. **Description of the Work to be Performed:**

1. The Contractor shall provide system administration for the data acquisition system, which consists of an archive computer, a data acquisition computer and an analysis workstations for 12 Ft. tunnel, 14x22 Ft tunnel, and Spin Tunnel. The Contractor shall:
   - Maintain system and acquisition software. Install software upgrades [R7]and security

patches on a non-interference basis and verify system operations following software upgrades.

Performance Standard: The system software is fully operational and kept up-to-date with no significant disruption in capability.

Performance Metrics: Exceeds: "Meets" and improvements are recommended. Meets: Software upgrades are installed and fully operational in a timely manner with no loss of data.

- Maintain test database with backups and data archival on a non-interference basis. Backup and archival plan to be approved by task monitor.

  Deliverables: Proposed schedule for backups and proposed archival scheme.

  Performance Standard: Archiving schedules are met and ability to restore in a timely manner is maintained.

  Performance Metrics: Exceeds: 'Meets' and improvement in recovery procedure is recommended and adopted. Meets: Archiving schedules are met.

- Provide configuration management of the hardware. The Contractor shall develop and maintain a historical configuration tracking log that identifies by date and time all changes, modifications, and upgrades that occur on systems supported by this task.

  Performance Standard: Inventory of equipment and software is up-to-date and accurate.

  Performance Metrics: Exceeds: "Meets" and semi-annual audit finds no deviations from the actual configuration, or improvements have been made in the configuration management system.

  Meets: Data format is satisfactory, semi-annual audit finds only minor deviations from actual configuration.

- Recommend system upgrades and improvements. The Contractor shall monitor user requirements and system performance as well as availability of updates and upgrades. The Contractor shall make recommendation for system upgrades based on system observations. NASA shall approve all upgrades.

  Performance Standard: The systems are kept up-to date with minimum disruption in capabilities due to upgrades

  Performance Metrics: Exceeds: All approved upgrades are installed on schedule and without disruption. Meets: All approved upgrades are installed with minor delays and disruptions.

- Operations: The Contractor shall diagnose anomalies in the system operation of equipment or system software and provide timely fixes or work-around where possible.

Performance Standard: The systems are operated efficiently and with minimal disruption in capability due to malfunctions.

Performance Metrics: Exceeds: 'Meets" and improvements in efficiency is noted or response time is faster than 'meets criteria'. Meets: System tuning is performed and response to problems during prime shift is within 2 hours.

Begin R7 block addition

1.a. The Contractor shall provide system administration for the additional wind tunnel and data acquisition engineering desktop systems indicated in Attachment A (Section 4, below). The Contractor shall:

- Install software upgrades and security patches on a non-interference basis and verify system operations following software upgrades.

  Performance Standard: The system software is fully operational and kept up-to-date with no significant disruption in capability.

  Performance Metrics: Exceeds: "Meets" and improvements are recommended. Meets: Software upgrades are installed and fully operational in a timely manner with no loss of data.

- Operations: The Contractor shall diagnose anomalies in the system operation of equipment or system software and provide timely fixes or work-around where possible.

  Performance Standard: The systems are operated efficiently and with minimal disruption in capability due to malfunctions.

  Performance Metrics: Exceeds: 'Meets" and response time is faster than 'meets criteria'. Meets: Timely response when notified of problem. (4 Hours)

End R7 block addition

2. A plan has been developed to upgrade the data acquisition system, eliminating known shortcomings, maintaining flow of current acquisitions, and incorporating a modular approach. User requirements have been documented in the ViGYAN Report R99-05, 'User Requirements for an Upgraded Vehicle Dynamics Branch Wind Tunnel Data Acquisition System'. The design of the new data acquisition system is documented in ViGYAN Report T99-06, 'High-Level Design of an Upgraded Vehicle Dynamics Branch Wind Tunnel Data Acquisition System'. The system is in the process of being developed. The Contractor shall complete this development. This software shall be developed in accordance to the LaRC software procedure using the control level of high. (LMS-CP 5528 and LMS-CP 5532)

   Deliverables:
   a) Source code
   b) Verification procedures and results of verification
   c) Validation test procedures and results

d) Users manual
e) Code installed and compiled on government furnished equipment

Performance Standard: The completed data acquisition shall meet the criteria specified in the documents listed above.

Performance Metrics: Exceeds: 'Meets" and agreed upon improvements are incorporated in the code. Meets: User requirements listed in the above documents are met, unless otherwise agreed upon by the NASA technical monitor.

3. R5(Rolled into new task Order 31RDA)

4. R10***Completed***

5. R7(Rolled into new task Order 31RDA)

6. R5(Rolled into new task Order 31RDA)

7. R1, R2 Deleted
Begin R2 block
8. R4(Sub-task to be completed by December 31,2001.) Deleted

9 R6 Sub-task completed

End R2 block

Begin R3 block
10 R7Completed

11. R7Completed

12. R5(Completed) -
End R3 block
**Begin R6 block addition*
13 R7(Rolled into new task Order 33RDC)

14. Forced Oscillation Code for VST: Implement the design developed by ViGYAN in subtask 12. The design is described in the document 'Design Recommendations for NASA LaRC 20-Foot Vertical Spin Tunnel Forced Oscillation Data System Upgrade' by Heather P. Houlden January 2002 (this is available from the task monitor).

Deliverables: Code for forced oscillation testing in the Spin Tunnel

Performance Standard: Code incorporates proposed ViGYAN design

Performance Metrics:

Exceed: 'Meets' and code is delivered ahead of schedule

Meets: Code is available for integration with the forced oscillation rig by November 1, R8 2003

End R6 block addition

Begin R8 block addition

15. Provide support for the data acquisition computers during VDB testing. This testing R10 ***shall be done on a one-shift operation***, with VDB conducting approximately 5 tests per year. Tunnel schedule will be provided to the Contractor at least two week in advance using best information available.

Performance Standard: Contractor sets up data acquisition computers for tunnel testing when proper notification has been given and contributes to the progress of the test.

Performance Metrics: Exceeds: 'Meets' and makes accessible archived data from previous tests when requested, and provides software updates, when approved, to support the changing test needs. Meets: Contractor provides computer setup for test using VDB data acquisition system.

End R8 block addition

3. Government Furnished Items:

Task may require integration or modification of hardware. In such cases the government may decide to purchase the required components. These will be provided to the Contractor for integration and modification and may be taken to Contractor site during integration or modifications and checkout. This will be determined on a case by case bases and will be decided by the technical monitor for the task

4. Other information needed for performance of task:

Software will be modified and developed in accordance to the LaRC LMS procedures.

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.

R8R7 ~~Maintenance on the data acquisitions system will be handled through this task as modifications to the task. The maintenance will include problem solution and minor code modifications to support specific tunnel entries.~~

	[R7]Attachment A: 1) Jay Brandon, Bldg 1192C, Rm 156, ECN – 2104345 2) Kevin Cunningham, Bldg 1192C, Rm 107, ECN –in process of being purchased 3) Bruce Owens, Bldg 1192C, Rm 111, ECN – 2100248 , 1884156, [R8]& 1885413
5.	**<u>Security clearance required for performance of work</u>**: Task may include support of secure wind tunnel testing. In such cases a secret clearance will be required.
6.	**<u>Period of Performance</u>:** Planned start date: 1/1/01 Completion date: [R4]~~1/1/02~~ [R7]~~1/1/03~~ [R8]~~1/1/04~~ [R9]~~1/1/05~~ 12/31/05
7.	**NASA Technical Monitor**: [R9]Susan Conry M/S: 132 Phone: 757-864-2011 NASA Competency/Other Technical Coordinator: M/S: Phone:

Task Order Number: 20RFM Revision: 1T1 Date of Revision: 11/1/02

Title: Explosive Joining of Shape Memory and Superelastic Alloys

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

   The purpose of this effort is to continue the development of explosive joining processes to join shape memory alloys for evaluation as actuators. This is an extension of Task RF22 under the SAERS contract.

Change 2: Dates of Subtasks 1 and 2 Standards are revised to agree with Change 2 of Contractor's Task Plan dated 4/11/2001 (see C2 below).
Revision 1: Extends the period of performance one year in continuation of NASA's support requirements with half of previous year's funding emphasis anticipated and documents the technical monitor change (see R1 below).
Technical Direction T1: Extends period of performance to accommodate earlier unexpected technical difficulties and documents another technical monitor change (see T1 below).

2. Description of the Work to be Performed: List all Subtasks, Deliverables and/or Products, Schedule(s), Performance Metrics (for surveillance), and Performance Standards (for award fee determination).

   Subtask 1. The contractor shall develop explosive joining processes to join narrow (less than half-inch width) lengths of shape memory and superelastic alloys in thicknesses of approximately 0.030 and 0.060 inch. Joint configurations will include single lap and two-sided laps to create tri-laminates.

   Deliverables: Joint strengths and bond areas of each thickness.

   Metrics: Progress will be evaluated on the logic used in assembly and the number of successful joints.

   Standards: Meets: Completion of evaluations by R1 ~~C2~~ ~~February 16~~ May 31, ~~2001~~ 2002.
   Exceeds: Completion of evaluations by R1 ~~C2~~ ~~January 30~~ May 18, ~~2001~~ 2002.

   Subtask 2. The contractor will develop tri-laminate joint configurations for evaluation of thermally induced elongation and force.

   Deliverables: Data on thermally-induced elongation and forces.

Task Order Number: 20RFM Revision: 1T1 Date of Revision: 11/1/02

Title: Explosive Joining of Shape Memory and Superelastic Alloys

Metrics: Progress will be evaluated on the logic used in assembly and the quantity of data collected on elongation and forces.

Standards: Meets: Completion of preliminary evaluations by R1 ~~C2~~ ~~March 30~~ September 30, ~~2001~~ 2002.

Exceeds: Completion of preliminary evaluations by R1 ~~C2~~ ~~March 16~~ September 16, ~~2001~~ 2002.

3. Government Furnished Items: NASA will provide all materials, the explosives, the facilities for assembly and test, and the machine work needed for evaluation.

4. Other information needed for performance of task: Langley safety procedures shall be used in the handling and testing of all pyrotechnic components. NASA will provide the necessary heat treating of materials, prior to joining.

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.

5. Security clearance required for performance of work: None

6. Period of Performance:

Planned start date: January 1, 2001 Completion date: T1~~R1~~ ~~September 30, 2001 2002~~ ***November 30, 2002***

7. NASA Technical Monitor: T1~~R1~~ ~~Richard A. Foss~~ ***Robert G. Bryant***

M/S: ***226*** Phone: 757-864-***8312***

NASA Competency/Other Technical Coordinator (*above branch level*):

Dr. Thomas Shull,

Assistant for Flight Systems Programmatic Implementation

Systems Engineering Competency

Mail Stop 430, Phone 757-864-1837

Task Order Number: 21RAB Revision: 2 Date of Revision: 12/07/01

Title: SEE Enhancements

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

The NASA Langley Research Center, Spacecraft and Sensors Branch (SSB) is currently developing an R2***Synergistic Engineering Environment (SEE)*** application in the Multi-dimensional User-oriented Synthetic Environment (MuSE). R2***The MuSE environment is no longer being supported by its commercial vendor thus porting of the SEE to another immersive integration environment is required.*** The scope of this work is to a) enhance the current R2***SEE*** application, b) investigate the potential of interfacing SSB and R2***other Revolutionary Aerospace Systems Concepts (RASC)*** analysis tools either in real-time or post processing mode, and c) perform analyses in select disciplinary areas to validate the environment.

Revision 1: Updates Subtasks 2 and 3 deliverables to accommodate termination of original software supply and delays in release of code information and documents technical monitor change made in January ‘01(see R1 below).

Revision 2: Extends the period of performance 11 months in continuation of NASA’s support requirements, redefines the requirements for the new period of performance by redirecting the focus of the task towards the Revolutionary Aerospace Systems Concepts (RASC) activity and porting of the SEE from the MuSE environment to a cross platform environment that will enable the SEE to be utilized on Windows and Linux PCs (see R2 above and below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. The Contractor shall maintain a knowledge base of overall R2***SEE*** architecture and capabilities. The Contractor shall perform configuration control of and facilitate the integration of new capabilities into the application. The Contractor shall provide SSB and the R2***RASC*** team with rapid application enhancements for on-going utilization of the application in support of R2***RASC advanced concept studies***. The Contractor shall document application enhancements, architecture and how to use it.

Deliverables and Schedule:

1. Deliver revised application architecture R2***that enables multi-platform portability and does not require the MuSE software package***. - ***March 30, 2002***
2. Application Software release with all new features captured in updated user/architecture documentation. – R2***July 30, 2002***
3. Application Software release with all new features captured in updated user/architecture documentation. – R2 ***November 30, 2002***

*****Begin R2 block requirements redefinition*****

2. The Contractor shall leverage the SEE in combination with existing and new capabilities to

develop an integrated system analysis tool to assess the effectiveness of Comet/Asteroid Protection System (CAPS) architecture and/or elements. This time-based simulator will facilitate the evaluation of detection and orbit modification concepts identified for CAPS, and their interdependent functionality. Two basic detection analyses are required for CAPS: 1.) Survey mode – simulate many near-Earth objects (NEOs) and determine the ability of surveying strategy to detect them. 2.) Tracking mode – simulate one or a few NEOs and determine how far in advance the orbit of each NEO would be known well enough to confirm an Earth impact and/or accurately determine the miss distance. The contractor shall work closely with study team personnel developing orbit determination, sensor detection, and orbit modification methodologies, and incorporate and/or allow for the future incorporation of these capabilities into the simulation software.

Deliverables and Schedule:

1) Accurate simulation of the solar system (Sun, planets, moons) and ability to input a user defined number of NEOs into the simulator for analysis and assign basic properties to objects (diameter, albedo, etc.).
2) Ability to model multiple spacecraft and sensors orbiting any body in the solar system or based on the surface of any planet or moon (including Earth based).
3) Ability to specify nominal orientation of spacecraft and define scanning parameters of sensors.
4) Allow the user to specify an impact trajectory and define time of collision for a NEO and be able to start simulation at any desired time prior to collision (including multiple orbital revolutions of the object prior to collision).
5) Develop basic framework for incorporating the rules that govern how a CAPS detection elements interact with the NEOs and other elements (initially, basic time based rules) and provide all necessary relational information between CAPS elements and NEOs.
6) Provide method for outputting required analysis data from simulations for display and inspection.

Beta CAPS analysis capability with the above features. – April 30, 2002

CAPS analysis capability, draft of associated user documentation and application test cases for lunar based CAPS architecture and space based CAPS architecture. – July 31, 2002

Provide simulation software training for CAPS study analysts and assist in the application of the analysis tool for specific simulations required for study. – October 31, 2002.

Provide status (report and presentation material) of final capabilities incorporated into the simulation software during the contract period and identify additional modifications that need to be incorporated during subsequent development work. Provide final version of associated user documentation for analysis software. – November 30, 2002

3. The Contractor shall enhance the SEE such that it can depict the vehicles and associated trajectories in support of the RASC Orbital Aggregation and Space Infrastructure Systems (OASIS) and Human Outer Planet Exploration (HOPE) missions. For each mission phase, the ability to simulate or script the trajectories and dynamics of the mission elements along with the ability to view the mission phases from any vantage point in the solar system, including the vehicles, will be required. Collision detection among vehicles, solar system objects and viewing cones is also a capability requirement.

Deliverables and Schedule:

Integrated OASIS/HOPE mission simulation/visualization in the SEE – 8/30/2002

*****End [R2] block requirements redefinition*****

Metrics:

To meet the minimum performance for this task, the Contractor shall provide the deliverables within the period of the contract. To exceed the minimum performance, the Contractor shall demonstrate reusability of software modules and incorporate these modules within a revision control system, and implement new software techniques identified which significantly enhance the capabilities of existing applications.

3. Government Furnished Items:

[R2]***Computer*** workstations
Solid models
Modeling software
C compilers
Synergistic Engineering Environment

4. Other information needed for performance of task:

Attendance at industry trade shows and conferences will be required two or three times a year to keep up with advances in immersive and collaborative technologies.

5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: R2 ~~1/01/01~~***1/01/02*** Completion date: R2 ~~12/31/01~~***11/30/02***
7.	NASA Technical Monitor: R1 Jonathan N. Cruz M/S: 328 Phone: 757-864-1951 NASA Competency/Other Technical Coordinator: Rita Verlander M/S: 328 Phone: 757-864-1944

Task Order Number: __21RBJ____ Revision: ____ Date of Revision:

Title: Research Facilities Branch Test Support for the Unitary Tunnel

1. Purpose, Objective or Background of Work to be Performed: (DA09, NAS1-96014)

The Research Facilities Branch (RFB) is responsible for the operation of and testing in a variety of different wind tunnels and facilities at Langley Research Center. During the year, the branch will conduct approximately 12 tests, each of 4 weeks duration, in each wind tunnel. The Contractor will be expected to support approximately 5 tests in the Unitary Plan Wind Tunnel (UPWT). Support activities include review and documentation of wind tunnel model check out, assembly, and installation, setup and documentation of the test data acquisition software and hardware, performance and documentation of instrumentation setup and calibration, aerodynamic data and facility flow data analysis, and documentation of the complete test process through run logs, shift notes, and facility world wide web sites.

Note: The test and data acquisition support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

2. Description of the Work to be Performed:

The Contractor shall perform the following subtasks:

1. (NOR) Conduct and document pre- and post-test activities and data reduction and analysis processes for each test supported. The Contractor shall provide a daily oral status report and consultation to the RFB Test Project Engineer (TPE) on the progress of each of the individual test activities and processes to be supported. The components which may be supported are listed below:

- Wind tunnel or facility model and instrumentation check out, assembly, and installation
- Derivation of instrumentation calibration constraints from sting/balance deflection, accelerometer, and pressure transducer calibrations
- Perform statistical quality control analysis of data from wind tunnel test
- Data acquisition process setup, monitoring, and operation
- Flow visualization and quantitative flow measurement test techniques setup and operation
- Support test plan development, approval and implementation

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Title: Research Facilities Branch Test Support for the Unitary Tunnel

- Support the design and fabrication of model systems and model support hardware and the identification and calibration of primary instrumentation (balances, ESP modules, etc.)
- Tunnel test shift support
- Perform pre-test uncertainty prediction

Deliverables:

Oral reports and written documentation for the supported test activities.

Minimum Acceptable Performance for activities to be supported:

a) Test setup including model and instrumentation installation and calibration and the derivation of data reduction constants prior to test scheduled start date

b) All described support performed for approximately 5 required tests at UPWT

c) Complete documentation of test process and procedures in run logs, shift notes, and electronic websites by the end of test

d) Wind tunnel or facility statistical quality control data analysis complete within 2 weeks of end of test

e) Test plan 3 weeks prior to test

Exceeds Acceptable Performance:

a) Support activity completed prior to scheduled date for minimum acceptable performance

b) Support activity completed independently with all initiative shown by the Contractor

3. Government Furnished Items:

Checkout area, wind tunnel model hardware and documentation access to wind tunnel support hardware and documentation, wind tunnel test instrumentation and documentation, data acquisition computer system and documentation, terminal to access data acquisition computer, uncertainty analysis software and documentation.

4. Other information needed for performance of task:

Any hardware or software recommended by the Contractor for purchase or use during the performance of this contract must be Y 2000 compliant.

5. Security clearance required for performance of work:

Work on classified projects may be required.

6. Period of Performance:

	Task Order Number: 21RBJ Revision: ____ Date of Revision: Title: Research Facilities Branch Test Support for the Unitary Tunnel

	Planned start date: 05/1/01 Completion date: 11/30/01
7.	NASA Technical Monitor: John R. Micol M/S: 413 Phone: 757-864-5250 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 21RDE Revision: 6 Date of Revision: 11/18/04

Title: Support to Synthetic Vision Systems General Aviation (SVS-GA) Research

1.	**Purpose, Objective or Background of Work to be Performed:** **1. Purpose:** The purpose of the task is to provide research and operations support for the Synthetic Vision Systems (SVS) General Aviation (SVS-GA) element of NASA's Aviation Safety and Security Program (AvSSP). This support is required to facilitate various research activities that include piloted simulation and flight test experiments designed to support goals defined in the SVS-GA Project Plan version [R4]5.0, December 31, 2003. **2. Background:** The SVS-GA element is striving to eliminate poor visibility as a causal factor in aircraft accidents as well as enhance operational capabilities of GA aircraft. Limited visibility is the single most critical factor effecting both the safety and operational capabilities of GA. Over 30-percent of all fatal accidents worldwide are categorized as Controlled Flight Into Terrain (CFIT) accidents where a mechanically normally functioning airplane is inadvertently flown into the ground, water, or an obstacle. Better pilot situation awareness during low visibility conditions can be provided by synthetic vision display systems. These display concepts employ computer-generated terrain imagery to facilitate presentation of three dimensional, perspective scenes with necessary and sufficient information and realism to be enable operations equivalent to those of a bright, clear, sunny day, regardless of the outside weather condition. Revision 1: Redefines the scope of work, adds clarifications for performance-based contracting concerns, documents the Technical Monitor change of February 2, 2001, updates the title, and extends the completion date to September 30, 2002. Revision 2: Adds requirements and deliverables and updates schedule, period of performance, and travel requirements. Revision 3: Extends the period of performance 13 months in continuation of NASA's support with clarified and/or redefined requirements for the new period of performance. [R4]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 21RDE, 21RDE01, 21RDE02v, and 21RDE03. Revision 4: Redefines the scope of work, documents the Technical Monitor change of December 1, 2003, updates schedule, period of performance, and travel requirements and extends completion date one year to December 31, 2004 (see [R4] above and below). Revision 5: Redefines the scope of work due to Project funding issues and subsequent Element re-planning. That is, (Sub)Tasks 2, 6, and portions of 7 are deleted. (See [R5] below). Revision 6: Extends the period of performance 9 months to September 30, 2005, in continuation of NASA's support with new schedule (see [R6] below).
2.	**Description of the Work to be Performed:**

The following tasks are ongoing and not necessarily concurrent activities. Their prioritizing and scheduling vary with research and programmatic developments and require the Contractor to coordinate detailed support with the Technical Monitor as the developments occur.

Task 1: Operational Support to the NASA SVS Project – The Contractor shall provide technical and operational support, to ensure simulation studies are properly planned and executed, consistent with the resources available in this task. Contractor activities shall include research planning, experimental apparatus development, and experiment review, preparation, and execution.

Task 2: SVS-GA Concept of Operations (CONOPS) R5***Deleted***

Task 3: SVS Experimentation Development and Execution – The Contractor shall provide concept development, principle investigation, scenario development, and test data analysis in support of simulation and flight research. This includes keeping abreast of the past and current research efforts through literature searches and attendance at meetings and conferences. Contractor activities shall include the generation of experiment plans, test scenarios, safety documentation, experiment presentations, data analysis, input for conference papers and report writing, operation plans, and safety review packages.

R4(Previous Task 4 deleted)

Task 4: R4(Previous Task 5) SVS Certification Strategy Support – Together with NASA, FAA, and NASA cooperative research agreement partners, and other industry teams the Contractor shall develop a strategy for Synthetic Vision technologies for commercial and general aviation aircraft.

Task 5: R4(Previous Task 6) Interagency/Industry Interface R4***and Integration*** – The Contractor shall attend appropriate industry and governmental conferences, seminars, and training as needed to perform other requirements of the task order. R4The Contractor shall provide operational and technical support to the SVS-GA element to ensure relevance of testing with respect to Federal Aviation Regulation (FAR) procedures, National Airspace System (NAS), Air Traffic Control (ATC) and crew procedures, other R&D projects, and technologies/systems.

R4**(Previous Task 7 combined above with re-designated Task 5)**

Task 6: R4(Previous Task 8) Experimental Apparatus Development and ConfigurationR5Deleted

Task 7: R4(Previous Task 9) Experiment Documentation - The Contractor shall R5continue documentation of the Symbology Development for Head-Down Displays simulation experiment R5series.

Task 8: R4(Previous Task 10) Flight Training - The Contractor shall conduct the training of pilot subjects for simulation and flight experiments. This activity shall include the development of training materials for the various experiments. The Contractor shall keep abreast with the latest FAA regulations, NASA safety policies and procedures, and airport standard operating procedures for which SVS experiments shall be conducted.

R4(Previous Task 11 deleted)

Task 9: R4(Previous Task 12*)* Documentation and Program Advocacy R4Recordings – The Contractor shall develop documentation and program advocacy R4recordings for various research activities of the SVS-GA team. Completed R4recordings will be in various formats and platforms (computers). R4~~The contractor shall support transcription of video tapes to assemble recorded pilot comments for reporting purposes.~~ Where appropriate, the Contractor shall utilize NASA LaRC Video Applications Group (VAG) resources.

Deliverables:
Deliverables shall be provided in accordance with the following schedule:

Deliverables and Schedule

No.	Description	Date Required*
	*****Begin R6 block schedule redefinition*****	
1	Video highlight of Equivalent Safety (ES) simulation experiment	01/05
2	Preparation and submittal of a NASA Technical Paper (TP) of the Symbology Development for the Head-Down Displays (SD-HDD) simulation experiments A and B	02/05
3	Submit an Abstract for a Conference to publish results of SD-HDD experiment B and C (No Guidance/Tunnel Results)	03/05
4	Preparation of a flight training syllabus for ES flight experiment	05/05
5	Video High light of ES flight experiment	06/05
6	Final data analysis of the SD-HDD simulation experiments, A, B, and C	07/05
7	Video highlight for Oshkosh.	07/05
8	Preparation and support of Oshkosh Exhibit	07/05
9	Conference report of SD-HDD B and C	08/05

	10 Monthly progress reports ______ 1st of each month ****End R6 block schedule redefinition***** *Required dates may change based on progress of other related activities and will be specified by the NASA Technical Monitor as the changes occur, with as much advance notice as possible for the new due dates. **Metrics for Deliverables**: Meets criteria if formal documents are delivered on time. Exceeds criteria if formal documents and deliverables are delivered more than one week ahead of schedule. Technical Performance: Technical Performance will be based on a qualitative assessment of both the technical and grammatical soundness of the formal documents delivered. Meets criteria if qualitative assessment rating is good. Exceeds criteria if qualitative assessment rating is very good or excellent.
3.	**Government Furnished Items:** Office space, furniture, specialized automation and supplies as required and approved by NASA technical monitor.
4.	**Other information needed for performance of task:** **Ownership of and Rights to Use**: The government shall have all rights of ownership of and rights to use of the data. **Travel:** **Begin R4 block travel redefinition** 1. Oshkosh, WI - EAA AirVenture Fly-in (7/26-8/3/03) (3 travelers) 2. Providence, RI – AIAA GNC Conference (8/04) (1 traveler) **End R4 block travel redefinition** Note: GA travel dates and durations are estimates for planning purposes.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** **Planned start date:** 1/02/2001 **Completion date:** R6 ***9/30/2005***

7.	**NASA Technical Monitor:** [R4]Monica F. Hughes M/S: 152 Phone: 757-864-3942 **NASA Competency/Other Technical Coordinator:** M/S: Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 21RFF Revision: ____ Date of Revision:

Title: Materials International Space Station Experiment (MISSE) Project Engineering Drawings

1. Purpose, Objective or Background of Work to be Performed:
   Modify existing MIR Environmental Effects Payload (MEEP) Project engineering drawings and CAD models, and provide new engineering drawings and CAD models to describe the MISSE hardware and the MISSE/International Space Station (ISS) interfaces.

2. Description of the Work to be Performed: The contractor shall provide modifications to existing ProEngineer-based engineering drawings and CAD models, and create new engineering drawings and CAD models, as described in detailed instructions from the MISSE Project representative for each drawing or group of drawings. Existing Pro/ENGINEER-based drawings, CAD parts, and CAD models will be furnished by the Government. The contractor will be required to produce new drawings and CAD models, and they shall be produced in Pro/ENGINEER.

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 described in section 3.2 and the following criteria:

3.1.1. Ability to meet delivery schedules for all drawings and CAD models. Delivery two weeks after stated milestones will constitute "MA" and delivery one week or more 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. Ability of generated and revised engineering drawings and CAD models to be utilized by the MISSE Project to describe accurately the delivered components and assemblies. 10 hours of engineering drafting required to make final release drawing in full compliance with stated drawing objectives shall constitute "MA" and 5 or less 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.	*Top assembly drawings.*	50 % of Drawings 20 working days after drawing definition 2/15/2001
		100 % of Drawings 40 working days after drawing definition 3/26/2001

Task Order Number: 21RFF Revision: ____ Date of Revision:

Title: Materials International Space Station Experiment (MISSE) Project Engineering Drawings

The contractor is to complete a minimum of 12 top assembly drawings of the MISSE flight hardware. The drawings will be new drawings with the same format as the existing MISSE drawings. An existing MISSE drawing will be used as the starting point for some of these supplied drawings. This task will involve creating new CAD models, and making changes to the existing CAD models used to generate the drawings.

PERFORMANCE METRIC: No additional requirements to those specified in section 3.1.

3. Government Furnished Items: MEEP and MISSE ProEngineer CAD part files, CAD models, and drawings. All drawing numbers.

4. 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.

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

6. Period of Performance:

Planned start date: 1/1/2001 Completion date: 3/26/2001

7. NASA Technical Monitor: Irby W. Jones
M/S: 432 Phone: 757-864-7181

NASA Competency/Other Technical Coordinator (*above branch level*): *name (This is the management interface between COTR and TM for efficiency in PBC, technical focus, timely funding, modifications, scheduling, and award fee evaluations--selected by Competency/Office.)*
M/S: *nnn* Phone: 757-864-*nnnn*

	Task Order Number: 22RAE Revision: 1 Date of Revision: June 8, 2001 Title: LaRC Launch Vehicle Systems Analysis Process Definition

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

This work is to define and document the various conceptual and preliminary (phases A and B) design and analysis processes in use at LaRC for reusable space transportation systems (RSTS) studies. Typical design processes will be documented for single-stage-to-orbit (SSTO) and two-stage-to-orbit (TSTO) systems. This work supports the R1 ~~Intelligent Synthesis Environment (ISE) Large-Scale Applications (LSA)~~ MSFC 2^{nd} Generation Reusable Launch Vehicle (2^{nd} Gen) Program RSTS team, task RSTS-FY00.1.

Revision 1: Reflects schedule and coordination changes as a result of ISE Program restructuring and resets the completion date (see R1 above and below).

2. Description of the Work to be Performed:

The Contractor shall document typical conceptual and preliminary design and analysis processes in use at LaRC for reusable launch vehicle (RLV) studies. The Contractor shall perform the following requirements:

(a) R1 ***Discontinued with partial completion***.

(b) Perform a review of design and analysis processes and tools used in the several LaRC organizations involved in RLV studies.

(c) R1 ***Discontinued with partial completion***.

(d) Provide an assessment and prioritization of needed process and tool enhancements which could be pursued within activities of this or related tasks.

(e) Provide briefing charts and report to summarize study findings.

Deliverables:

The Contractor shall deliver a final report for the processes selected to be included in this study.

Metrics:

Minimum acceptable performance:

Each final report shall be assessed for:

- technical accuracy
- findings must be clearly stated
- recommendations must be clearly stated

Task Order Number: 22RAE Revision: 1 Date of Revision: June 8, 2001

Title: LaRC Launch Vehicle Systems Analysis Process Definition

	Exceeds minimum performance: Each 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
3.	Government Furnished Items: None.
4.	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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: January 1, 2001 Completion date: R1 ~~June 30, 2001~~ December 31, 2001
7.	NASA Technical Monitor: John Korte M/S: 159 Phone: 757-864-6920 NASA Competency Technical Coordinator: ASCAC/Rita Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 22RBA Revision: 5 Date of Revision: 1/11/05

Title: SBRT Instrumentation and Drive Integration Support

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

The Subsonic Basic Research Tunnel (SBRT) is located in the rear portion of building 1212 and is used to perform sub-scale aerodynamic tests on a wide range of aircraft configurations and concepts and to calibrate and develop a broad range of instrumentation techniques and equipment used in aerodynamic testing. [R4]As such, the SBRT is considered to be a valuable tool by both the Configuration Aerodynamics Branch and Academia. However, there are many associated systems and components that need to be updated to maintain that value. In addition, many modifications are planned for both the control room and test-section areas; many of which will increase the ease of use, model preparation, and general safety.

Change 1: Submitted by Contractor to reschedule deliverables and extend period of performance to account for unavailability of GFI (see [C1] below).

Revision 1: Adds subtask five, modifies deliverable dates to account for unavailability of GFI, and extends the completion data to July 1, 2002 (see [R1] below).

Revision 2: Extends period of performance and (sub)task 5 schedule from 7/1/02 to 12/2/02 to accommodate delayed installation of new controller (see [R2] below).

Revision 3: Extends the completion date on the documentation deliverables to Feb. 28, 2003, and adds requirements as new (sub)task 6 with an overall completion date 12/31/03 (see [R3] below)

[R4]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as “doc” files 22RBA, 22RBAu, 22RBA001, 22RBA01, and 22RBA03.

Revision 4: Extends the period of performance one year to December 31, 2004, in continuation of NASA’s support, annotates completed subtasks, redefines the requirements for the new period of performance, and updates other info (see [R4]above and below).

Change 1: Contractor-initiated change extends the period of performance 2 months to February 28, 2005 (see [R4.1] below).

Revision 5: Extends the period of performance 4 additional months to June 30, 2005 (see [R5] below)

2. Description of the Work to be Performed:

[R4]Subtasks 1-5 Complete.

6. [R3]Provide support for the initial setup and checkout of the data acquisition system for [R4]four possible tests from [R4]January 2, 2004 thru [R4.1]~~December 2004~~ [R5]~~February 28, 2005~~ ***June 30, 2005***. Each test will require approximately one week of support time.

Begin [R4] block addition

7. Contractor shall assist the SBRT manager to develop a plan for tunnel upgrades and subsequent interface of related hardware and/or software in the following areas:
   a. Data Acquisition Computer hardware and software upgrades
   b. Data Acquisition Hardware upgrades

c. Potential Drive Motor replacement that will allow continuous operation at the lower end of the SBRT speed range
d. Control Room to Test-Section wiring interface
e. Addition of digital video and image capture capability
f. Provision of additional electrical power outlets and lighting near the test-section
g. Provisions for separate Laser system electrical supply, water supply, and drain

8. Contractor shall interface any new hardware and/or software that is acquired as a result of the subtask 7 above.

End R4 block addition

Deliverables: R4Provide written list of suggested hardware and software upgrades for each subtask item listed above (due February, 2004). Document any software modifications. Update written operating instructions to include R4any new hardware and/or software implemented as a result of the subtasks above. R4Documentation of hardware and software modifications, and/or changes to the operating instructions are due within two months of the implemented change. Provide monthly progress reports of status of each task and state any potential problems with task completion.

Minimum acceptable performance: Task completion on scheduled delivery date.

Exceeds minimum acceptable performance: Task completion ahead of scheduled delivery date.

Schedule of Deliverables: Work on this task order is scheduled to start 7/01/01 and conclude C1 ~~10/31/01~~ R1~~4/30/02~~ R2~~7/01/02~~ R3~~12/02/02~~ R4.1R4~~12/31/04~~ R5~~2/28/05~~ ***6/30/05***.

3. Government Furnished Items:

All necessary computer software and hardware. Office space near the SBRT if needed. Access to the SBRT mechanical hardware as needed.

4. Other information needed for performance of task:

Not travel required.
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.

5. Security clearance required for performance of work:

None required.

6. Period of Performance:

Planned start date: 07/01/01 Completion date: C1 ~~10/31/01~~ R1~~4/30/02~~ R2~~7/01/02~~ R3~~12/02/02~~ R4~~12/31/03~~ R4.1~~12/31/04~~ R5~~2/28/05~~ ***6/30/05***

7.	**NASA Technical Monitor:** Bryan A. Campbell (administratively replaces Harry Morgan 7/2/03) M/S: 286 Phone: 757-864-5069 **NASA Competency/Other Technical Coordinator:** M/S: Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

Task Order Number: 22RDG Revision: 4 Date of Revision: 11/30/04

Title: Simulate Closed-Loop Operation of Flight Control System Hardware

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

Research conducted under the [R3]Vehicle Systems Program and the Aviation Safety and Security Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. This research will lead directly to the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, [R2]to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions. This task provides engineering support in these areas for research conducted under these programs.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the schedule and requirements for the new period of performance (see [R1] below).

Revision 2: Extends the period of performance one year in continuation of NASA's support with updated schedule and requirements for the new period of performance (see [R2] above and below).

Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with updated schedule and requirements for the new period of performance (see [R3] above and below).

Revision 4: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with updated schedule and requirements for the new period of performance (see [R4] below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. Modify, update, and maintain hardware and software required for closed-loop simulation between (i) the [R1]Honeywell Quad-Redundant Computer (QRC), [R1](ii) the Honeywell Recoverable Computer System (RCS), (iii) other assigned hardware systems and the B737 aircraft, engine, sensor, actuator, and atmosphere models using analog and discrete interface signals, the [R4]***appropriate*** data bus, [R1]and/or the 429 data bus. The Contractor shall verify all simulation software for accuracy and fidelity after modifications are made. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for closed-loop simulation between [R1](i) the Honeywell [R4]***Hardware*** and the B737 aircraft, engine, sensor, actuator, and atmosphere models using analog and discrete interface signals [R4]***as well as digital*** data bus.

Schedule: Closed-loop simulation software to be modified, updated, and maintained through R4 ***12/31/05***.

Metrics: (Satisfactory Effort) All sensor inputs and control command outputs shall be within 10% of the corresponding values generated by Simulink simulation code of the R2 B737.
(Exceeds) All sensor inputs and control command outputs shall be within 5% of the corresponding values generated by Simulink simulation code of the R2 B737.

2. The Contractor shall modify, update, and maintain hardware and software required for the real-time display of data collected from closed-loop experiments. The Contractor shall verify all data display software for accuracy and fidelity after modifications are made. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for the display of data collected from closed-loop experiments.

Schedule: Closed-loop experiment data display software to be modified, updated, and maintained through R3 ***12/31/04***.

Metrics: (Satisfactory Effort) Aircraft pitch, roll, yaw, throttle command, and lateral and longitudinal displacement from the glideslope shall be displayed in real-time as plots with a delay time not greater than 500 ms of data capture.
(Exceeds) Aircraft pitch, roll, yaw, throttle command, and lateral and longitudinal displacement from the glideslope shall be displayed as a real-time 4-D animation with a delay time less than 500 ms of data capture.

3. The Contractor shall develop and install software required for closed-loop simulation between R1 (i) the Honeywell Quad-Redundant Computer (QRC), (ii) the Honeywell Recoverable Computer System (RCS), (iii) and/or R4 ***the Honeywell Distributed Flight Control System*** and the B757 aircraft (and/or other aircraft), engine, sensor, actuator, and atmosphere models. The Contractor shall verify all simulation software for accuracy and fidelity after installation is completed. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for closed-loop simulation [R4]***one of the Honeywell Computers*** and the B757 aircraft (and/or other aircraft), engine, sensor, actuator, and atmosphere models.

Schedule: Closed-loop simulation software to be installed by [R4]***12/31/05*** with the availability of the B757 simulation models.

Metrics: (Satisfactory Effort) All sensor inputs and control command outputs shall be within 10% of the corresponding values generated by Simulink simulation code.
(Exceeds) All sensor inputs and control command outputs shall be within 5% of the corresponding values generated by Simulink simulation code.

4. The Contractor shall provide software support as assigned to the development of the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory and its links to other LaRC Laboratories. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Engineer.

Deliverable: Assigned software to link operations of the SAFETI Lab and other LaRC Labs.

Schedule: Software support to be supplied through [R4]***12/31/05***.

Metrics: (Satisfactory Effort) Delivery of assigned software within 60 days.
(Exceeds) Delivery of assigned software with documentation within 60 days.

5. The Contractor shall provide documentation and tutorial information on all closed-loop simulation hardware/software configurations and data collection protocol as assigned.

Deliverable: (i) Written document with diagrams of hardware/software configuration, voting schemes, interface requirements, and data collection protocol. (ii) Oral tutorial with hand-outs.

Schedule: Oral tutorial to be delivered as assigned by [R4]***12/31/05***. Written documents to be delivered as assigned by [R4]***12/31/05***.

Task Order Number: 22RDG Revision: 4 Date of Revision: 11/30/04
Title: Simulate Closed-Loop Operation of Flight Control System Hardware

Metrics: (Satisfactory Effort) Delivery of assigned documents/tutorials R4 ***12/31/05***.
(Exceeds) R4 ***Timely delivery with suggestions or solutions for system improvement.***

6. The Contractor shall support R1 hardware-in-the-loop experiments in the SAFETI Lab R3 and in other laboratories. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Data acquisition software and experimental test data.

Schedule: Experiment support to be provided through R4 ***12/31/05***.

Metrics: (Satisfactory Effort) All simulation and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.
(Exceeds) All simulation and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

7. The Contractor shall write controlling software for instrumentation and support bulk cable injection experiments in the SAFETI Laboratory. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Experiment control software, data acquisition software, and experimental test data.

Schedule: Experiment support to be provided through R4 ***12/31/05***.

Metrics: (Satisfactory Effort) All experiment control and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.
(Exceeds) All experiment control and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

Task Order Number: 22RDG Revision: 4 Date of Revision: 11/30/04

Title: Simulate Closed-Loop Operation of Flight Control System Hardware

3.	**Government Furnished Items**: Computer equipment, hardware, software, and equipment associated with the Closed-Loop Systems Laboratory and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work shall be performed in NASA Langley Building 1220 on a non-interference basis.
4.	**Other information needed for performance of task**: Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.
5.	**Security clearance required for performance of work**: Security clearance is not required.
6.	**Period of Performance**: Planned start date: R3 ~~1/1/01~~ R4 ~~1/1/04~~ ***1/1/05*** Completion date: R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***
7.	**NASA Technical Monitor**: Celeste M. Belcastro M/S: 130 Phone: 757-864-6182 NASA Directorate/Other Technical Coordinator: M/S: Phone: 757-864-

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

	Task Order Number: 22RFJ Revision: 6 Date of Revision: 9/03/04 Title: FTS "Testbed," Stationary FTS, and SuperWeb/THUNDER Linear Motor Projects Engineering Design

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

The Contractor shall prepare conceptual layouts and engineering designs for opto-mechanical components and systems. The efforts include: 1) Fourier Transform Spectrometer (FTS) Testbed-WEB/CARRIAGE/THUNDER FTS instrument package opto-mechanical component integration upgrade design; 2) FTS Advanced Stationary Configuration; 3) FTS SuperWeb/CARRIAGE/THUNDER instrument package opto-mechanical component integration; [R2] 4) Stationary Infrared FTS (SIFTS) optical component design and integration; [R4] 5) Advanced miniature high-resolution and high-throughput FTS systems; and 6) Advanced Fabry-Perot interferometer (FPI) systems. The task also provides for the preparation of detail/assembly fabrication drawings of the required components and liaison support during the fabrication/assembly/integration phases of the projects

Revision 1: Extends the period of performance two months and adjusts schedule to accommodate external delays in Subtasks 1 and 2 (see [R1] below).
Revision 2: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance by noting increased complexity in subtask 1 and adding subtask 4, SIFTS optical design and integration (see [R2] above and below).
Revision 3: Extends the period of performance and Subtask 4 schedule through Mar 31, 2003 (see [R3] below).
Revision 4: Adds new requirements as Subtasks 5 and 6, extends the period of performance by one year accordingly, annotates completed work, and documents Technical Monitor replacement (see [R4] above and below).
Revision 5: Extends the period of performance six months through September 30, 2004, to accommodate external delays in Subtasks 5 and 6 (see [R5] below, Section 6).
Revision 6: Extends the period of performance twelve months through September 30, 2005, to accommodate external delays in Subtasks 5 and 6 (see [R6] below, Section 6).

2. Description of the Work to be Performed:

Subtask 1 [R4]Complete.
Subtask 2 [R4]Complete.
Subtask 3 Complete

Begin [R2] block requirements redefinition
Subtask 4 [R4]Complete.
End [R2] block requirements redefinition

Begin [R4] block requirements addition
Subtask 5 (planned start: February 12, 2003) a. The Contractor shall provide detailed designs of opto-mechanical components as required for miniature FTS instruments. The Contractor shall develop conceptual design layouts that meet accuracy requirements for the placement and motion of optical components as specified by the Government. The concepts shall be presented to NASA Technical Monitor for review and approval. Fabrication detail and assembly/integration drawings shall be developed. Liaison support shall be provided for the

fabrication/integration of all components. A vendor component search shall also be conducted to identify sources for the required vendor items. The Contractor shall work with machinists to determine practical limits to machine accuracy and adjust the opto-mechanical designs accordingly.

Deliverables:
FTS carriage – Fabrication/integration support and design refinement: ongoing

Metrics:
This task will be evaluated on the Contractor's ability to meet the design performance metrics and the schedule of all deliverables and on how well the conceptual designs were translated into functional integrated instrumentation hardware. The effort will also be evaluated on the Contractor's ability to release final engineering detail drawings and analyses that accurately describe the 'as built condition of all hardware components and assemblies.

Subtask 6 (planned start: February 12, 2003) The Contractor shall provide detailed designs of opto-mechanical components as required for miniature FPI instruments. The Contractor shall develop conceptual design layouts that meet accuracy requirements for the placement and motion of optical components as specified by the Government. The concepts shall be presented to NASA for review and approval. Fabrication detail and assembly/integration drawings shall be developed. Liaison support shall be provided for the fabrication/integration of all components. A vendor component search shall also be conducted to identify sources for the required vendor items. The Contractor shall work with machinists to determine practical limits to machine accuracy and adjust the opto-mechanical designs accordingly.

Deliverables:
Determined on an as-needed basis.

Metrics:
This task will be evaluated on the Contractor's ability to meet the design performance metrics and the schedule of all deliverables and on how well the conceptual designs were translated into functional integrated instrumentation hardware. The effort will also be evaluated on the Contractor's ability to release final engineering detail drawings and analyses that accurately describe the 'as built condition of all hardware components and assemblies.
End R4 block requirements addition

3. **Government Furnished Items**: As required to perform task order requirements.

4. 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.

5. **Security clearance required for performance of work:**

Task Order Number: 22RFJ Revision: 6 Date of Revision: 9/03/04
Title: FTS "Testbed," Stationary FTS, and SuperWeb/THUNDER Linear Motor Projects Engineering Design

	None		
6.	**Period of Performance**		
	Planned start date: January 1, 2001	Completion date:	R1 ~~October 31, 2001~~ R2~~December 31, 2001~~ R3~~December 31, 2002~~ R4~~March 31, 2003~~ R5~~March 31, 2004~~ R6~~September 30, 2004~~ ***September 30, 2005***
7.	**NASA Technical Monitor** M/S: 468	R4David G. Johnson Phone: 757-864-8580	

Task Order Number: 23RAA Revision: 1 Date of Revision: 3/22/01

Title: R&M Composite Materials Database

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

A key element in the support of space flight is the reliability of the space vehicle and its' components. Historically major components for launch vehicles have not been manufactured out of composites, however the promise of lighter, stronger composite materials has meant these types of components are increasingly being included in new vehicle designs. Currently, there does not exist a database of space flight related composite hardware components that could be used to develop reliability and maintainability (R&M) support estimates. Therefore, this task is to capture historical R&M information on similar types of composite hardware that has been on both military and commercial vehicles for years. This information will be used to develop reliability and maintainability factors for composite components of similar technologies on space vehicles that can be used to aid in estimating R&M requirements of new launch systems. In addition, it will also be necessary to develop a similar R&M database for current technologies such as aluminum when used for the same function and in a similar environment. This information will be used as a benchmark against which composite factors can be compared.

Revision 1: Completion date extended to give researchers time to respond to inquiries ([R1]).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1.0 The Contractor shall provide research to determine maintenance rates and support information for actual flight experienced composite hardware. This research may be accomplished through library/internet searches, military data systems, and interview with experienced personnel, among other sources. The number of maintenance actions and the support it required shall be determined per flight hour and per sortie for particular composite technologies. The Contractor shall provide support parameters in terms of Mean Time Between Maintenance Actions (MTBMA), Manhours per Flying Hour (MH/FH), Mean Time To Repair (MTTR), touch labor crew size, and skill requirements. The procedures used, equipment and facilities needed and repair costs shall also be provided, where possible.

2.0 The Contractor shall provide information on a benchmark of comparable hardware to be used for comparison with the aforementioned composite hardware. These comparisons can then be used to develop reliability comparisons between the traditional technology and the newer composite technology.

Deliverables:
The Contractor shall provide informal progress reports biweekly. In addition, a final report consisting of a spreadsheet database of the above parameters and written report documenting

	the characteristics of the data. Electronic media for both Excel and Word are acceptable. Metrics: Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above. To exceed minimum performance, the Contractor may: (a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or (b) suggest innovative approaches to achieving the task goals that result in time and/or cost savings or an improved product.
3.	Government Furnished Items: None.
4.	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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 1/1/01 Completion date: R1 ~~4/1/01~~ 7/1/01
7.	NASA Technical Monitor: W. D. Morris M/S: 365 Phone: 757-864-4499 NASA Competency/Other Technical Coordinator: ASCAC/Rita Verlander M/S: 327 Phone: 757-864-1944

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

	Task Order Number: 23RBH Revision: 1 Date of Revision: 12/7/01 Title: Wind Tunnel Test of Boeing's SLI Configuration

1.	**Purpose, Objective or Background of Work to be Performed:** The NASA Langley Research Center Aerothermodynamics Branch (AB) provides aerodynamic support to Boeing's Space Launch Initiative (SLI) Architectural development under NRA 8-30 Government Task Agreement. The general purpose of this task is to test Boeing's SLI configuration in the Vigyan tunnel to determine approach/landing characteristics. Revision 1: Slips schedule and period of performance (see R1 below).
2.	**Description of the Work to be Performed:** The Contractor shall conduct up to 2 weeks (10 days) of testing on the Boeing SLI configuration. The test shall be composed of configuration build up and design study parametrics. 1. The Contractor shall provide standard force and moment data in an electronic format by R1 ~~18 Dec 01~~ ***25 Jan 02***. These measured items shall include: 6-component force and moment data, 2-8 base pressures, model attitude, and tunnel flow conditions. 2. The Contractor shall conduct model installation, instrumentation checkout, test, and data acquisition. 3. The parametric test matrix shall consist of, at a minimum, angles of attack from –2 to 20, angles of sideslip from –10 to 10, grit-type boundary layer trips on/off, as well as model configuration changes. 4. Flow visualization runs of either oil flow or micro-tufts will likely be requested. Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays not under Contractor's control. Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional runs as requested by customer to supplement agreed upon data.
3.	**Government Furnished Items:** The government will furnish test article and force and moment balance.
4.	**Other information needed for performance of task:** The Boeing configuration and test data is considered proprietary and should be handled as such. Contractor needs to sign Non-Disclosure Certification.
5.	**Security clearance required for performance of work:** N/A
6.	**Period of Performance:** Planned start date: R1 ~~3 Dec 01~~ ***7 Jan 02*** Completion date: R1 ~~18 Dec 01~~ ***25 Jan 02***

7.	NASA Technical Monitor: Greg Brauckmann M/S: 408A Phone: 757-864-5234 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 23RDG Revision: 4 Date of Revision: 11/30/04

Title: Emulate Effects of Controller Malfunctions on Aircraft Dynamics

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

Research conducted under the R3 Vehicle Systems Program base research program and the Aviation Safety R3 and Security Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. This research will lead directly to the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, R2 to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the schedule and requirements for the new period of performance (see R1 below).

Revision 2: Extends the period of performance one year in continuation of NASA's support with updated schedule and requirements (including new Subtask 8) for the new period of performance (see R2 above and below).

Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with updated schedule and requirements (including new Subtask 9) for the new period of performance (see R3 above and below).

Revision 4: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with updated schedule and requirements for the new period of performance (see R4 below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. Update and maintain the capability to use Matlab Real-Time Workshop to develop C code from Simulink simulations, and modify generated code as required for real-time application in the R1 Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory. The Contractor shall verify the accuracy and fidelity of the assigned C code developed. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Project Engineer.

   Deliverables: Assigned Real-Time Workshop C Code of Simulink simulations with modifications required for real-time operation in the R1 SAFETI Laboratory.

   Schedule: Assigned C code shall be developed, tested, and debugged through R4 ***12/31/05***.

   Metrics: (Satisfactory Effort) Assigned software developed, tested, and debugged in 60 days. All parameter values generated by the C code shall be within 10% of the corresponding values generated by the Simulink simulation.

(Exceeds) Assigned software developed, tested, and debugged in less than 60 days. All parameter values generated by the C shall be within 5% of the corresponding values generated by the Simulink simulation.

2. Support the development and maintenance of a nonlinear B737 simulation in Simulink consisting of individual blocks for the B737 aircraft, control laws, engine, sensors, actuators, and atmosphere models. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Project Engineer.

   Deliverables: Simulink Nonlinear B737 simulation.

   Schedule: Simulink Nonlinear B737 simulation shall be developed, tested, and debugged by R4***12/31/05***.

   Metrics: (Satisfactory Effort) Simulation developed, tested, and debugged by R4***12/31/05***. All sensor and command values shall be within 10% of the corresponding values generated by the baseline simulation code of the B737 Simulation.

   (Exceeds) Simulation developed, tested, debugged, and documented earlier than R4***12/31/05***. All sensor and command values shall be within 5% of the corresponding values generated by the baseline simulation code of the B737 Simulation.

3. Support the development and maintenance of a B757 simulation in Simulink consisting of individual blocks for the B757 aircraft, control laws, engine, sensors, actuators, and atmosphere models. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Project Engineer.

   Deliverables: Simulink B757 simulation.

   Schedule: Simulink B757 simulation shall be developed, tested, and debugged by R4***12/31/05***.

   Metrics: (Satisfactory Effort) Simulation developed, tested, and debugged by R4***12/31/05***. All sensor and command values shall be within 10% of the corresponding values generated by the IOG simulation code of the B757 Simulation.

(Exceeds) Simulation developed, tested, debugged, and documented earlier than R4 ***12/31/05***. All sensor and command values shall be within 5% of the corresponding values generated by the IOG simulation code of the B757 Simulation.

4. Support the integration and maintenance as assigned of aircraft simulations in the SAFETI Lab consisting of the aircraft dynamics models, equations of motion, control laws, engine, sensors, actuators, and atmosphere models. All software shall be controlled and documented in accordance with the Langley Management System for the level defined by the Project Engineer.

   Deliverables: Assigned aircraft simulations implemented in the SAFETI Lab.

   Schedule: Aircraft simulations shall be implemented and debugged by R3 ***12/31/04***.

   Metrics: (Satisfactory Effort) Simulation developed, tested, and debugged by R4 ***12/31/05***. All sensor and command values shall be within 10% of the corresponding values generated by the baseline simulation code.
   (Exceeds) Simulation developed, tested, debugged, and documented earlier than R4 ***12/31/05***. All sensor and command values shall be within 5% of the corresponding values generated by the baseline simulation code.

5. Provide software support as assigned to the SAFETI Laboratory. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Engineer.

   Deliverables: Assigned software for use in the SAFETI Lab.

   Schedule: Software shall be developed, tested, and debugged as assigned by R3 ***12/31/04***.

   Metrics: (Satisfactory Effort) Assigned software developed, tested, and debugged by R4 ***12/31/05***.
   (Exceeds) Assigned software and documentation developed, tested, and debugged by R4 ***12/31/05***.

6. Provide documentation and tutorial information on Simulink aircraft simulations as assigned.

   Deliverable: (i) Written document with Simulink diagrams. (ii) Oral tutorial with hand-outs.

Schedule: Oral tutorial to be delivered as assigned by R4 ***12/31/05***. Written documents to be delivered as assigned by R4 ***12/31/05***.

Metrics: (Satisfactory Effort) Delivery of assigned documents/tutorials in 60 days.
(Exceeds) Delivery of assigned documents/tutorials in less than 60 days.

7. Modify and maintain aircraft simulation software and documentation as required in support of research experiments. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Engineer.

   Deliverables: Assigned software modifications and documentation in support of research experiments.

   Schedule: Software shall be developed, tested, and debugged as assigned by R3 ***12/31/04***.

   Metrics: (Satisfactory Effort) Assigned software developed, tested, and debugged by R4 ***12/31/05***.
   (Exceeds) Assigned software and documentation developed, tested, and debugged by R4 ***12/31/05***.

Begin R2 new subtask addition

8. Develop, modify, and maintain software for the sub-scale Generic Transport Model (GTM) ***Ground Facilities*** as assigned in support of research experiments. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Engineer.

   Deliverables: Assigned software and documentation for the GTM R4 ***ground*** station in support of research experiments.

   Schedule: Software shall be developed, tested, and debugged as assigned by R3 ***12/31/04***.

   Metrics: (Satisfactory Effort) Assigned software developed, tested, and debugged by R4 ***12/31/05***.
   (Exceeds) Assigned software and documentation developed, tested, and debugged by R4 ***12/31/05***.

End R2 new subtask addition

Begin R3 new subtask addition

9. The Contractor shall support hardware-in-the-loop experiments in the SAFETI Lab

and in other laboratories. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Data acquisition software and experimental test data.

Schedule: Experiment support to be provided through R4 ***12/31/05***.

Metrics: (Satisfactory Effort) All simulation and data acquisition software shall be completed and verified for accuracy and fidelity prior to each experiment. All nominal data variables shall be within 10% of the corresponding baseline values.
(Exceeds) All simulation and data acquisition software shall be completed and verified for accuracy and fidelity, and presented to the Lead Test Engineer for review prior to each experiment. All sensor inputs and control command outputs shall be within 5% of the corresponding baseline values.

End R3 new subtask addition

3. Government Furnished Items:

Computer equipment, hardware, software, and equipment associated with the R1 SAFETI Laboratory and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work is to be performed in NASA Langley Building 1220 on a non-interference basis.

4. Other information needed for performance of task:

Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.

5. Security clearance required for performance of work:

Security clearance is not required.

6. Period of Performance:

Planned start date:	R3 ~~1/1/01~~	Completion date:	R1 ~~12/31/01~~
	R4 ~~1/1/04~~		R2 ~~12/31/02~~
	1/1/05		R3 ~~12/31/03~~
			R4 ~~12/31/04~~
			12/31/05

7. NASA Technical Monitor: Celeste M. Belcastro
M/S: 130 Phone: 757-864-6182
NASA Directorate/Other Technical Coordinator:
M/S: Phone: 757-864-

Task Order Number: 23RFF Revision: 2 Date of Revision: 9/13/01
Title: B-757 Airborne Research Integrated Experiments System (ARIES) Laboratory Aft Flight Deck (AFD)

1.	Purpose, Objective or Background of Work to be Performed: The goal of the Airborne Research Integrated Experiments System (ARIES) Laboratory is to provide a fully operational flight station for the AIRES Laboratory. This station will be mounted in the passenger section of the NASA B-757 aircraft. The Aft Flight Deck shall provide an avenue to take conceptual layouts from the existing Research Flight Deck (RFD) simulator and incorporate them onto the aircraft. Revision 1: Adds modeling requirement with new deliverables, makes minor word changes for clarity and performance-based contracting concerns, extends the completion date. (See R1 below.) Revision 2: Adds detail and drafting support and deliverables for the AFD shell and aircraft interface (see R2 below).
2.	Description of the Work to be Performed: R1 The Government will provide to the Contractor information on activity previously accomplished under NAS1-96013 (SAERS) Contract Task Order RF17. The Contractor shall use this information as a starting point to provide an engineering design package, to include design, analysis and production drawings, for the Aft Flight Deck Main Instrument Panel package, Interior Skins and the Environmental Control System (ECS). These packages shall help provide for the fabrication, integration, and operation of an Aft Flight Deck for the ARIES Laboratory. The NASA Technical Monitor will provide specifications of each of the design packages. The Main Instrument Panel (MIP) package includes the Main Instrument Panel, the Glare Shield and the Mode Control Panel. The MIP and its attachment to the cockpit structure shall be designed to be easily removable from the AFD. The MIP faceplate layout shall be modular to accommodate diverse future configurations. The support structure shall be designed so that it can remain in place while a different instrument layout is implemented. Ideally, instruments should be structurally supported from their faceplates. The initial configuration of the instruments and controls in the MIP shall be identical to the configuration of the MIP of the RFD. The Glare Shield structure shall house the Glare Shield instrumentation and Mode Control Panel, and shall be mounted to the MIP and the Cockpit Shell. However, it must remain separate and removable without removing the MIP. The interior skins of the AFD shall be designed such that individual components on the instrument panel, overhead panel, and center console may be easily removed and replaced with other panel arrangements to support research requirements. These skins shall support the lighting, speakers and ECS vents required and shall be identical to the RFD. Included in this task is the housing for the Side Arm Controllers. Since this is the fourth simulator to be manufactured, the molds for this effort already exist in the other simulators. The actual drawing work required for this task is therefore minimal. The most effort should be concentrated in the area of analysis. Also, where possible, flat aluminum panels shall be designed instead of molded ones. The Environmental Control System effort shall require design and analysis of the ducts, registers and gaspers needed to provide conditioned air to the AFD. The AFD ECS shall tie into the existing ECS on the B-757 aircraft. The

engineering design drawings shall be prepared with Pro/Engineer CAD source code. Paper and electronic copies of engineering and assembly drawings representing 'as-built' condition of deliverable hardware shall also be deliverables. Though hand analysis is acceptable, it is desirable that the Contractor provides analysis in either Patran or ProMechanica where possible. The final package for each item in this task include all ProEngineer, Patran and ProMechanica files, in the standard Mechanical Design Branch (MDB) format, the production drawing package and a formal analysis report with all associated notes. The Contractor shall be responsible for design related issues during fabrication and installation of the hardware. Bi-monthly status meetings shall be scheduled and held with the project engineer to provide design updates and resolve engineering development issues within the scope of this task. Additionally, the Contractor will be required to prepare and present a presentation in the scheduled Preliminary Design Review (PDR) and Critical Design Review (CDR) for their respective item.

[R1] The Contractor shall develop a model of the aircraft fuselage from station 560 to 700. The model shall include the actual deck structural members and associated structural components, a solid form representation of the fuselage structural components, and an envelope representation of the ECS and interior skin components. The model assembly shall also include the floor seatrail arrangement and floor beam stiffeners to be developed from information provided by the Government. Fabrication detail and assembly drawings of the modified floor beams shall be developed. The codes shall be generated such that they can be loaded into the existing database management system utilized by the Mechanical Design Branch.

Begin [R2] block

The Contractor shall provide additional modeling of the floor structure from Fuselage Stations 1240 to 1320 as necessary for required modifications to the aircraft floor beams at these locations. A search of aircraft drawings shall be performed to determine the exact structural arrangements at these locations and shall be used to develop the model. The model of this section shall be created in support of the CDR on Aircraft Modifications, to be held on Sept. 27th. An additional seat rail, as well as various doublers, shear webs, and tension straps shall be added to provide the structural integrity specified by NASA. NASA will provide a model of the structural members to be added to this assembly model. Assembly drawings of the flooring sections as well as the associated fabrication detail drawings of structural components shall be generated.

The Contractor shall provide engineering drawing detailing support for the AFD Shell structural members. NASA will furnish the shell model and information on any drawings that have been previously completed. The Contractor shall also support the design effort for modifications and additions to the shell model as additional brackets and hardpoints are required. Fabrication detail and assembly drawings of all of the AFD Shell structural members not completed by NASA will be developed. Existing individual parts will be renamed

Task Order Number: 23RFF Revision: 2 Date of Revision: 9/13/01
Title: B-757 Airborne Research Integrated Experiments System (ARIES) Laboratory Aft Flight Deck (AFD)

with their corresponding drawing numbers. A family table shall be created for each part; the instances will include the part as well as a flat pattern. Once the family tables are completed, part drawings shall be generated.
End R2 block

2.1 DELIVERABLES:

2.1.1	Preliminary MIP Package design		02/15/01
2.1.2	Preliminary Interior Skin design		02/15/01
2.1.3	Preliminary ECS design		02/15/01
2.1.4	PDR presentation support		02/15/01
2.1.5	Final MIP design		04/15/01
2.1.6	Final Interior Skin design		04/15/01
2.1.7	Final ECS design		04/15/01
2.1.8	CDR Presentation Support		04/15/01
R1 2.1.9	Assembly and integration configuration drawings	12/15/01	
2.1.10	Component analysis		04/15/01
** R1 Block Start **			
2.1.11	Hardware assembly and integration completion	(put it in ARIES)	04/02/01
2.1.12	As-built engineering data package		04/02/01
2.1.13	Final Engineering Operations Follow-up	06/30/01	
2.1.14	Preliminary floor structure Design model		04/15/01
2.1.15	Final floor structure modification fabrication drawings		06/15/01
2.1.16	Preliminary ECS design model		04/15/01
2.1.17	Final ECS design model		06/15/01
2.1.18	Fuselage Assembly model		06/29/01
** R1 Block End **			
Begin R2 block			
2.1.19	***Floor structure model***		***9/17/01***
2.1.20	***Floor bracket fabrication detail drawings***		***9/28/01***
2.1.21	***Family Table***		***9/28/01***
2.1.22	***Detail Items 25req***		***9/28/01***
2.1.23	***Detail Items 40req***		***10/31/01***
2.1.24	***Detail Items 40req***		***11/30/01***
2.1.25	***Additional bracket models***		***10/31/01***
2.1.26	***Additional bracket details***		***12/31/01***

End R2 block

Task Order Number: 23RFF Revision: 2 Date of Revision: 9/13/01

Title: B-757 Airborne Research Integrated Experiments System (ARIES) Laboratory Aft Flight Deck (AFD)

	2.2. 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 2.1.1 - 2.1.13 and the following criteria: 2.2.1. Ability to meet delivery schedules for all assemblies. Delivery within two weeks of stated milestones will constitute "MA" and delivery within a minimum of 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. 2.2.2. Manufacturability of designed components per Contractor-generated engineering detail drawings. 2.2.3. 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.	Government Furnished Items: R1 Access to specialized software will be furnished for the design of the deliverable items.
4.	Other information needed for performance of task: R1 Contractor shall have access to Government facilities to support this task, but not limited to fabrication, design and testing facilities. 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.
5.	Security clearance required for performance of work: None.
6.	Period of Performance: Planned start date: 01/02/01 Completion date: R1 12/31/01
7.	NASA Technical Monitor: James E. Price M/S: 432 Phone: 757-864-7079 NASA Competency/Other Technical Coordinator: Dr. Thomas Shull M/S: 430 Phone: 757-864-1837

Task Order Number: 24RAA Revision: 4 Date of Revision: 3/25/02

Title: CFD and Propulsion Analysis for Hypersonic Airbreathing Vehicles

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

This work will support the continued study of hypersonic airbreathing vehicles [R1] including lifting bodies, waverider vehicles, and vehicles with inward turning propulsion flowpaths. This work will initially focus on single-stage-to-orbit configurations which are included in the ABLV program. Two-stage-to-orbit configurations [R1] will also be studied. Vehicles with inward turning flow paths will be compared to a baseline lifting body vehicle which has a two-dimensional propulsion flow-path.

Task Technical Requirements will include:

Analytical studies of HTHL vehicles with inward turning flowpaths will be completed Vehicles with one or two propulsion flowpaths will be considered. [R1] Analytical studies of horizontal take-off, horizontal landing (HTHL) vehicles will be completed using CFD methods. Cruise vehicles in the Mach 4.5 to Mach 10 range may also be analyzed.

Revision 1: Deletes and adds requirements (See [R1] above and below).
Revision 2: Extends three schedule dates and the completion date to accommodate NASA's program emphasis (see [R2] below).
Change 1: Adjusts schedule and completion date to agree with approved Contractor task plan (see [C1] below).
Revision 3: Extends period of performance to 3/31/03 (see [R3] below).
Revision 4: Extends period of performance to 7/31/03 (see [R4] below).

2. Description of the Work to be Performed:

2.1 Scope of Work:
2.1.1 Complete three dimensional CFD analysis of the inlet for a vehicle with one inward turning propulsion flow path and perform SRGULL analysis of the propulsion system using the CFD results. (1/1/01 through [R1] ~~2/28/01~~ 4/30/01)
2.1.2 [R1] Deleted
2.1.3 Complete three-dimensional CFD analysis of the inlet for a vehicle with two-dimensional propulsion flow path and perform SRGULL analysis of the propulsion system using the CFD results. (4/1/01 through [R1] ~~4/30/01~~ 6/18/01)
2.1.4 Complete three-dimensional CFD analysis of nozzles for inward turning and two-dimensional propulsion flow paths. (5/1/01 through [R1] ~~9/30/01~~ 8/1/01)
[R1] 2.1.5 Complete three dimensional CFD analysis of one or more TSTO vehicles with staging Mach numbers of 4.5 or greater. (4/15/01 through 9/30/01)

2.2 Deliverables and Schedule:
2.2.1 The Contractor shall provide inlet and engine analysis results for vehicle with single inward turning flowpath. ([R1] ~~2/28/01~~ 4/30/01)
2.2.2 [R1] Deleted

	2.2.3 The Contractor shall provide inlet and engine analysis results for vehicle with two-dimensional propulsion flowpath. (R1 ~~4/30/01~~ R2 ~~6/18/01~~ 11/15/01) 2.2.4 The Contractor shall provide nozzle analysis results for vehicles with inward turning and two-dimensional propulsion flowpaths. (R1 ~~9/30/01~~ R2 ~~8/1/01~~ C1 ~~12/1/01~~ R3 ~~9/1/02~~ ***3/31/03***) R1 2.2.5 The Contractor shall provide CFD analysis results for one or more TSTO vehicles with staging Mach numbers of 4.5 or greater. The results shall include lift, drag, and heat load. (R2 ~~9/30/01~~ C1 ~~3/15/02~~ R3 ~~9/1/02~~ ***3/31/03***) 2.3 Metrics: 2.3.1 Meet schedule and cost. 2.3.2 Analysis performed with state-of-the-art methods and documented in presentations and copy in VAB official files. 2.4 Exceeds Minimum Requirements: 2.4.1 Novel use of methods to enhance efficiency without compromising quality. 2.4.2 Results presented in NASA contractor reports, AIAA Technical Reports, etc.
3.	Government Furnished Items: 3.1 Computational support in the form of specialized regression analysis. 3.2 Computer Resources: - Limited access to NAS
4.	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.
5.	Security clearance required for performance of work: Most of this work will be unclassified. Some of the work will require a secret clearance.
6.	Period of Performance: Planned start date: 1/1/01 Completion date: R2 ~~9/30/01~~ C1 ~~3/15/02~~ R3 ~~9/1/02~~ R4 ~~3/31/03~~ ***7/31/03***

7.	NASA Technical Monitor: Dennis Petley M/S: 365 Phone: 757-864-3759

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	

	Task Order Number: 24RBE Revision: 5 Date of Revision: 11/27/01 Title: Aeroacoustics Prediction Code Development

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

[R5] Subtask 1: As part of the NASA Quiet Aircraft Technology Program, it is required to study the scattering of the engine noise by wings and fuselage of the aircraft. One of the methods proposed by Langley researchers is using a ray acoustics method. The objective of this work is the development and validation of a computer code to implement this method.

Note: [R5]Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports.

For Revisions 1-4, see [R1,R2,R3, R4] in ETOS file *24RBE04u.doc*.
Revision 5: Extends the period of performance one year in continuation of NASA's support requirements, rescopes the requirements for the new period of performance around Subtask 3 while removing Subtasks 1 and 2, renumbering Subtask 3 as Subtask 1, and rewording NOR note (see [R5] above and below).

2. **Description of the Work to be Performed:**

1. [R5]***(formerly 3.)*** The Contractor shall perform the following requirements:
   a) Study and verify the analytic results derived and supplied by Langley researchers on geometrical and ray acoustics.
   b) Develop computer algorithms for code development.
   c) Specify surface and volume grids for aircraft geometric description and acoustic calculations.
   d) Develop ray acoustic codes based on the analytic results of Langley researchers.
   e) Validate the code against available experimental noise data.

   Deliverables shall include:
   A computer code in Fortran and a users manual describing in detail the input data, default values of input parameters and examples on the input and output. Also several cases of scattering of engine noise using realistic aircraft geometry must be run using the computer code developed . Comparison between measured and predicted data must be supplied to Langley researchers. Hard copies and electronic files of the computer code, the users manual and the computed cases of engine noise scattering must be delivered to Langley personnel.

Task Order Number: 24RBE Revision: 5 Date of Revision: 11/27/01

Title: Aeroacoustics Prediction Code Development

	Metric/Standard: Minimum acceptable performance is the delivery of an efficient Fortran code and the users manual. An experienced user should be able to modify a case with an available aircraft surface geometry in 30 minutes or less. Installation of an entirely new aircraft geometry should take under 24 hours. A given case should take less than an hour on one processor of an Origin 2000 computer. Significant surpassing of the minimum acceptable performance will be consideration for an "exceeds" standard. Schedule: May 1, 2001 through R5 ~~September 30,~~ December 31***, 2002***
3.	**Government Furnished Items:** R5 1: All aircraft surface geometries will be supplied by the Government. The Contractor will be allowed to use the SGI UNIX computers at Langley. Measured aircraft noise data for comparison with predicted noise data will be furnished by the Government. All aircraft operating conditions and microphone positions will be specified by the Government.
4.	**Other information needed for performance of task**: All software and codes developed will be property of NASA to use and distribute. 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.
5.	Security clearance required for performance of work: None.
6.	**Period of Performance:** Planned start date: R5 ***(Rescoped) Dec***. 1, 2001 Completion date: R5 December 31, ***2002***
7.	**NASA Technical Monitor:** F. Farassat M/S: 461 Phone: 757-864-3626 NASA Competency/Other Technical Coordinator: Lorenzo R. Clark M/S: 461 Phone: 757-864-3637

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 4 Statement of Work

Task Order Number: 24RDG Revision: 4 Date of Revision: 11/30/04

Title: Provide Electronic Cables, Connectors, Troubleshooting, and Electronic Interface Modification for Closed-Loop Test Hardware

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

Research conducted under the [R3]Vehicle Systems Program and Aviation Safety [R3]and Security Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. This research will lead directly to the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, [R2]to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions. This task will provide engineering technician support in these areas for research conducted under these programs.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the schedule and requirements for the new period of performance (see [R1] below).

Revision 2: Extends the period of performance one year in continuation of NASA's support with updated schedule for the new period of performance (see [R2] above and below).

Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with updated schedule for the new period of performance (see [R3] above and below).

Revision 4: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with updated schedule for the new period of performance (see [R4] below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements/subtasks:

1. Provide required cables (either by fabrication or acquisition), connections, troubleshooting, and modification of electronic interfaces to maintain the closed-loop simulation between the Quad-Redundant Flight Control Computer, the Honeywell [R1]Recoverable Flight Control Computer, the [R1]Honeywell VIA Computer, the [R4]***Distributed Flight Control System,*** and all other equipment and instrumentation in the [R1]Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory.

   Deliverables: Cables, connections, troubleshooting, and electronic circuitry modification as required to maintain the testbeds, equipment, and instrumentation in the SAFETI Laboratory.

   Schedule: Cables, connections, troubleshooting, shall be provided through

R4 ***12/31/05***.

Metrics: (Satisfactory Effort) Experiment down-time due to problems with cables or connections shall be less than 2 weeks.
(Exceeds) Experiment down-time due to problems with cables or connections shall be less than 1 week.

2. Fabricate custom equipment as assigned in support of the base and focused research projects and the SAFETI Laboratory.

Deliverables: Assigned custom equipment to support the SAFETI Lab.

Schedule: Fabrication of custom equipment shall be provided through R4 ***12/31/05***.

Metrics: (Satisfactory Effort) Delivery of custom equipment in 90 days.
(Exceeds) Delivery of custom equipment in less than 90 days.

3. Coordinate with the mechanical and electrical shops for all fabrication work.

Deliverables: Fabricated components from the electrical/mechanical shops.

Schedule: Coordination with fabrication shops shall be provided through R4 ***12/31/05***

Metrics: (Satisfactory Effort) Delivery of fabricated equipment in 90 days.
(Exceeds) Delivery of fabricated equipment in less than 90 days.

4. Develop, maintain, and provide all drawings and documentation of cables, connections, and circuitry.

Deliverables: Drawings and documentation of cables, connections, electronic circuitry.

Schedule: Drawings and documentation shall be provided through R4 ***12/31/05***

Metrics: (Satisfactory Effort) Drawings and documentation developed or updated in no more than 30 days.
(Exceeds) Drawings and documentation developed or updated in less than 30 days.

5. Provide routine maintenance for all printers associated with the Assessment

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Title: Provide Electronic Cables, Connectors, Troubleshooting, and Electronic Interface Modification for Closed-Loop Test Hardware

Technology Branch.

Deliverables: Routine maintenance of ATB printers.

Schedule: Routine printer maintenance shall be provided through [R4] ***12/31/05***

Metrics: (Satisfactory Effort) Printer down time not to exceed 1 day.
(Exceeds) Printer down time of less than 1 day.

6. Operate instrumentation in the [R1]SAFETI and/or HIRF Laboratory as assigned in support of bulk cable injection experiments.

Deliverables: Operation of equipment in support of bulk cable injection experiments.

Schedule: Operation of equipment shall be provided through [R4] ***12/31/05***.

Metrics: (Satisfactory Effort) Minimal experiment delay due to operation of equipment.
(Exceeds) No experiment delay due to operation of equipment.

7. The contractor shall operate instrumentation in the SAFETI Laboratory as assigned in support of experiments.

Deliverables: Operation of equipment in support of laboratory experiments.

Schedule: Operation of equipment shall be provided through [R4] ***12/31/05***.

Metrics: (Satisfactory Effort) Minimal experiment delay due to operation of equipment.
(Exceeds) No experiment delay due to operation of equipment.

3. Government Furnished Items:

Computer equipment, hardware, software, and equipment associated with the [R1]SAFETI Laboratory and a Desk-Top Workstation will be made available to the contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work is to be performed in NASA Langley Building 1220 on a non-interference basis.

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4.	**Other information needed for performance of task:** Manuals and schematics will be made available to the contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.
5.	**Security clearance required for performance of work:** Security clearance is not required.
6.	**Period of Performance:** Planned start date: R3 ~~1/1/01~~ R4 ~~1/1/04~~ ***1/1/05*** Completion date: R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***
7.	**NASA Technical Monitor:** Celeste M. Belcastro M/S: 130 Phone: 757-864-6182 NASA Directorate/Other Technical Coordinator: M/S: Phone: 757-864-

Task Order Number: 24RFI Revision: 7 Date of Revision: 2/24/04
Title: Gas Filter Correlation Radiometer (GFCR)

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

The objective of this task is to develop GFCR and Differential Absorption Radiometer (DAR) instrumentation and documentation.

The Gas Filter Correlation Radiometer (GFCR) is a fast-response, non-mechanical remote gas sensor being developed by NASA for measurement of trace gas species. NASA applications include measurement of tropospheric, stratospheric, or mesospheric constituents from space. 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).

Revision 1: Travel requirement added in section 4 and schedule adjustment I Task #1. ([R1])
Revision 2: Extends the period of performance nine months in continuation of NASA's support requirements and redefines the requirements for the new period of performance as: (1) deletes Task#4 since SPX Inc. decided not to expand the data acquisition system, (2) changes the schedule and criteria of Task #5, and (3) adds Tasks#7 and 8 (see [R2] below).
Revision 3: Extends the period of performance and schedule in 8.2 to August 31, 2003 (see [R3] below).

Revision 4: Adds material purchase requirement in Section 4 and new requirements as (Sub)task #9 and extends the period of performance to October 31, 2003 (see [R4] below).

Revision 5: In NASA's interest for technical completeness, extends the period of performance and (sub)Tasks #8 and #9 schedule to December 31, 2003 (see [R5] below).

Revision 6: Extends the period of performance two months to February 29, 2004 in continuation of NASA's support with some added requirements in (sub)Task 9.1 for the new period of performance (see [R6] below).

Revision 7: Extends the period of performance two months to April 30, 2004, and adds new requirements as (sub)Tasks 10-12 (see [R7] below).

2. **Description of the Work to be Performed:**

Task #1 Mechanical Drawings of Prototype Sensor

1.1 Contractor with Technical Monitor shall complete conceptual mechanical design of prototype sensor.
1.2 Contractor shall complete shop-ready mechanical drawings in Pro Engineer format.

Schedule
Deliver mechanical drawings by [R1]June 30, 2001.

Criteria
Meets
Deliverables provided on schedule.
Exceeds
Deliverables provided 2 weeks ahead of schedule.

Task#2 Characterization of NASA/SPX Prototype Sensor Components
2.1 Contractor shall characterize the performance of the following components for the 4-channel prototype sensor:
2.1.1 Photodetectors – relative D* as a function of temperature; frequency response
2.1.2 Gas cells – using FTIR measure spectral transmission upon receipt and 3 months afterward
2.1.3 Waveplate – measure phase retardation versus wavelength and versus incident angle
2.1.4 Optical Filters – using "collimated" FTIR measure spectral transmission
2.1.5 Photo-elastic modulator – measure phase retardation versus incident angle and location on aperture
2.1.6 Source filament – measure filament temperature
2.1.7 Beam divider/combiner (GUTS) – using HeNe laser produce interferogram between output beams
2.2 Contractor shall submit reports of the above results to Technical Monitor.

Schedule
Reports submitted to Technical Monitor within 2 months of receipt of components.

Criteria
Meets
Results of performance tests delivered within 2 months of contractor receiving component.
Exceeds
Results of performance tests delivered within 1.5 months of contractor receiving component.

Task#3 Assembly of Prototype Sensor
3.1 Contractor shall assemble 4-channel prototype sensor from parts ordered from manufacturers and parts machined from mechanical drawings discussed in task#1.

Schedule
Complete assembly two months after receiving all parts and components.

Criteria
Meets
Complete assembly two months after receiving all parts and components.
Exceeds

Complete assembly one month after receiving all parts and components.

Task#4. R2Deleted

Task#5 Experimental demonstration/tests of prototype sensor performance

5.1 Contractor shall experimentally determine $H_2O(v)$ interference effects for the NO gas channel.
5.2 Contractor shall conduct experiments to assess the measurement sensitivity of the NO gas channel.
5.3 Contractor shall laboratory demonstrate the operation of the 4-channel prototype.
5.4 Contractor shall conduct on-road demonstrations of the 4-channel prototype.
5.5 Contractor shall provide documentation from the experiments to the Technical Monitor.

Schedule
R2Demonstrations shall be completed by July 1, 2002.

Criteria
Meets
R2Demonstrations completed on schedule.
Exceeds
R2Demonstrations completed 1 month ahead of schedule.

Task# 6 Instrument Model Improvements

6.1 Contractor shall enhance the instrument model by including the following parameters/effects:
- 6.1.1 Spectral characteristics of the sapphire cell windows.
- 6.1.2 Spectral characteristics of the 45-degree incidence filters in the aft optics.
- 6.1.3 Spectral emission of the filament source.
- 6.1.4 Detector response versus wavelength.
- 6.1.5 Temperature dependence of interference filters.

6.2 Contractor shall provide documentation demonstrating the above enhancements.

Schedule
Provide documentation by June 1, 2001

Criteria
Meets
Deliverables provided on schedule.
Exceeds
Deliverables provided 1 week ahead of schedule.

Begin [R2] block requirements redefinition

Task# 7 Prototype Demonstration-Related Tasks

7.1 Contractor shall design and assemble a facility to conduct "drive by" tests of the prototype sensor.
7.2 Contractor shall write software automating the arming and sampling of the data acquisition system for vehicle "drive-by" demonstrations.
7.3 Contractor shall reduce two CO2 and two CO signals from selected drive-by demonstrations to enable assessment of the measurement linearity correction technique.

<u>Schedule</u>
Complete tasks by July 1, 2002.

<u>Criteria</u>
Meets
Deliverables provided on schedule.
Exceeds
Deliverables provided 1 month ahead of schedule.

Task# 8 Remote CH4 Sensing Feasibility Study

8.1 Contractor shall modify and utilize the instrument model for the following purposes:
- 8.1.1 Optimize instrument design parameters (e.g. bandpass filter specs, correlation cell parameters, etc.)
- 8.1.2 Estimate CH4 sensitivity and artifact signal from air-ground difference temperature.
- 8.1.3 Estimate ability of N2O channel to detect and potentially correct artifact signal from air-ground difference temperature.

8.2 [R6](Cancelled due to funding considerations)

<u>Schedule</u>
Provide results of above theoretical studies by [R3] ~~September 30, 2002~~ October 1, 2002 and results of experimental studies by [R5R3]~~August 31, 2003~~ December 31, 2003.

<u>Criteria</u>
Meets
Deliverables provided on schedule.
Exceeds
Deliverables provided 1 month ahead of schedule.
End [R2] block requirements redefinition

Begin [R4] block addition

Task# 9 Develop and Test Sensor Digital/Analog Electronics System

9.1 Contractor shall develop and test digital/analog electronics with the following capabilities:

(a) Control sensor parameters through D/A and Digital Output boards.
(b) Acquire and process data through A/D boards.
(c) Acquire wavelength data through analog LIA (lock-in-amplifier) boards.

Begin R6 block addition

(d) Design and test PC board for control of optical shutter.
(e) Design and test power supply for electronics system.
(f) Design and test PC board for 3F filters.
(g) Integrate subsystems (c) through (f) into one rack mountable cage

End R6 block addition

Schedule

Provide above electronics by R5~~October 31, 2003~~ R6~~December 31, 2003~~ ***February29, 2004***.

Criteria

Meets

Complete above electronics system for 1 gas channel.

Exceeds

Complete above electronics system for R6~~2~~ 3 gas channels.

End R4 block addition

*****Begin R7 block addition*****

Task# 10 Software Development for Digital/Analog Electronics

10.1 Contractor shall develop/test Lab View code to communicate with PC boards developed under Task #9 above. Software shall:

(a) Control light source parameters.
(b) Acquire and process data.
(c) Stabilize wavelength.
(d) Control shutter operation.

10.2 The Contractor shall test software/hardware communication and optimize software/hardware as necessary.

Schedule

Provide operating software by April 30, 2004.

Criteria

Meets

Complete above electronics system for 1 gas channel.

Exceeds

Complete above electronics system for 3 gas channels.

Task# 11 Integrate Electronics into System Chassis

11.1 Contractor shall design, assemble and test chassis containing electronics developed and optimized in tasks #9 and 10 above.

(a) Chassis shall contain all PC boards developed in previous tasks.
(b) Through input/output connectors and back planes, electronics shall connect with system computer and optical system.
(c) Chassis shall include manual "enable" and light source selection switches.
(d) Chassis shall include one display per gas channel.
(e) Chassis shall be tested with software developed in task #10 and modified if necessary.

Schedule

Provide above electronics chassis by April 30, 2004.

Criteria

Meets

Complete electronics chassis on schedule.

Exceeds

Complete electronics chassis by April 23, 2004.

Task# 12 Develop Chopper-less Sensor Capability

12.1 Contractor shall test optical detector/preamp and, if necessary, redesign to enable chopper-less sensor operation.

(a) Test LN2-cooled detectors for DC shift associated with LN2 servicing, LN2 reservoir pressure variations, and temperature variations of preamp and surroundings.
(b) Develop pressure relief system to stabilize LN2 reservoir pressure.
(c) Model cold aperture baffling of detector and redesign if necessary.

Schedule

Complete testing and component redesigns by April 30, 2004.

Criteria

Meets

Complete Task #12 by April 30, 2004.

Exceeds

Complete Task #12 by April 23, 2004.

Task# 13 Design new XYZ mounts for collimating lenses

13.1 Contractor shall design, assemble and test hardware for new XYZ mounts.

(a) Design and provide CAD drawings for adapter plates to accommodate Optosigma linear stages into XYZ configuration.
(b) Assemble XYZ stages, install in sensor and check for proper function.

Schedule

Provide above electronics by April 15, 2004.

Criteria
Meets
Complete by April 15, 2004.
Exceeds
Complete by April 8, 2004
End R7 block addition

3. Government Furnished Items:

For the purpose of developmental tests and performance demonstration, access to the following, in Room 262 of Building 1202:

- 5µm GFCR sensor
- IBM Compatible PC, Pentium or better with operating system software
- Commercial data acquisition and control system, including operating software (Lab Windows, PC Hitran)
- Laboratory power supply

- 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.
- The vacuum bell jars located in B1250 may be used to conduct the vacuum tests described in task #4.

4. Other information needed for performance of task:

R1 Some travel for technical interchange required.
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.
R4 In order to perform subtasks in a timely manner, material purchase may be required.

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

6. Period of Performance:

Planned start date: January 1, 2001 Completion date: R2 R3 ~~September 30, 2002~~
R4 ~~August 31, 2003~~
R5 ~~October 31, 2003~~
R6 ~~December 31, 2003~~
R7 ~~February 29, 2004~~
April 30, 2004

7.	**NASA Technical Monitor:** Glen Sachse M/S: 472 Phone: 757-864-1566 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

	Task Order Number: 25RAA Revision: 3 Date of Revision: 10/18/02 Title: Airbreathing Launch Vehicle (ALBV) Studies

1.	**Purpose, Objective or Background of Work to be Performed:** **Begin R2 block requirements redefinition** This work will support the Revolutionary Aerospace Systems Concepts (RASC) program. Engines examined include turbojets, dual mode ramjets, and Rocket Based Combined Cycle (RBCC) systems. Emphasis is now being placed on two stage to orbit (TSTO) systems in a horizontal take-off / horizontal landing design with the upper stage being rocket and/or airbreather propelled. Task Technical Requirements: Studies will be performed on HTHL lifting-body and wing-body/waverider TSTO systems with airbreathing 1st stages and rocket power/airbreather upper stages. A design study will be performed on HTHL cruise and TSTO systems with airbreathing 1st stages and rocket power or RBCC upper stages. The cruise mission is 6500 nm in 3 hours or less. The TSTO mission is to be 10 klb to ISS under the Airbreathing Launch Vehicle Program (ABLV) design requirements (margins, etc.). **End R2 block requirements redefinition** Revision 1: Deletes/adds new requirements including deliverables, clarifications, typo corrections, and GFI contract compliance and extends the completion date accordingly. (For details of issued original and revision 1 SOWs see ETOS files *25RAA.doc, 25RAA01v.doc*, respectively) Revision 2: Extends the period of performance nine months in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see R2 above and below). Revision 3: Extends the period of performance to 3/31/03 (see R3 above and below).
2.	**Description of the Work to be Performed:** **Begin R2 block requirements redefinition** 2.1 Scope of Work: The Contractor shall re-size/modify global transport (GT) cruise vehicles and design and analyze orbital transports (OT) including 2STO and 3STO vehicles which use the GT vehicle as the first stage as follows: 2.1.1 Re-size/modify a waverider turbojet cruise vehicle to be used as a hydrocarbon fueled Mach 4.5 GT and first stage of OT. 2.1.2 Design and aerodynamic analysis of a vehicle with turbojet waverider first stage _ Stage at Mach 4.5 and Mach 8 with top rear integration of the two upper stages: Mach 4.5-8 airbreather and Mach 8-LEO rocket orbiter. 2.1.3 Re-size/modify a lifting body turbojet cruise to be used as a hydrogen fueled Mach 4.5 GT and first stage of OT. 2.1.4 Design and aerodynamic analysis of a vehicle with turbojet lifting body first stage _ Stage at Mach 4.5 with double boosters and top integration of RBCC orbiter.

2.2 Deliverables and Schedule:

2.2.1 Updated waverider turbojet cruise vehicle for Mach 4.5 GT and first stage of OT. (3/1/02)

2.2.2 Design and aerodynamic analysis of for the 3-stagevehicle described in 2.1.2. (5/1/02)

2.2.3 Updated lifting body turbojet cruise vehicle for Mach 4.5 GT and first stage of OT. (6/1/02)

2.2.4 Design and aerodynamic analysis of for the double booster vehicle described in 2.1.4. ([R3]~~11/1/02~~ ***3/31/03***)

End [R2] block requirements redefinition

2.3 Metrics:

2.3.1 Meet schedule and cost.

2.3.2 Analysis performed with state-of-the-art methods and documented in presentations and copy in VAB official files.

2.4 Exceeds Minimum Requirements:

2.4.1 Novel use of methods to enhance efficiency without compromising quality.

2.4.2 Results presented in NASA Contractor reports, AIAA Technical Reports, etc.

3. **Government Furnished Items:**

3.1 Computational support in the form of specialized regression analysis.

3.2 Computer Resources:
- Limited access to NAS
- Limited access to NASA's Consolidated Supercomputing facility
- Access to secure Cray J90 (8 CPU's, 4 GIGABYTES RAM)
- Suns, SGI workstations on secure and open networks

3.3 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
- MASCTHERMAL – HYPERSIZER – I3G – ACAD – AML
- Other desktop software for word processing, graphics generation, spreadsheets, PC based math codes, communication tools, etc.

3.4 Special furniture: safes for storage of classified material

4. **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.

5.	**Security clearance required for performance of work:** For most of the work to be performed a secret clearance will be required.
6.	**Period of Performance:** Planned start date: 1/1/01 Completion date: R2 ~~2/1/02~~ R3 ~~11/1/02~~ ***3/31/03***
7.	**NASA Technical Monitor:** Dennis Petley M/S: 365 Phone: 757-864-3759 NASA Competency Coordinator: M/S: Phone:

Task Order Number: 25RBG Revision: 7 Date of Revision: 2/22/05

Title: Virtual Diagnostics Interface (ViDI)

1. **Purpose, Objective or Background of Work to be Performed:** (This is an extensive update of 25RBG requirements.)

Begin R6 Block Update

The work performed under this task will be for development and testing of Virtual Diagnostics Interface (ViDI) technology. The ViDI technology developed within this task will be targeted for (a) enhancements to a ViDI-based flow visualization system previously developed for the NASA LaRC Unitary Plan Wind Tunnel (UPWT), (b) DGV instrumentation system layout for upcoming tests in the UPWT and within an S-inlet duct, (c) Vision-system development for guidance, navigation, and control of personal air vehicles, and (d) Rapid Technology Assessment projects for enhanced wind tunnel testing. Funding for these efforts will be provided from a number of different sources within the NASA Vehicle Systems Program and NASA LaRC Wind Tunnel Service Activity.

End R6 Block Update

Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as doc files 25RBG, 25RBG01, 25RBG02, 25RBG03, 25RBG04, and 25RBG05.

Revision 6: Extends the period of performance 8 months in continuation of NASA's support with requirements redefined for the new period of performance (see R6 above and below).

Revision 7: Extends the period of performance four months to November 30, 2005 in continuation of NASA's support with extended (Subtask 3), descoped (Subtask 5), and added (Subtasks 6-8) requirements and redefined required travel (see R7 below).

2. **Description of the work to be performed**

The Contractor shall perform the following requirements:

Begin R6 Block Update

Subtask 1: The Contractor shall perform software enhancements to the LiveView3D ViDI-based flow visualization system previously delivered under this task in FY2004. The software enhancements shall provide the capability of the LiveView3D system to interface with the UPWT data acquisition system (DAS). This will allow the LiveView3D system to receive wind tunnel parameters (Test, Run, Point, Mach, Q, AoA, pressures, etc.) from the DAS for display to the user. The software shall also provide the capability to construct real-time (e.g. plotted immediately after the acquisition of each test point) chord plots of surface pressure measurements obtained from pressure taps within the model. At a minimum these chord plots will be of conventional X-Y format (pressure vs. chordwise location). Alternate representations of the surface pressure distribution are welcome and will be considered to exceed minimum requirements. The user should have the ability to select which row(s) of pressure taps to plot in the event that multiple chordwise rows of taps are present on the model. The software enhancements will also automatically adjust the angle-of-attack (AoA) of the virtual wind tunnel model in the ViDI environment according to the actual AoA indicated by the tunnel DAS. The software shall also provide the ability to show dynamic, vectoral representations of the axial and lift forces indicated by the DAS. Similar representations of the model pitch, roll, and yaw moments are welcome and will be considered to exceed minimum requirements. All visual representations of tunnel DAS data should be provided as an option to the user, so the user may select which of the visual elements to turn on/off for display. The software shall also provide the ability for the user to save the visual representations, in either still images or movie format, for future recall and display. The Contractor shall rigorously test all software developed under this subtask to ensure bug-free execution under nominal operating conditions and proper functionality. The Contractor shall provide thorough written documentation describing the functionality of each new software feature, user instructions on how to use each new feature, and any hardware / software dependencies. This documentation may be an amendment or revision of prior documentation established for the LiveView3D system under this subtask, but the complete set of documentation must be provided. The Contractor shall install the upgraded software and documentation on the UPWT LiveView3D-designated computer and conduct demonstrations showing its capabilities. The Contractor shall provide introductory training to UPWT personnel on how to use the enhanced LiveView3D system.

Deliverables: The Contractor shall provide:

1. Software revisions to the ViDI-based LiveView3D system to extend its capabilities as described in the subtask description.
2. System administration services to install the enhanced LiveView3D software on the UPWT LiveView3D computer and test.
3. Demonstrations of the enhanced LiveView3D system showing its capabilities.
4. Full documentation of the LiveView3D system, including instructive user manuals.
5. Detailed software documentation that identifies (a) compilers used, (b) external software dependencies (e.g. custom *.dlls), (c) hardware dependencies, (d) installation instructions.
6. A CD containing all source code, scripts, ActiveX controls, and executable code developed for the LiveView3D system, including a readme.txt file describing the contents of the disk.
7. Personal introductory training to designated NASA personnel on the operation and use of the LiveView3D system.
8. Contractor developed software and documentation shall be provided to the government for unrestricted government use and duplication.

Schedule: This subtask shall be completed by April 30, 2005

Metrics:

The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Rate of software development, judged on the likelihood that the software will be completed to specification by the contracted date
2. User friendliness of the software and its level of functionality
3. Level of detail of the LiveView3D system documentation and software documentation.

Standards:

Minimum Acceptable Performance Standards:

1. Completion of this subtask within the specified time and contracted cost
2. Delivery of all deliverables specified for this subtask.
3. Software developed must be fully functional and bug free under nominal operating conditions

Exceeds minimum performance standards: The Contractor can exceed minimum performance standards by providing either one of the following:

1. Adding the capability to have different real-time visual representations of the wind tunnel model surface pressure distribution measured using pressure taps
2. Adding the capability to have a vectoral representation of pitch, roll, and yaw moments as indicated by the wind tunnel DAS.
3. Preparing and presenting at least one paper on the LiveView3D capability at a scientific conference.

Subtask 2: R7 ***Complete***

End R6 Block Update

Subtask 3: The Contractor shall provide interrelated experiment system administration, network support, and computer programming support within the LaRC Advanced Sensing and Optical Measurement Branch (ASOMB). The Contractor shall develop, test, and implement code modules for advanced instrumentation systems and the Virtual Diagnostics Interface (ViDI). Codes shall be written in C/C++ and Visual Basic programming languages. The Contractor shall also write ViDI subelements in the 3D-Studio MaxScript programming language. All code developed under this subtask shall be thoroughly tested for functionality and robustness prior to delivery to NASA.

Deliverables: The Contractor shall provide the following interrelated experiment system

deliverables:
1. System administration and network support for ASOMB computer systems
2. System administration of the ASOMB ADAPT computer site

Begin R6Block Update
3. Web page design and authoring for the ASOMB web site
4. System administration of the ASOMB web site
5. System administration of the ASOMB multi-viewport flight simulator

End R6Block Update
6. Validated code modules for use in the ViDI environment for display and manipulation of scientific data sets.

Schedule: Subtask 3 shall be completed by R7R6~~July 31, 2005~~ ***November 30, 2005***.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:
1. Code quality, efficiency, and robustness, based on achieving the desired functionality without significant code overhead, with error-free code
2. Rate of software development

Standards: Minimum acceptable performance standards:
1. Providing all deliverables for this subtask within the specified time and contracted cost
2. Delivery of error-free code with documentation describing the functionality of the code, the scope of its operation, and internal/external software and/or hardware dependencies.

Exceeds Minimum Standards: The Contractor can exceed the minimum performance standards by either:

Begin R6Block Update
1. Organizing, identifying, tagging, and storing old CRT-based computer monitors in a centralized storage location (such as the B1200 wind tunnel mezzanine), or
2. Assisting in performing preparation and archival of large data sets obtained by ASOMB branch members in wind tunnel or flight tests.

Subtask 4: The Contractor shall provide ViDI support for determining the optimal placement of Doppler Global Velocimetry (DGV) fiber-bundled receivers for velocity measurements within an S-inlet duct. The primary DGV configuration is assumed to consist of (a) up to three independent receivers placed at locations either internal or external to the duct, and (b) multiple different light sheet planes illuminating the cross-section of the duct, at various locations along the duct centerline, from the duct inlet to exit. The Contractor shall develop ViDI simulations that accurately depict the view of the DGV receiver(s) when imaging a dot card calibration target (or similar as determined by the government) when positioned at different axial locations along the length of the duct. The position and focal length of the receivers will be variable, with the overall objective being to identify where the receivers must be located to obtain the required receiver field-of-view characteristics for different positions of the calibration target within the duct. The receiver imaging characteristics will be as modeled under Subtask #2 of this task. Once the appropriate receiver locations are determined for various positions of the dot card, the Contractor shall simulate laser illumination of the dot card plane from up to four illumination ports, placed circumferentially about the duct at the axial location of the dot card. The divergence specifications of the laser illumination shall be provided by the government. The Contractor shall determine the common area within the receiver field-of-view illuminated from 1, 2, 3, or 4 circumferential ports.

The simulations will likely result in the identification of several different "optimal" DGV system configurations to measure velocities in general regions within the duct. Determination of the "optimal" DGV system configuration(s) will be made by NASA personnel. Once the optimal configuration(s) have been determined, the Contractor shall write a summary report documenting the DGV system configuration(s) and expected illumination / receiver characteristics.

Deliverables: The Contractor shall provide:

1. A ViDI model of the S-inlet duct, not specific to any particular LaRC facility;
2. ViDI renderings, still graphics, and animations that simulate the DGV illumination planes and fiber bundled receiver system views within the S-inlet duct for all configurations investigated (non-optimal as well as optimal);
3. A summary report, with descriptive still images and captions, that documents the "optimal" DGV system configuration(s) and expected illumination / receiver characteristics for application to the S-inlet duct;
4. All ViDI models / documentation / imagery / animations produced as work product for this subtask shall be provided on CD/DVD to the government for unrestricted use and duplication.

Schedule: Subtask 4 shall be completed by July 31, 2005.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Rate of ViDI simulation development, judged on the likelihood that the Contractor will produce the deliverables within the contracted time and cost.
2. Level of detail and quality of the graphics/animations produced.
3. Quantitative accuracy and photorealism of the simulations.

Standards:

Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Acceptable Standards: The Contractor can exceed minimum performance standards by providing:

1. ViDI "fly-by" or overview animations of the DGV setup in/about the S-inlet duct (including sequential illumination from multiple light sheet ports) for the purposes of illustrating the test configuration in presentations.

Subtask 5: The Contractor shall provide support for the development of a Vision-based Guidance, Navigation, and Control system for personal air vehicles. Under this subtask, the Contractor shall provide science and engineering expertise to team participants based on experience piloting general aviation aircraft. The Contractor shall participate in all pre-and post-test meetings required for obtaining multi-camera flight video from the NASA OV-10 aircraft on various approaches and landings at different local community airports, and runway hazard flyovers at NASA Wallops. In collaboration with NASA personnel, the Contractor shall author and/or co-author documentation required for conducting the flights (both pre- and post-flight) on-board the NASA OV-10. The Contractor shall prepare flight video and associated data sets acquired during the OV-10 flights for distribution to other project partners. R7~~The Contractor shall provide assistance in performing the analysis of the flight video. The Contractor shall provide expertise for operating the ASOMB multi-viewport flight simulator. The Contractor shall use the Vision System Design Tool previously developed under this task to develop simulated aircraft approaches and landings to establish sample data sets for algorithm testing. The Contractor shall provide support for integrating the ASOMB multi-viewport flight simulator with the NASA LaRC Naturalistic Flight Deck.~~

Deliverables: The Contractor shall provide:

****Begin R7block descope*****

Cataloged and archived video tapes and data files collected during the execution of the research flights on the NASA OV-10.

1. ~~Using the Vision System Design Tool, animations and still image series of simulated aircraft approaches and landings for use as software testing and validation data sets (minimum 5 different test cases).~~
2. ~~Prototype software required to interface the ASOMB multi-viewport flight simulator with the NASA LaRC Naturalistic Flight Deck~~
3. ~~Software documentation for the software developed as deliverable #2 under this subtask.~~
4. ~~Using the multi-viewport flight simulator, the stored simulations of approaches~~

~~and landings at different airports in different flight scenarios. Minimum 10 different test cases.~~

5. ~~All work product delivered under this subtask will be delivered to the government on CD/DVD for unrestricted use and duplication.~~

****End [R7]block descope*****

Schedule: Subtask 5 shall be completed by [R11]~~July 31, 2005~~ ***March 15, 2005***.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Level of participation in OV-10 flight activities (both pre- and post-flight)
2. [R7]~~Rate of progress towards achieving systems integration between the ASOMB multi-viewport flight simulator and the Naturalistic Flight Deck~~
3. Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.

Standards:

Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost

Exceeds Minimum Acceptable Standards: The Contractor can exceed minimum performance standards by providing:

1. Prototype software to test various published image processing algorithms for runway detection and tracking and obstacle detection and classification.

End [R6]Block Update

****Begin [R7]block addition*****

Subtask 6: The Contractor shall provide graphics design assistance in the development of materials for marketing capabilities and technologies developed within the Advanced Sensing and Optical Measurement Branch. These services include the draft conceptual designs of posters and brochures that highlight ASOMB capabilities that are suitable for distribution to potential external customers. Upon ASOMB management approval, the Contractor shall finalize the draft poster and brochure designs and prepare them for printing.

Deliverables: The Contractor shall provide:

1. Draft and final designs for a poster(s) (standard poster size) that highlight the measurement science capabilities within ASOMB, intended to solicit future business

from both NASA and non-NASA partners;
2. Draft and final designs for a brochure that highlight the measurement science capabilities within ASOMB, intended to solicit future business from both NASA and non-NASA partners;
3. Draft and final designs for posters that provide details about specific technology areas within ASOMB, such as (a) molecular flow diagnostics, (b) particle-based diagnostics, (c) structural diagnostics, (d) virtual diagnostics, (e) Surface Properties, (f) Nanosensors, and (g) innovative measurement concepts.

Schedule: Subtask 6 shall be completed by May 2, 2005.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.

Standards:
Minimum acceptable performance standards:
1. Providing all deliverables for this subtask within the specified time and contracted cost.
2. Poster and brochure designs must be highly graphical and informational, and of professional-looking quality.
Exceeds Minimum acceptable performance standards: The Contractor can exceed minimum performance standards by providing:
1. Draft designs of posters highlighting specific techniques (e.g. DGV, PMI, ViDI, PSP, etc.) under development within ASOMB for dissemination and display.

Subtask 7: The Contractor shall provide support for the Nosecone Deployment Trajectory Tracking Test to be conducted in the NASA Langley 8-Foot High Temperature Tunnel, March, 2005. The Contractor shall participate in all pre-test planning meetings and coordinate the acquisition, processing, and analysis of high speed video of the nosecone shroud deployment. The Contractor shall participate in calibration of the high speed video system in the 8-HTT. Two nosecone shrouds will be deployed during this tunnel entry. The Contractor shall use ViDI technology to develop post-test animations of the nosecone shroud trajectory using shroud position data produced under SAMS Task 14RBG. The Contractor shall perform cursory analyses of the nosecone trajectory to investigate fundamental properties of the deployment, such as general observations of fall position, roll rate, and comparisons of trends between the two different nosecone shrouds. In-depth data analysis of the trajectory data is beyond the scope of this subtask. The Contractor shall prepare the animations and co-author professional quality summary reports, including generalized trajectory observations, for delivery of the data to the test customer. The Contractor shall engage in post-test correspondence with the test customer to ensure customer satisfaction with the data / report / animation quality and to clarify any questions the customer may have.

Deliverables: The Contractor shall provide CDs / DVDs containing:
1. ViDI-based animations of the nosecone shroud trajectory data produced under SAMS task 14RBG for both nosecone shrouds.
2. Excel Spreadsheets containing the time-dependent trajectory data produced by SAMS Task 14RBG – both shrouds.
3. Professional quality summary reports describing the high speed video acquisition, data processing, data analyses, and animations. This report must include a best-effort estimation of the trajectory data accuracy.

Schedule: Subtask 7 shall be completed by May 2, 2005.

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

1. Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.

Standards:
Minimum acceptable performance standards:
1. Providing all deliverables for this subtask within the specified time and contracted cost.
2. Maintaining correspondence with customer to ensure customer satisfaction

Exceeds minimum acceptable performance standards: The Contractor can exceed minimum performance standards by providing either one of the following:
1. Providing additional animations or still-image renderings of the nosecone trajectory data to satisfy post-test customer requests.
2. Using ViDI technology to map Infrared Thermography imagery to the nosecone shrouds prior to deployment.

Subtask 8: The Contractor shall provide on- and off-site training to Air Force Research Laboratory – Air Vehicles Directorate staff to instruct them on the use of the Virtual

Diagnostics Interface for generalized wind tunnel testing. Additionally, the Contractor shall transfer the LiveView3D Enhanced Flow Visualization System technology (Version 1 – not including enhancements as performed under Subtask 1 of this task) to AFRL for their use. This cooperative agreement is sanctioned by Interagency Agreement IA1-568 Annex #9.

Deliverables: The Contractor shall provide:

1. A list of recommendations/specifications/sources for the computer hardware and software required for AFRL-VA to establish their own ViDI and LiveView3D capability;
2. Provide two weeks of hands-on ViDI training and mentoring at LaRC to up to two AFRL-VA personnel;
3. Provide an additional one week of hands-on ViDI training and mentoring at WPAFB to the same group of AFRL-VA personnel;
4. Provide CDs or DVDs containing pertinent ViDI models, scripts, code modules, and documentation for generalized use of ViDI for wind tunnel testing at WPAFB;
5. Provide two (2) additional weeks (distributed over several months) of periodic phone and e-mail support/instruction/correspondence;
6. Provide CDs or DVDs containing the LiveView3D software (Version 1 - executable code only) and User's Guide documentation;
7. Provide system integration services at WPAFB to configure a LiveView3D system for AFRL-VA use;
8. Demonstrate and instruct the use of the AFRL-VA LiveView3D system for enhanced real-time flow visualization.

Schedule: The following deliverables schedule must be met to remain in compliance with the terms of the interagency agreement:

1. Deliverable #1: by March 15, 2005
2. Deliverable #2: by July 29, 2005
3. Deliverable #3: by September 30, 2005
4. Deliverable #4: by July 29, 2005
5. Deliverable #5: by November 30, 2005
6. Deliverable #6: by September 30, 2005
7. Deliverable #7: by September 30, 2005
8. Deliverable #8: by September 30, 2005

Metrics: The following metrics will be used to assess the Contractor's progress towards meeting the standards:

Task Order Number: 25RBG Revision: 7 Date of Revision: 2/22/05

Title: Virtual Diagnostics Interface (ViDI)

1. Rate of progress towards meeting the deliverables, judged on the likelihood that the Contractor will be able to provide the stated deliverables, with reasonable quality, within the contracted cost by the contracted date.
2. Ability to adhere to the deliverables schedule
3. Quality of preparation of training materials prior to training AFRL staff

Standards:

Minimum acceptable performance standards:

1. Providing all deliverables for this subtask within the specified time and contracted cost.
2. Closely adhering to the deliverables schedule

Exceeds Minimum acceptable performance standards: The Contractor can exceed minimum performance standards by:

1. Provide mentoring assistance to AFRL-VA personnel in the construction of ViDI models for the AFRL/WPAFB Trisonic Gas Facility (TGF).

****End R7 block addition*****

3. **Government Furnished Items:**

R6 Office and laboratory space will be provided in Building 1200. Desk/work areas with Pentium desktop computers, printers, and necessary software and supplies will be provided. All specialized hardware and software requirements discussed in Subtasks 1 - ***5*** will be provided for these efforts.

4. **Other information needed for performance of task:**

The Contractor must be suitably trained in laser safety and follow the laser safety guidelines outlined in LHB 1710.8 when using lasers in a NASA Langley facility.

Begin R6 Block Update

Travel for one contract personnel is anticipated to present a paper on the LiveView3D system at the 22nd IEEE Instrumentation and Measurement Technology Conference, Ottowa, Ontario, Canada, May 17-19, 2005.

R7 ~~Travel for two contract personnel is anticipated for participation in flight testing at NASA Wallops, Wallops Island, VA. Both personnel to be present on the same trip. This will be a one night trip occurring in mid-December, 2004. Transportation will be via government-owned vehicle.~~

End R6 Block Update

R7 ***Travel for one contract personnel is anticipated for two one-week trips to Wright-Patterson AFB, Dayton, OH to deliver on-site ViDI training to AFRL-VA staff, and to configure and demonstrate a LiveView3D system for use in AFRL-VA facilities.***

	Task Order Number: 25RBG Revision: 7 Date of Revision: 2/22/05 Title: Virtual Diagnostics Interface (ViDI)

5.	**Security clearance required for performance of work**: All work will be unclassified.
6.	Period of Performance: Planned start date: R6 12/01/04 Completion date: R7R6 ~~7/31/05~~ ***11/30/05***
7.	NASA Technical Monitor: Gary A. Fleming M/S: 493 Phone: 757-864-6664

Task Order Number: 25RDC Revision: 6 Date of Revision: 01/03/05

Title: Controls Testbed Development and Support

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

A system of experimental R2vehicles for the testing of guidance, control, and system identification technologies in the Guidance and Control Branch (GCB) are to be designed, developed, and/or dynamically characterized. In addition, as appropriate, this task provides support for deployment and operation of these R2systems. They include:

- Free-flying Aircraft for Sub-scale Experimental Research (FASER) – a radio-controlled small (7ft wingspan) electrically powered aircraft instrumented for flight controls research,
- R1A dynamically scaled 5.5% civil transport model for flight controls research. This system will extend test capabilities available on FASER to a control surface and overall airframe configuration more representative of a full-scale civil transport. R5The Generic Transport Model (GTM) will be developed and maintained as part of the Airborne Subscale Transport Aircraft Research (AirSTAR) Testbed.
- R3Other testbed support.

The above items include flight elements and ground elements, which include R2integration of ground control-computational and telemetry equipment and software.

R4R2~~In addition to these aircraft, this task includes design of an experimental magnet for researching the use of magnetohydrodynamic regeneration of electricity in aerobraking. Requirements for Flexible Flying Fixture (FFF), Flapping Flight Test Hardware (FFTH), and a compact system for providing supersonic flow through a small orifice on a hypersonic wind tunnel model. are discontinued for NASA's convenience.~~

R3Additional engineering support for research concerning aeroelastic effects and structural mode control R4*or* other testbed support may also be included within this task.

For original issued version of SOW, see ETOS file 25RDC.doc.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see R1 above and below, R2also ETOS file 25RDC01.doc).

Revision 2: Extends the period of performance in continuation of NASA's support with updated and additional requirements and new Technical Monitor for FY/CY03 (see R2 above and below).

Revision 3: Adds new requirements as Subtask 4 (see R3 above and below)

Revision 4: Extend the period of performance to December 31, 2004, in continuation of NASA's support with some requirements updated/redefined for the new period of performance (see R4 above and below).

Revision 5: Extend the period of performance to December 31, 2005, in continuation of NASA's support with some requirements updated/redefined for the new period of performance (see R5 above and below).

Revision 6: Provide flight ready UAV's for the GTM project in support of the various GTM pilot training project activities.

2. **<u>Description of the Work to be Performed</u>:**

The subtasks are:

1. Support of FASER Deployment, as required, including:
   - Aerodynamic and dynamical characterization of baseline FASER.
   - Development of FASER variant with two wing-mounted electric motors for propulsion.
   - Design and prediction of behavior of an aeroservoelastic wing for FASER.
   - Modification, maintenance, and field deployment of FASER for flight control research.

   DELIVERABLES:
   - Monthly technical progress reports.
   - Design drawings for aeroservoelastic wing.
   - Design drawings for two-engine FASER variant.
   - FASER variant with two engines, flight-ready.

   METRICS
   - Progress reports monthly.
   - Design drawings for two-engine variant [R4]within 9 months (Meets) or 6 months (Exceeds) of initiation by NASA.
   - FASER variant with two engines, flight ready [R4]within 6 months (Meets) or 3 months (Exceeds) of design completion.
   - [R2R4]Support of ground station for FASER deployment, suitable for RC-piloted and computer-controlled flight.

2. Dynamically scaled 5.5% civil transport model:
   - Trade-off studies of hardware cost/complexity versus testing capabilities.
   - [R4]Continued design and development of baseline [R5]and alternate model systems, [R2] as required, and of non-dynamically-scaled preliminary test vehicle(s).
   - Support for the development, review, and approval of operational and safety procedures and for the flight system.
   - Hardware integration for baseline model system.

Begin [R6] *******
   - **Provide UAV maintenance support of GTM vehicles.**
   - **Provide UAV repair of GTM vehicles.**
   - **Provide UAV modifications to GTM vehicles.**
   - **Provide UAV ground support at local and at remote flying sites scheduled by the GTM project manager.**

End [R6] ************

   DELIVERABLES:

- Monthly technical progress reports.
- Design drawings/documentation sufficiently detailed for hardware fabrication.
- Transport model flight elements with actuated control surfaces, propulsion system, and hardware necessary to support RC [R4]flight testing.
- [R4]Operational [R5]and safety procedures definition, documentation, and support.
- **[R6] UAV maintenance, modification, repair, and flight support**

METRICS:

- Progress reports monthly
- Design drawings for [R4]models (or model modifications) within 9 months (Meets) or 6 months (Exceeds) of initiation by NASA.
- Integration of major airframe components [R2]for dynamically-scaled vehicle(s) (fuselage, wings, empennage surfaces, and propulsion) by [R5]1 June, 2005/exceeds by 1 March, 2005.
- [R4]Development and documentation of operational procedures within 9 months (Meets) or 6 months (Exceeds) of determination of a requirement and initiation.

Begin [R2] block addition

- [R4]Support development and operation of integrated testbed by [R5]1 Oct. 2005/exceeds by 1 June. 2005.
- **[R6] Quality of workmanship (model skills and best practices) and best value to the government to meet the GTM schedule set by the project manager.**

[R4](Previous subtask 3deleted)

Begin [R3] block addition

[R6]3. Miscellaneous Testbed Development and Support[R5](as assigned by NASA):

The Contractor shall design and oversee the fabrication of R&D Testbed concepts as assigned by NASA. The Contractor shall also support continuing design and development of test fixtures for various upgraded concepts. The design approach should focus on optimal designs and fabrication methods necessary to meet the current design criteria of the test model itself. 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 shall be purchased from vendors or manufactured by the U.S Government per Contractor specifications. The Contractor shall deliver final testbed fixture assemblies, coordinate the integration of these assemblies into the component test apparatus, and/or participate in the testing of test specimens.

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, and the following criteria:

3.1.1 Ability to meet delivery schedules for all mechanical 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.

Ability to complete all test activities with delivered test setup. 70% completion of tests will constitute "MA" and 95% percent will constitute "SE".
End [R3] block addition

3. **Government Furnished Items:**

- Access to equipment and facilities in Advanced Control Research Laboratory, building 1232, room 116
- Access to workstations with [R1]ProE CAD software.
- Parts required to complete tasks above will be provided by government.

4. **Other information needed for performance of task:**

- No travel will be required.
- 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.

5. **Security clearance required for performance of work:**

- No security clearance will be required.

6. **Period of Performance:**

Planned start date: [R1]1 Jan. 02

Completion date: [R1 R2]~~31 Dec. 02~~
[R4]~~30 Nov.~~ 03
[R5]~~31 Dec 2004~~

	31 Dec 2005
7.	**NASA Technical Monitor:** R2Christine M. Belcastro M/S: 161 Phone: 757-864-4035 NASA Competency/Other Technical Coordinator: Tricia Johnson M/S: 162 Phone: 757-864-1718

Task Order Number: 25RFL Revision: 1 Date of Revision: 5/24/01

Title: Blended Wing Body – Low Speed Vehicle Technical Support

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

NASA LaRC, along with Dryden Flight Research Center (DFRC) and industry partner Boeing, have committed to develop a subsonic, remotely piloted, horizontal take-off and landing vehicle called the Low Speed Vehicle (LSV). The vehicle is an advanced-scaled model of a transport Blended Wing Body (BWB) configuration. The LSV will be designed, fabricated and integrated at LaRC with DFRC responsible for the flight operations and testing.

The purpose of this task is to acquire support for the assembly of Government-provided components, check-out, test, and delivery of completed hardware and documentation for the BWB project.

Revision 1: Extends Subtasks 1 and 2 completion date to October 31, 2001 (see [R1] below).

2. **Description of the Work to be Performed:**

Subtask 1

1. The Contractor shall fabricate and test a NASA designed prototype avionics DC/DC converter system for the Blended Wing Body (BWB) Project. The Contractor shall test this system in accordance with NASA provided test procedures

2. The Contractor shall fabricate and test a NASA designed prototype avionics power distribution unit for the BWB Project. The Contractor shall test this system in accordance with NASA provided test procedures.

3. The Contractor shall fabricate and test a NASA designed prototype avionics battery assembly for the BWB Project. The Contractor shall test this system in accordance with NASA provided test procedures

Deliverables

1. A prototype of the NASA designed avionics DC/DC converter system tested in accordance with NASA test procedures.
2. A prototype of the NASA designed avionics power distribution unit tested in accordance with NASA test procedures.
3. A prototype of the NASA designed avionics battery assembly tested in accordance with NASA test procedures.
4. Completed drawings of each system utilizing OrCAD Capture design software.
5. Monthly written status reports.

Performance Standards and Evaluation Criteria

Meets:

All monthly reports received on time, and all prototype systems fabricated and successfully tested by [R1] ~~May~~ ***October*** 31, 2001.

Exceeds:

All monthly reports received on time, and all systems fabricated, successfully tested and system drawings completed by [R1] ~~May~~ ***October*** 31, 2001.

Subtask 2

1. The Contractor shall fabricate and test a NASA designed prototype actuator DC/DC converter system for the Blended Wing Body (BWB) Project. The Contractor shall test this system in accordance with NASA provided test procedures

2. The Contractor shall fabricate and test a NASA designed prototype actuator power distribution unit for the BWB Project. The Contractor shall test this system in accordance with NASA provided test procedures

3. The Contractor shall fabricate and test a NASA designed prototype actuator battery assembly for the BWB Project. The Contractor shall test this system in accordance with NASA provided test procedures

Deliverables

1. A prototype of the NASA designed actuator DC/DC converter system tested in accordance with NASA test procedures.
2. A prototype of the NASA designed actuator power distribution unit tested in accordance with NASA test procedures.
3. A prototype of the NASA designed actuator battery assembly tested in accordance with NASA test procedures.
4. Completed drawings of each system utilizing OrCAD Capture design software.
5. Monthly written status reports.

Performance Standards and Evaluation Criteria

Meets:

All monthly reports received on time, and all systems fabricated and successfully tested by [R1] ~~May~~ ***October*** 31, 2001.

Exceeds:

All monthly reports received on time, and all systems fabricated, successfully tested and system drawings completed by [R1] ~~May~~ ***October*** 31, 2001.

Subtask 3

1. The Contractor shall test individual components for the Communications and Tracking (C&T) system for the BWB Project as required to meet BWB programmatic schedules. The Contractor shall test these components in accordance with NASA provided test procedures.
2. The Contractor shall coordinate with the C&T lead in the mechanical layout of the communications hardware.
3. The Contractor shall provide OrCAD electrical drawings for the NASA design of the C&T System.

Deliverables
1. Tested components and a written report of results.
2. Completed mechanical layout drawings for the C&T hardware utilizing OrCAD.
3. Completed electrical drawings of the C&T system utilizing OrCAD.

Performance Standards and Evaluation Criteria
Meets:
All monthly reports received on time, and all testing completed by October 2001.

Exceeds:
All monthly reports received on time, and all testing and all finalized drawings completed by October 2001.

3. **Government Furnished Items:**
1. Individual components for the avionics DC/DC converter prototype.
2. Individual components for the avionics power distribution unit prototype.
3. Individual components for the avionics battery assembly prototype.
4. Individual components for the actuator DC/DC converter prototype.
5. Individual components for the actuator power distribution unit prototype.
6. Individual components for the actuator battery assembly prototype.
7. Individual components for C&T testing.
8. Laboratory space.
9. Access to specialized (OrCAD) software and plotting equipment.

4. **Other information needed for performance of task**:
1. Drawings shall be completed utilizing OrCAD software to Langley LMS standards.
2. Soldering shall be performed to NASA Standard NASA-STD 8739.3.
3. Crimping, interconnecting cables harness, and wring shall be performed to NASA Standard NASA-STD-8739.4.
4. Electro Static Discharge procedures stated in n NASA-STD-8739.7 shall be followed.
5. Wiring, crimping, installation, etc., of aircraft hardware must be performed by certified personnel.
6. 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 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. 7. Contractor may utilize NASA furnished parts and components. 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.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: February 1, 2001 Completion date: October 31, 2001
7.	**NASA Technical Monitor:** Donna A. Gallaher M/S: 257 Phone: 757-864-1621

Task Order Number: 26RAE Revision: 2 Date of Revision: 8/16/01

Title: Uncertainty Analysis and Variable-Fidelity Modeling

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

This work consists of two components. R1 ~~, each with four phases, with each component extending over three years.~~ In the first component, (subsequently called the "Differentiation Task, R3***or new Simplified Differentiation*** Task" with NASA LaRC Point of Contact (POC) of Lawrence Green, 42228, l.l.green@larc.nasa.gov), the Contractor augments several analysis codes with derivative calculations for use in gradient-based optimization. R1 ~~One or more analysis codes may comprise a "disciplinary analysis" in the second component.~~ The augmentation will be accomplished for ISE-specified codes (with ISE-specified dependent and independent variables) using the Adifor3.0 Automatic Differentiation tool to compute the gradients; NASA will provide training to the Contractor in the use of the Adifor3.0 tool. In the second component (subsequently called the "Wrapping Task" R1 ~~with NASA LaRC POC of Natalia Alexandrov, 47059, n.alexandrov@larc.nasa.gov~~), the Contractor will wrap the analysis and gradient codes for modular use in R1 the Phoenix Model Center framework. NASA will then use the R1 wrapped analysis and gradient codes in R1 uncertainty analyses and design optimization for particular single- and multidisciplinary ISE-specified RLV applications.

Begin R2 block

Note: Some of the required code augmentation and wrapping is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

End R2 block

Change 1: Two deliverable dates (see C1 below).

Revision 1: Simplifies both the Differentiation and Wrapping Tasks by reducing the number of application codes and redefines the Wrapping Task. The Schedule of deliverable is also changed to reflect the reduced number of application codes, and the period of performance is shortened accordingly. (See R1 above and below.)

Revision 2: Adds the NOR feature with the anticipated number of required codes to be processed (see R2 above and below).

Revision 3: Extends the period of performance through March 31, 2002, clarifies requirement priority and focus, and adds a simplified differentiation requirement (see R3 above and below).

2. Description of the Work to be Performed:

R2 It is anticipated that 3 codes will be submitted by NOR for the following subtasks:

2.1 R2 (NOR) The Differentiation Task:

For each code to be differentiated, the Contractor shall:

1. Demonstrate that the NASA-provided code "reproduces to NASA's satisfaction" the NASA-provided sample output(s), when the NASA-provided code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). This demonstration shall be accomplished prior to the Contractor making any changes to the code. Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

Note: The phrase "reproduces to NASA's satisfaction" generally means to machine precision, but in some instances, which cannot be identified in advance, some interpretation of the UNIX diff command output may be required, due to compiler and machine-specific implementation issues of the executable code.

2. Demonstrate that the pre-Adifor3.0 code reproduces to NASA's satisfaction the NASA-provided sample output(s), when the pre-Adifor3.0 code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). This demonstration shall be accomplished prior to the Contractor executing Adifor3.0. Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

3. Apply the Adifor3.0 Automatic Differentiation tool to the code for the ISE-specified dependent and independent variables.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor shall deliver to NASA any required pre-Adifor3.0 code modules, scripts, Makefiles, etc. and any Adifor3.0-generated code modules. The Contractor shall also report to NASA order of magnitude estimates of time required by the Contractor to create or modify any files necessary for Adifor3.0 processing, and the time required by Adifor3.0 to process the code. The standard for exceeding the subtask requirement is that the Contractor documents reductions in user time for Adifor3.0 applications, where the reduced user time is attributable to documented improved Adifor3.0 application techniques, automation of required Adifor3.0 pre- and post-processing steps, and/or knowledge gained about using the Adifor3.0 tool.

If Adifor3.0 fails to generate the required gradient code modules, the Contractor shall either: a) modify the code (as appropriate, in response to Adifor3.0-generated messages) to allow for correct processing of the code and then return to step 2, or b) report any problems suspected with the Adifor3.0 tool to the NASA LaRC subtask POC and suspend work on this code until a work-around can be identified.

4. Having obtained the required Adifor3.0-generated gradient code modules, create the required driver module to call the Adifor3.0-generated gradient code modules for the derivative applications required.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor shall deliver to NASA any required code modules, scripts, Makefiles, etc. necessary to compile and execute the complete gradient code. No provision is made in this standard to exceed the subtask requirements.

5. Demonstrate that the complete gradient code reproduces to NASA's satisfaction the NASA-provided sample output(s), when the complete gradient code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

6. Demonstrate that the complete gradient code produces gradients that can be verified for accuracy by comparison with finite-difference approximations, when the complete gradient code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). Any substantial discrepancies between the Adifor3.0-generated derivatives and the finite-difference approximations must be resolved, either by the Contractor alone (to NASA's satisfaction), or in cooperation with NASA, before proceeding. *****Begin [R3] block***** The Simplified Differentiation Task involves only computing gradients by finite-difference approximations, within a semi-automated process in which the user selects independent and dependent variables for the required gradients and supplies step increments for each independent variable. The Simplified Differentiation Task does not include any application of

Adifor3.0 to the code, or verification for accuracy of the gradients. For both the Differentiation Task and Simplified Differentiation Task, Contractor shall formulate a loop to compute output (dependent) variable uncertainties as a dot product of the computed gradient vector and the associated, user-specified input (independent) variable uncertainty vector. *****End R3 block***** Subtask Standard: The standard for meeting the subtask requirement is that the Adifor3.0-generated derivatives and finite-difference approximations are shown to agree to within one percent (1%), for some value of the independent variable step size within the range of independent variable step sizes used for the finite-difference approximations. No provision is made in this standard to exceed the subtask requirements.

7. Demonstrate that the complete gradient code executes in a reasonable amount of time. The execution time of the gradient code is expected to be proportional to the number of independent variables for forward-mode differentiation, and proportional to the number dependent variables for reverse-mode differentiation. Individual gradient code execution times, relative to undifferentiated code execution times, vary from code to code, and with the compiler options and machine types/classes used. A rule of thumb is that forward-mode differentiation may require as much as three times the execution time of the undifferentiated code execution times for each independent variable; reverse mode code may require as much as three times the execution time of the undifferentiated code execution times for each dependent variable. If substantially worse gradient code execution performance than these guidelines is observed, the Contractor may investigate, as time permits, enhancing the gradient code execution performance, either with advanced compiler options, or modifying the Adifor3.0-generated code (with subsequent revalidation for correctness and accuracy of derivatives) in response to messages from execution performance profiling tools.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor document the execution time ratio of the gradient code relative to the undifferentiated code, using the compiler options and machine type/class specified by NASA for the NASA-delivered code. The standard for exceeding the subtask requirements is demonstrated execution performance improvements beyond the Adifor3.0-generated code performance, either through the use of additional compiler options, or post-Adifor3.0 code modifications. A lesser standard for exceeding the subtask requirements is that the Contractor simply document, but not implement, the potential for performance improvements beyond the Adifor3.0-generated code performance, either through the use of additional compiler options, or post-Adifor3.0 code modifications.

Differentiation Task Deliverables:

1. All NASA-delivered codes and sample input/output files
2. All final pre-Adifor3.0 code, auxiliary files, and scripts
3. All final Adifor3.0-generated code

4. All final Contractor-generated gradient code driver modules, scripts, and Makefiles
5. All final execution correctness verification results
6. All final derivative accuracy verification results
7. All final execution performance verification results
8. All documentation of attempts, whether successful or not, to exceed subtask requirements, as appropriate.
9. All Contractor-generated gradient code driver modules, scripts, Makefiles needed to achieve improved user application time and/or gradient code execution performance time in excess of the subtask requirements.

2.2 R2 (NOR)The Wrapping Task:

R1 1. The Wrapping Task now consists of NASA providing access and training to the Contractor in the use of the Phoenix Model Center framework. The Contractor then wraps the Task 2.1 analysis and gradient codes, as necessary, for use in multidisciplinary analyses, uncertainty analyses, and optimizations within the Phoenix Model Center framework. The Wrapping Task is done by, perhaps, a combination of writing wrapper code and graphically constructing the necessary interfaces (data communication paths) to use the codes under consideration for the proposed purposes within the Phoenix Model Center framework. The wrapping and construction of necessary interfaces must account for all analysis and gradient variable values that must be passed between the codes to accomplish the desired purposes within the framework; these variables will include, as a subset, those variables defined within the Differentiation Task. The interfaces will probably include other variables, as defined by the analysis code execution experts.
Contractor shall validate the wrapper by demonstrating that the wrapped analysis produces the same outputs as the stand-alone analysis, per input/output specifications of the Differentiation Task.

R1 ~~Contractor shall validate the robustness of the wrapped analysis by writing and executing a FORTRAN driver that calls the wrapped analysis to evaluate objective functions and constraints at uniformly distributed points in the design domain. The wrapped analysis will be considered robust if it fails in less than 5% of the trials, with the number of trials specified by NASA. In the event of failure, the wrapped analysis code shall not abort the driver run, but returns control to the driver software with an appropriate diagnostic error flag. The error diagnostic feature will be determined in more detail in discussions between NASA and Contractor, based on the specific analysis code.~~ The Contractor shall also report to NASA order of magnitude estimates of time required by the Contractor to wrap the analysis R1 and gradient codes. ~~and/or discipline.~~

Subtask standard: The standards for meeting the subtask requirements are as follows. In writing the wrappers, Contractor shall not change the analysis code itself from the final version used in the Differentiation Task. Should any changes become necessary for the code to be wrapped, the changes shall be discussed and resolved with NASA prior to making any modifications to the analysis code. The wrapper codes calling sequences shall comply with NASA specifications. The wrapper codes shall be validated according to Task specifications. Contractor shall deliver to NASA all wrappers, driver modules, analysis codes, scripts,
Makefiles, etc., with the attendant documentation, necessary to compile, link, and execute the complete wrapped analysis code and the validation runs. No provision is made in this standard to exceed the subtask requirements.

2. R1 ~~Wrap the sensitivity analysis code for use in optimization as follows. Write a single-precision FORTRAN-callable wrapper and a double-precision FORTRAN-callable wrapper of the following form:~~

~~call SENSITIVITY (nx, x, nf, ldgradf, gradf, nc, ldgradc, gradc, error, aux),~~

~~where~~
~~nx - number of design variables (input),~~
~~x - design variable array of length nx (input),~~
~~nf - number of objective functions (input),~~
~~ldgradf - leading dimension of gradf (input)~~
~~gradf - array of dimension (ldgradf,nf) containing the gradient of f (output)~~
~~nc - number of constraints (input),~~
~~ldgradc - leading dimension of gradc (input)~~
~~gradc - array of dimension (ldgradc,nc) containing the gradient of c (output)~~
~~error - diagnostic error flag (TBD, analysis dependent)~~
~~aux - auxiliary variables, TBD on consideration of each sensitivity analysis in discussions between NASA and Contractor (input/output)~~

Contractor shall validate the wrapper by demonstrating that the wrapped sensitivity analysis produces the same outputs as the stand-alone sensitivity analysis, per input/output specifications of the Differentiation Task.

R1 ~~Contractor shall validate the robustness of the wrapped sensitivity analysis by writing and executing a FORTRAN driver that calls the wrapped sensitivity analysis to evaluate the gradients of the objective functions and constraints at uniformly distributed points in the design domain. The wrapped sensitivity analysis will be considered robust if it fails in fewer than 5% of the trials, with the number of trials specified by NASA. In the event of failure, the wrapped sensitivity analysis code shall not abort the driver run, but shall return control to the driver software with an appropriate diagnostic error flag. The error diagnostic feature will be~~

~~determined in more detail in discussions between NASA and Contractor, based on the specific sensitivity analysis code. The Contractor shall also report to NASA order of magnitude estimates of time required by the Contractor to wrap the sensitivity analysis code and/or discipline.~~

~~Subtask standard: The standards for meeting the subtask requirements are as follows. In writing the wrappers, Contractor shall not change the sensitivity analysis code itself from the final version used in the Differentiation Task. Should any changes become necessary for the code to be wrapped, the changes shall be discussed and resolved with NASA prior to making any modifications to the sensitivity analysis code. The wrapper codes calling sequences shall comply with NASA specifications. The wrapper codes shall be validated according to Task specifications. Contractor shall deliver to NASA all wrappers, driver modules, sensitivity analysis codes, scripts, Makefiles, etc., with the attendant documentation, necessary to compile, link, and execute the complete wrapped sensitivity analysis code and the validation runs. No provision is made in this standard to exceed the subtask requirements.~~

3. [R1] ~~Validate the wrapped analysis and sensitivity analysis codes for use with design optimization as follows. Write a FORTRAN driver for use with a NASA-specified commercial optimization code and run a NASA-specified number of optimization cases using the wrapped analysis and sensitivity code, with a variety of starting points (the number to be specified by NASA, depending on the analysis code). The optimization shall be done in single-fidelity mode, for every available level of fidelity.~~

~~Test results shall include optimization printouts with NASA-specified iteration history and the number of analyses and sensitivity analyses necessary to obtain solutions.~~

~~Subtask standard: The standards for meeting the subtask requirement are as follows. In running the optimization tests, Contractor shall not change the wrapped analysis and sensitivity codes, nor the wrappers or any attendant codes. The only code developed or modified in this subtask is the FORTRAN optimization driver. Should any modifications to the wrapped codes or wrappers become necessary at this stage, they shall be resolved with NASA. Contractor shall deliver to NASA all FORTRAN driver modules, Makefiles, the attendant documentation, and the outputs of the optimization runs in the form that will allow for complete replication to outputs by NASA. No provision is made in this standard to exceed the subtask requirements.~~

Wrapping Task Deliverables:

1. All NASA-delivered codes and sample input/output files
2. All final wrapped code, auxiliary files, and scripts
3. All final Contractor-generated wrapped code driver modules, scripts, and Makefiles
4. All final execution correctness verification results

5. All final execution accuracy verification results
6. All final execution performance verification results
7. All documentation requested

Joint Task Schedule:

01/01/01 - NASA receives Authority To Proceed

01/31/01 - NASA Selection of Phase 1 analysis codes, specification of dependent and independent variables, and test cases complete

CONSIZ or equivalent (Weights and Sizing)

R1 ~~TPSsizer or equivalent (Thermal Protection System Sizing)~~

~~MINIVER or equivalent (Aero-thermal analysis)~~

02/01/01 - NASA Phase 1 transfer of codes to Contractor complete; Contractor Phase 1 work begins

C1 ~~03/31/01~~

05/31/01- Contractor delivers first code under Differentiation Task complete; includes verification for correctness, differentiation, and verification of accuracy of derivatives

C1 ~~05/31/01~~

06/30/01 - Contractor Phase 1 of Differentiation Task Complete; Contractor Phase 1 of Wrapping Task begins

08/31/01 - Contractor Phase 1 of Wrapping Task complete

R1 ~~09/01/01 - NASA Selection of Phase 2 analysis codes, specification of dependent and independent variables, and test cases complete~~

~~APAS or equivalent (Aerodynamics analysis)~~

~~09/01/01 - Contractor Phase 2 work begins~~

~~12/31/01 - Contractor Phase 2 of Differentiation Task complete; Contractor Phase 2 Wrapping Task begins~~

~~03/31/02 - Contractor Phase 2 Wrapping Task Complete~~

R1 ~~04/01/02~~

08/31/01- NASA Selection of Phase ***2*** analysis codes, specification of dependent and independent variables, and test cases complete

POST or equivalent mission analysis

R1 ~~04/01/02~~

09/01/01 - Contractor Phase ***2*** work begins

R1 ~~07/31/02~~

12/31/01 - Contractor Phase ***2*** Differentiation Task complete; Contractor Phase 3 Wrapping Task begins

R1 ~~10/31/02~~

01/31/02 - Contractor Phase ***2*** Wrapping Task complete

****Begin R3 block*****

02/02/02 - Contractor Begins extension to current task order
Develop semi-automated Simplified Differentiation Task process for "LittleMAC" codes (POST, APAS, and geometry). Wrap semi-automated, finite-differencing "LittleMAC" codes, and existing CONSIZ.AD code, for use in the Phoenix Model Center framework.

03/31/02 - Contractor extension task complete.

****End R3 block*****

R1 ~~11/01/02 - Contractor Phase 4 Differentiation Task (integrated code suite) work begins~~

~~10/31/03 – Contractor Phase 4 Differentiation Task complete; Contractor Phase 4 Wrapping Task begins~~

~~01/31/04 – Contractor Phase 4 Wrapping Task Complete; end of Contractor work.~~

Joint Task Performance Metrics:

1. Subtasks are completed within schedule and within the agreed upon cost
2. Subtasks fulfill the standards to meet or exceed the subtask requirements

3. Government Furnished Items:

Analysis codes and sample input/output files for Differentiation and Wrapping Tasks, Training in the use of the Adifor3.0 Automatic Differentiation tool, access to the Adifor3.0 Automatic Differentiation tool, specification of independent and dependent variables for the Differentiation Task, specification of the wrapper format for the Wrapping Task.

4. Other information needed for performance of task:

1. The Contractor shall perform all computations on UNIX-based platforms, unless otherwise agreed upon in discussions with NASA (the unexpected exceptions may be due to the original analysis code being designed explicitly for a different platform).
2. The Contractor agrees that all deliverables will be owned by NASA and can be used and distributed by NASA with no restrictions imposed by the Contractor.

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.

5. Security clearance required for performance of work:

None applicable. Some issues with respect to code distribution to the Contractor may need to be addressed.

6. Period of Performance:

Planned start date: 02/01/01 Completion date: R1 ~~01/31/04~~ R3 ~~01/31/02~~ ***03/31/02***

7.	NASA Technical Monitor: Lawrence Green for the Differentiation Task, phone 757-864-222 Natalia Alexandrov for the Wrapping Task., phone 757-864-7059 M/S: 159 NASA Competency/Other Technical Coordinator: Marguerite Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 26RBE Revision: 5 Date of Revision 3/17/05

Title: Aircraft NOise Prediction Program (ANOPP) Development, Maintenance, and Support

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

The ANOPP code has the capability to predict source noise for supersonic and subsonic fixed-wing aircraft. It can fly these sources in steady fly-over, take-off and approach (landing) configurations accounting for noise propagation corrections. It computes and plots several acoustic metrics for aircraft noise certification and community noise impact studies. For this contract effort, the ANOPP program as defined in TM-83199 (Parts 1-4) is restricted to conventional take-off and landing (CTOL) aircraft. No effort to support the rotorcraft or the propeller analysis system source noise prediction capabilities of ANOPP is herein required. The current ANOPP Level [R3]L03/02/19 will be the baseline prediction system for this effort. This continuing effort may include codes recently generated but not necessarily incorporated or documented under the Advanced Subsonic Technology (AST) program, and will include codes developed under the Quiet Aircraft Technology (QAT) program.

The objective of this task is to implement new prediction capabilities for the ANOPP system, provide maintenance services for code updates, debugging and corrections, and provide prediction code support to NASA and Government approved ANOPP customers. The government will track progress of the Contractor utilizing monthly technical progress reports, monthly financial reports and comprehensive semi-annual and annual technical oral reviews.

Begin [R1] block clarification

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic decisions, and research developments and customer requests. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

End [R1] block clarification

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, updates and/or clarifies the requirements for the new period of performance, and adds NORs reporting (see [R1] above and below).
Revision 2: Extends the period of performance one year in continuation of NASA's support with some requirements updated for the new period of performance (see [R2] above and below).
Revision 3: Extends the period of performance one year in continuation of NASA's support with some requirements updated for the new period of performance (see [R3] above and below).

Task Order Number: 26RBE Revision: 5 Date of Revision 3/17/05

Title: Aircraft NOise Prediction Program (ANOPP) Development, Maintenance, and Support

Revision 4: Extends the period of performance 3 months to March 31, 2005, in continuation of NASA's support. Changes in the QAT project may require some revision to SOW later. (See [R4]below.)

Revision 5: Extends the period of performance 2 months to May 31, 2005 in continuation of NASA's support while changes in the QAT project are being planned (see [R5]below, Section 6).

2. **Description of the Work to be Performed**:

The Contractor shall perform the following subtasks:

Task 2.1 [R1](NOR) The Contractor shall maintain a master copy of the ANOPP source code on a GFE DEC ALPHA computer system. After each new system update generation as required in this subtask (2.1), the Contractor shall deliver an archive copy of the code to the Government. Code changes shall be implemented and tracked using the GFE computer systems detailed in section 3. The Contractor shall maintain a capability to generate executable versions of the code which run on DEC Alpha computer systems.

The Contractor shall keep an updated executable copy of the code available on the GFE DEC ALPHA for Government acquisition and use and shall add each new module, from subtask 2.2 when they are completed. The Contractor shall debug and correct code errors as reported to them by NASA or approved industry customers [R1]and shall include a tabulated summary these debugging/correction activities in the monthly progress reports. If the Contractor determines that a reported error or correction requires a major effort, he shall contact the Technical Monitor for approval before committing resources to implement an update to the code. [R1]Under no circumstances shall the Contractor exceed the funding level approved by the Contracting Officer. The Contractor shall distribute updated or corrected copies of the ANOPP code to those customers that are approved by the Government and who want to be updated. The Contractor will not be held responsible to actively support old ANOPP versions if the versions are more than four levels behind the current update level.

Metric: The Contractor is expected as a minimum to provide easily readable archived copies of the master codes. The new codes as specified under task 2.2 shall be incorporated into each respective archived copy of the code.

If the code can be easily accessed with only minor problems for execution and the technical documentation is completed for the included codes for each archived code copy, then these criteria will be used accordingly to assess a level of performance exceeding the acceptable level.

Deliverables and schedule: 1. Updated archived ANOPP code copy on the NASA Langley Distributed Mass Storage System on [R3]June 18, 2004 and [R3]December 17, 2004. 2. Monthly progress report tabulated summary of debugging/correction activities giving dates reported and corrected/archived and brief descriptor.

Task 2.2 The Contractor shall implement into ANOPP, prediction codes or module updates being developed by the Government or its contractors under QAT, AST or base research and technology development programs. R3 This effort shall include the generation of the appropriate technical documentation for the new prediction modules or updates. The Government will make an effort to share with the Contractor beta versions or code components as soon as they become available to the government or are readied by the Government. Following are the known code modules (or updates) currently under development for predicting source noises:

Begin R3 block update

- R1 ~~(a) Jet shear layer correction module (new code)~~
- R1 ~~(b) Engine Noise Model (new code for BPR [Bypass Ratio] up to 14)~~
- ~~(c)~~ R3 ~~Boeing Fan Noise Module (new code for BPR up to 14)~~
- (d) Boeing Jet Noise Module (new code for BPR up to 14)
- ~~(e)~~ R3 ~~Heidmann Fan Noise Module (AST implementation)~~
- (f) Update Gas Constants
- (g) Noise Reduction Technologies

End R3 block update

Metric: The Contractor is expected to deliver completed codes (executable versions) with documentation concerning input, output and results of execution of each of the codes. The codes shall be demonstrated to reproduce the government furnished results using the data that was used for code development and/or validation.

In addition to the generation of the code module technical documentation, the generation of documentation to introduce persons to the operation of code and other written information or ideas and concepts which result in making the utilization of the code easier or faster executing will all be used to assess a level of performance exceeding the acceptable level.

Deliverables and schedules:

ANOPP Source module code with documentation as follows:

Source module:	Due date
R1 (a) Jet shear layer correction module (new code)	6/27/02
R1 (b) Engine Noise Model (new code)	11/29/02

Begin R3 block update

(a) [R3]~~Boeing Fan Noise Module~~	~~4/26/03~~(b)
(b) Boeing Jet Noise Module	[R3]5/10/04
(c) [R3]~~Heidmann Fan Noise Module~~	~~2/8/03~~
(d) Update Gas Constants	5/10/04
(e) Noise Reduction Technologies	10/08/04

End [R3] block update

Task 2.3 [R1](NOR) Government and Customer Software Support

The Contractor shall provide NASA and its approved customers support as follows:

a. The Contractor shall use ANOPP or other government-furnished codes such as the FAA's Integrated Noise Model, [R2]ASACNIM, the AirForce's NoiseMap, or the NASA-LaRC Flight Operations code/programs to generate predicted community noise footprints and certification levels for candidate aircraft scenarios as defined in writing by the Technical Monitor. [R1]This shall also include studies to investigate the potential upgrade of ANOPP to increase the prediction fidelity for engine attitude effects, lateral attenuation effects and forward flight effects. About [R3]six studies or scenarios will be provided per [R3]year.

[R2]b. The Contractor shall use ANOPP or other government-furnished codes to determine the component, total airframe noise, [R3]and total aircraft noise for a [R3]large twin and regional jet during approach and takeoff.

Metric: Computation of A-weighted Sound Levels, Sound Exposure Levels (SEL), Day/Night Average Sound Levels (DNL), Noise exposure Forecasts (NEF),
Perceived Noise Levels (PNL), Tone Corrected Perceived Noise Levels (PNLT), and Effective Perceived Noise Levels (EPNL) shall be in accordance with the established noise metrics standards (NASA CR 3406) or Federal Air Regulations, Part 36. Results of ground level contours or [R1]study results for the above metrics is expected within four weeks of the written request.

Deliverables and schedule:

1. Reports summarizing prediction results for the aircraft [R1]studies and scenarios provided within four weeks of the respective requests.

Task 2.4 ANOPP System Redesign and Implementation Support

The Contractor shall provide support for a Government contracted effort to redesign and code a new, more efficient, user-friendly version of the ANOPP. The services provided shall include consulting with the redesign contractor to insure compatibility and a smooth transition into the new system. While the actual coding and code structural components may change, the functionality and results obtained must be assured to be consistent with the results obtained from the original ANOPP. [R1] It will be the responsibility of the Contractor to insure that any new code development be compatible with the current software code control system and system generation procedures. It is anticipated that this subtask would not require more than 0.25 full-time equivalent effort for an engineer intimately familiar with ANOPP.

Begin [R1] block requirements redefinition
Metric: As a minimum the Contractor is expected to provide the Technical Monitor with periodic reports of compatibility between the new and old code results commensurate with the redesign progress.

If the Contractor suggests remedies for and/or sources of problems noted that are on target, then these criteria will be used accordingly to assess a level of performance exceeding the acceptable level.

Deliverables and schedule: Periodic compatibility reporting as needed to be included in the monthly progress reports.
End [R1] block requirements redefinition
Begin [R3] block addition
Task 2.5

The Contractor shall provide support to generate an electronic version of the ANOPP theoretical manuals based upon NASA TM-83199, Parts 1 and 2. This documentation shall be updated to reflect the technical content of ANOPP level L03/02/19 master code.

Deliverables and schedule: Completed task as demnoinstrated by the delivery of a CD containing the electronic version of ANOPP theoretical Manuals, Parts 1&2.
End [R3] block addition

3. <u>Government Furnished Items</u>:

The Government will furnish two DEC Alpha 3000 and one MicroVAX 3300 computer systems to be used to maintain the master ANOPP code copy, for implementation of new prediction code capability, to perform acoustic system studies, and to debug and/or correct code errors.

The Government will furnish an approved list of ANOPP customers. This list shall serve as an example of the customer database that is to be maintained by the Contractor and to serve as the

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Title: Aircraft NOise Prediction Program (ANOPP) Development, Maintenance, and Support

basis for determining customer support requirements.

The Government will furnish on the schedule shown below the databases and/or computer codes along with documentation to provide the basis for the prediction code generation specified in subtask 2:

Source modules/data	*Date*
R1(a) Jet shear layer correction module (new code)	1/31/02
R1(b) Engine Noise Model (new code)	3/31/02
R2(c) Engine noise databases for the 777 and Regional Jet	12/31/02
R2(d) Airframe noise database for the 777	12/31/02
R3(e) Gas Constants and Noise Reduction Technologies databases and documentation	3/19/04
R3(f) Engine liner data for the 777 and Regional Jet	4/6/04
R3(g) Engine noise data for the P&W Geared Turbofan engine	9/10/04

4. **Other information needed for performance of task:**

To accomplish the implementation of new prediction capabilities for the ANOPP system and to provide maintenance services for code updates, debugging and corrections, the Contractor is required to implement the practices and methodologies consistent with TMX-74029, ANOPP Programmers' Reference Manual for the Executive System and TM-84486, Aircraft Noise Prediction Program User's Manual.

R1Under NASA LMS-CP-5528, the ANOPP has been classified as low controlled NASA software. As such the Contractor is expected to implement software development and configuration control procedures consistent with this LMS procedure. Additionally as required by LMS-CP-5528, the Contractor is expected to implement and follow a software configuration management plan according to the requirements specified in LMS-CP-5529.

The ANOPP computer code, its databases and documentation are to be considered as U.S. Government controlled property. The Contractor shall not distribute or disclose any of the material/information/data associated with this code without the expressed written consent of the Government. Additionally, some of the databases, technical information and codes to be worked with may be company proprietary or LERD. It is a requirement of this task that the Contractor abide by any such NASA agreements for the handling of these data bases, technical information, and codes.

	To insure compliance with NPD 2210.1, External Release Of NASA Software, and as the intent of NASA is to share the contents of the ANOPP prediction system with other Government agencies and U.S Industries, the Contractor shall assign the intellectual property rights to NASA for any codes developed for or prepared for use with the ANOPP system. 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.
5.	**Security clearance required for performance of work:** None of the work required is classified
6.	**Period of Performance**: Planned start date: 01/01/01 Completion date: R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ R5 ~~3/31/05~~ ***5/31/05***
7.	**NASA Technical Monitor:** Robert A. Golub M/S: 461 Phone: 757-864-5281 NASA Competency/Other Technical Coordinator (*above branch level*): M/S: 461 Phone: 757-864-5281

	Task Order Number: 26RDC Revision: 4 Date of Revision: 11/30/2004 Title: Engineering Services for Safety Related Systems & Controls Research

1.	**Purpose, Objective or Background of Work to be Performed:** Research conducted under the [R3]Vehicle Systems Program (VSP) and the Aviation Safety and Security Program (AvSSP) requires engineering support in three primary areas: simulation support; control system design, demonstration, evaluation, and validation support; and support of software tool development for emerging new methods in systems and control modeling, analysis, design, and [R2]validation. Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and updates the requirements for the new period of performance (see [R1] below). Revision 2: Extends the period of performance one year in continuation of NASA's support with updated requirements (including a new Subtask 2 and old Subtasks 2-5 renumbered as 3-6) for the new period of performance (see [R2] above and below). Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with updated/redefined requirements for the new period of performance, and updates other info (see [R3] above and below) Revision 4: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with updated/refined requirements for the new period of performance (see [R4] below).
2.	**Description of the Work to be Performed:** The Contractor shall perform the following requirements/subtasks: 1. The Contractor shall develop, modify as necessary, and maintain a Matlab / Simulink B757 Enhanced Simulation on computers in Guidance & Control Branch (GCB), Dynamics & Control Branch (DCB), Vehicle Dynamics Branch (VDB), and/or Assessment Technology Branch (ATB) for use by [R3]VSP and AvSSP researchers, based on a nominal nonlinear simulation of the B737 to be developed in Matlab/Simulink from existing code. This subtask will include obtaining the B757 simulation source code [R4]***and updates*** from Systems Development Branch (SDB), and the determination and coordination of any requirements associated with data protection issues. The Contractor shall develop standard simulation functions for the nominal vehicle (e.g., generation of vehicle trim conditions, generation of linear vehicle models, and running nonlinear vehicle simulations). Test cases shall be obtained/generated for comparison with the B757 simulation maintained by SDB. The Contractor shall identify existing effective methods and develop modules for characterizing sensor, actuator, and surface failures, surface and fuselage damage, and other adverse conditions (including wind shear, turbulence, and wake vortices) within the nonlinear simulation. This shall include a survey of the literature and/or the aerospace community to identify effective methods that are currently being used, implementation of the most effective

methods in software, and their integration into the Matlab/Simulink B757 Enhanced Simulation. Wind tunnel data being generated to better characterize the B757 under upset conditions shall also be incorporated into the Matlab/Simulink B757 Enhanced Simulation. The effect of the implemented adverse and upset conditions on vehicle dynamics will be demonstrated through simulation runs involving single/multiple-event adverse and upset conditions. The Contractor shall add functionality to the Matlab/Simulink B757 simulation by including a user-friendly graphical user interface (GUI) for generation of vehicle trim conditions, generation of linear vehicle models, and running nonlinear vehicle simulations under nominal, adverse, and upset conditions. Coordination for integration into the SDB B757 simulation is also included as part of this subtask. The enhanced B757 simulation shall be fully documented as part of this subtask.

Deliverables: Matlab/Simulink [R3]~~B737 Simulation, and Matlab/Simulink~~ B757 [R1]Nominal and Enhanced Simulation software with GUI and Documentation (including plots showing comparison of test cases and other simulation checks) and Matlab/Simulink Simulation Updates for the B757 (and B737 upon request).

Begin [R2] block update

Schedule: Matlab/Simulink B757 Enhanced Simulation including nominal open-loop aircraft (trim, linearization, and nonlinear simulation), sensor models, fault and failure models developed, installed, and functional assessment completed with partial documentation by [R4]***12/31/04***; Matlab/Simulink B757 Enhanced Simulation Update #1 with database and model enhancement(s) for upset characterization implemented and functional assessment completed with partial documentation by [R4]***12/31/04***; Matlab/Simulink B757 Enhanced Simulation Update [R4]***#2*** with atmospheric models, any additional data/model updates, and a fully functional GUI implemented and functional assessment completed with full documentation by [R4]***5/1/05;*** Initiation of the development of structural damage models by [R4]***10/1/05*** with input provided by NASA.

Metrics: (Satisfactory Effort) B757 Enhanced Simulation installed and functional assessment completed with partial documentation, including a comprehensive set of test cases, by [R4]***1/31/05***; B757 Enhanced Simulation Update #1 installed and functional assessment completed with partial documentation, including a comprehensive set of test cases, by [R4]***3/1/05***; B757 Enhanced Simulation Update #2 installed and functional assessment completed with full documentation, including a comprehensive set of test cases, by [R4]***7/1/05***.

(Exceeds) B757 Enhanced Simulation installed and functional assessment completed with partial documentation, including a comprehensive set of test cases, by [R4]***12/31/04***; B757 Enhanced Simulation Update #1 installed and functional assessment completed with partial documentation, including a comprehensive set of test cases, by [R4]***1/31/05***; B757 Enhanced Simulation Update #2 installed and functional assessment completed with full documentation, including a comprehensive set of test cases, by [R4]***5/1/05***.

End [R2] block update
Begin [R2] subtask addition

2. The Contractor shall develop, modify as necessary, and maintain a Matlab/Simulink simulation and provide software support for the [R3]Airborne Subscale Transport Aircraft Research (AirSTAR) Testbed. The Matlab / Simulink Vehicle Simulations shall be supported on computers in GCB, DCB, VDB, and/or ATB, and shall include all aircraft model configurations as specified by NASA. These simulations shall provide full 6-DOF nonlinear dynamics models, trim and linearization routines, and be based on any available preliminary simulations developed and/or information provided by VDB, GCB, DCB, and/or ATB, and shall be developed to support pilot training as well as research experiments. Simulation components shall include models for engines (including gyroscopic effects), landing gear, flap effects, control gearing and servos, control laws, and any other components/effects requested by NASA. [R3]AirSTAR software support under this subtask shall include the software development, updates, and maintenance as required for [R3]AirSTAR development and research support.

<u>Deliverables</u>: Matlab/Simulink Simulations for various aircraft associated with the [R3]AirSTAR; Interface software for desktop simulation station to interface Matlab/Simulink simulation with visualization software and pilot input devices (e.g., RC controller boxes and wheel/column/rudder input devices); software and data files in support of [R3]AirSTAR development and operation, and simulation and software documentation.

<u>Schedule</u>: Simulation development for [R3]GTM-T2 by [R4]***5/1/05*** with subsequent updates [R3]for T1/T2 and documentation by [R4]***8/31/05***; Software development, as required, by [R4]***12/31/05***.

<u>Metrics</u>: (Satisfactory Effort) Matlab/Simulation Software developed for [R3]GTM-T2 by [R4]***3/1/05*** with documentation by [R4]***3/31/05***; Software interfaces for [R4]***ground*** station by [R4]***6/1/05***.

(Exceeds) Matlab/Simulation Software developed for [R3]GTM-T2 by [R4]***2/1/05*** with documentation by [R4]***3/1/05***; Software interfaces for [R4]***ground*** station by [R4]***5/1/05***.

End [R2] subtask addition

3. The Contractor shall provide trim conditions, linear models, and simulation runs, as required, for aircraft safety/[R1]security-related system and control design studies. Interfacing other software, such as the Robustness Analysis for Simulation-Based Control Law Evaluation (RASCLE) software tool and the DCB Achievable Dynamics Tool (ADT), with the Matlab/Simulink Enhanced Simulation is also included as part of this subtask. Conducting studies to assess controllability and observability under various failure conditions and execution of the Matlab/Simulink Enhanced Simulation for various adverse and upset conditions is also included as part of this task.

Deliverables: Software interfaces for RASCLE and ADT with the B757 Matlab/Simulink Enhanced Simulation, data files, and results of studies to determine controllability/observability and achievable vehicle dynamics under various failure and adverse condition scenarios.

Schedule: Software development and data generation, as required, by [R1]~~12/31/01~~ [R2]~~12/31/02~~ [R3]~~12/31/03~~ [R4]~~12/31/04~~ ***12/31/05***.

Metrics: (Satisfactory Effort) Software interfaces for RASCLE and ADT with the B757 Matlab/Simulink Enhanced Simulation, data files provided within 2 weeks of issued request, and timely results of studies to determine controllability / observability and achievable vehicle dynamics under one or more failure and adverse/upset condition scenarios with draft documentation by [R1]~~12/31/01~~ [R2]~~12/31/02~~ [R3]~~12/31/03~~ [R4]~~12/31/04~~ ***12/31/05***.

(Exceeds) Software interfaces for RASCLE and ADT with the B757 Matlab/Simulink Enhanced Simulation, data files provided within 1 week of issued request, and timely results of studies to determine controllability / observability and achievable vehicle dynamics under comprehensive set of adverse/upset condition scenarios with full documentation by [R1]~~12/31/01~~ [R2]~~12/31/02~~ [R3]~~12/31/03~~ [R4]~~12/31/04~~ ***12/31/05***.

4. The Contractor shall develop, modify, and maintain simulation software for various aerospace vehicles, as required.

Deliverables: Simulation Software with GUI and Documentation (including plots showing comparison of test cases and other simulation checks).

Schedule: Simulation and Documentation, as required, shall be developed and installed, and functional assessment completed by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***.

Metrics: (Satisfactory Effort) Simulation installed and functional assessment completed with documentation, including a comprehensive set of test cases, by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***.

(Exceeds) Simulation installed and functional assessment completed with documentation, including a comprehensive set of test cases, by R1 ~~10/1/01~~ R1 ~~10/1/02~~ R3 ~~10/1/03~~ R4 ~~10/1/04~~ ***10/1/05***.

5. The Contractor shall develop, modify, and maintain software, as required, in support of the Systems and Airframe Failure Emulation, Testing, and Integration (SAFETI) Lab.

Deliverables: Software and Documentation.

Schedule: Software and Documentation, as required, shall be developed and installed, and functional assessment completed by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***.

Metrics: (Satisfactory Effort) Software developed and installed and functional assessment completed with documentation, including a comprehensive set of test cases, by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***.

(Exceeds) Software developed and installed and functional assessment completed with documentation, including a comprehensive set of test cases, by R1 ~~10/1/01~~ R1 ~~10/1/02~~ R3 ~~10/1/03~~ R4 ~~10/1/04~~ ***10/1/05***.

6. The Contractor shall develop, modify, and maintain software tools, as required, to implement systems and controls modeling, analysis, design, and validation methods developed under the R3 VSP and AvSSP research programs.

Deliverables: Software and Documentation.

Schedule: Software and Documentation, as required, shall be developed and installed, and functional assessment completed by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***.

	Metrics: (Satisfactory Effort) Software developed and installed and functionalassessment completed with documentation, including a comprehensive set of test cases, by R1 ~~12/31/01~~ R2 ~~12/31/02~~ R3 ~~12/31/03~~ R4 ~~12/31/04~~ ***12/31/05***. (Exceeds) Software developed and installed and functional assessment completed with documentation, including a comprehensive set of test cases, by R1 ~~10/1/01~~ R1 ~~10/1/02~~ R3 ~~10/1/03~~ R4 ~~10/1/04~~ ***10/1/05***.
3.	**<u>Government Furnished Items</u>:** Computer equipment, hardware, software, and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work shall be performed in NASA Langley Building 1268, 1192, 1220, or 1232 on a non-interference basis.
4.	**<u>Other information needed for performance of task</u>:** Manuals, schematics, technical reports, and papers will be made available to the Contractor as required to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All software will be developed in compliance with LMS procedures, and (as applicable) should be Y2K compliant.
5.	**<u>Security clearance required for performance of work</u>:** Security clearance is not required. However, Contractor will be subject to the limited data rights and proprietary information restrictions of the B757 simulation (and other possible simulations) relative to distribution of the software tools to be developed.
6.	**<u>Period of Performance</u>:** Planned start date: R1 ~~January 1, 2001~~ R2 ~~January 1, 2002~~ R3 ~~January 1, 2003~~ R4 ~~January 1, 2004~~ ***January 1, 2005*** Completion date: R1 ~~December 31, 2001~~ R2 ~~December 31, 2002~~ R3 ~~December 31, 2003~~ R3 ~~December 31, 2004~~ ***December 31, 2005***
7.	**NASA Technical Monitor**: *Christine M. Belcastro* M/S: *161* Phone: 757-864-*4035* NASA Directorate/Other Technical Coordinator: ***Tricia Johnson*** M/S: 162 Phone: 757-864-***1718***

Task Order Number: 26RFH Revision: 2 Date of Revision: 3/27/02

Title: Cancer Detection With Passive Microwave Radiometry

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

Funded under C&I, this research will evaluate microwave radiometry to detect cancer growth. Because of time constraints, it is anticipated that drawing upon recent radiometer development work for space applications will be necessary.

Revision 1:Extends the period of performance and schedule allowing further study while accommodating delays in receiving GFE and its documentation (see R1 below).

Revision 2: Adds requirements to and extends schedule of Subtask 2 and extends the task period of performance nine months (see R2 below).

2. **Description of the Work to be Performed:**

1. Conduct a system front-end tradeoff study for a radiometer based cancer detection system operating in the microwave spectrum (0.9GHz to 10GHz). Determine the best operating frequency versus depth penetration versus system physical size. (Estimated study time period is R1 ~~three~~ ***six*** months.)

Deliverables/Schedule:

a) Status reports monthly

b) Final report R1 ~~June 30, 2001~~ ***January 25, 2002***

Metrics: Positive progress reported monthly.

Standards:

a) Meets: Complete study on time resulting in one viable configuration.

b) Exceeds: "Meets" with more than one viable configuration.

2. Perform a system front-end design based on the results from the trade study. R2 ***Conduct phantom materials study to select dielectric properties for simulation test articles, and provide specifications for test articles. Conduct applicator (antenna) design study, in conjunction with University of Arkansas modeling and analysis task, to determine applicator design requirements.*** Conduct tests on prototype assemblies to verify performance objectives (Up to _" detection depth). (Estimated design time period is R1,R2 ~~four~~ ~~eight~~ ***seventeen*** months.)

Deliverables/Schedule:

c) Status reports monthly

d) Final report R1,R2 ~~September 30, 2001~~ ~~March 29~~ ***December 31,2002***

Metrics: Positive progress reported monthly.

Standards:

Task Order Number: 26RFH Revision: 2 Date of Revision: 3/27/02

Title: Cancer Detection With Passive Microwave Radiometry

	a) Meets: Complete design and prototype testing on time with 90% positive validation rate. b) Exceeds: "Meets" with 98% positive validation rate.
3.	**Government Furnished Items**: All special equipment necessary for performing the task order will be GFE.
4.	**Other information needed for performance of task**: *None*.
5.	**Security clearance required for performance of work:** *None.*
6.	**Period of Performance:** Planned start date: March 26, 2001 Completion date: R1 ~~Sep. 30, 2001~~ R2 ~~Mar 29, 2002~~ ***Dec. 31, 2002***
7.	**NASA Technical Monitor:** Randy Regan M/S: 488 Phone: 757-864-1869 **NASA Competency/Other Technical Coordinator:** Steve Jurczyk M/S: 488 Phone: 757-864-1865

	Task Order Number: 27RAE Revision: 1 Date of Revision: 8/24/01 Title: Computational Fluids Laboratory 3-Dimensional (CFL3D) Code Modification

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

In this task, the Contractor shall modify the [R1] ***August 2001 version of*** CFL3D (Computational Fluids Laboratory 3-Dimensional) code, version 6 (CFL3Dv6), with non-inertial frame-of-reference motion capability. The Contractor shall then apply the Adifor3.0 Automatic Differentiation tool to provide for exact differentiation of this non-inertial frame-of-reference motion capability for use in computational Stability and Control (S&C) derivative work; NASA will provide training to the Contractor in the use of the Adifor3.0 Automatic Differentiation tool. NASA will specify the dependent and independent variables for the target differentiation. The Contractor shall demonstrate the new capability on one or more test case(s) supplied by NASA. The work shall be completed within six months of task start. The NASA LaRC Point of Contact (POC) is Lawrence Green, (42228, l.l.green@larc.nasa.gov).

Revision 1: Restarts the work using the latest version of the CFL3D code and extends the schedule and completion date accordingly (see [R1] above and below).

2. Description of the Work to be Performed:

The Contractor shall perform the following requirements:

1. Demonstrate that the NASA-provided code "reproduces to NASA's satisfaction" the NASA-provided sample output(s), when the NASA-provided code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). This demonstration shall be accomplished prior to the Contractor making any changes to the code. Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

Note: The phrase "reproduces to NASA's satisfaction" generally means to machine precision, but in some instances, which cannot be identified in advance, some interpretation of the UNIX diff command output may be required, due to compiler and machine-specific implementation issues of the executable code.

2. The Contractor shall implement non-inertial frame-of-reference motion capability within the current CFL3Dv6 code following the formulation and implementation details from three sources: 1) George Washington University Master's Thesis written by Michael A. Park, 2) Park's notes from a partial implementation of this formulation within an earlier version of the CFL3Dv6 code, and 3) AIAA paper number 2000-4321 by Park and Green.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. The sample case will exercise only the partial implementation previously demonstrated by Park. A series of test cases shall be defined, in cooperation with the Contractor, to demonstrate that other portions of the implementation are working correctly. No provision is made in this standard to exceed the subtask requirements.

3. The Contractor shall modify the CFL3Dv6 code, as necessary, to allow for Adifor3.0 processing. The Contractor shall demonstrate that the pre-Adifor3.0 code reproduces to NASA's satisfaction the NASA-provided sample output(s), when the pre-Adifor3.0 code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). This demonstration shall be accomplished prior to the Contractor executing Adifor3.0. Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

4. Apply the Adifor3.0 Automatic Differentiation tool to the code for the NASA-specified dependent and independent variables.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor shall deliver to NASA any required pre-Adifor3.0 code modules, scripts, Makefiles, etc. and any Adifor3.0-generated code modules. The Contractor shall also report to NASA order of magnitude estimates of time required by the Contractor to create or modify any files necessary for Adifor3.0 processing, and the time required by Adifor3.0 to process the code. The standard for exceeding the subtask requirement is that the Contractor documents reductions in user time for Adifor3.0 applications, where the reduced user time is attributable to documented improved Adifor3.0 application techniques, automation of required Adifor3.0 pre- and post-processing steps, and/or knowledge gained about using the Adifor3.0 tool.

If Adifor3.0 fails to generate the required gradient code modules, the Contractor shall either: a) modify the code (as appropriate, in response to Adifor3.0-generated messages) to allow for correct processing of the code and then return to step 2, or b) report any problems suspected with the Adifor3.0 tool to the NASA LaRC subtask POC and suspend work on this code until a work-around can be identified.

4. Having obtained the required Adifor3.0-generated gradient code modules, create the required driver module to call the Adifor3.0-generated gradient code modules for the derivative

applications required.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor shall deliver to NASA any required code modules, scripts, Makefiles, etc. necessary to compile and execute the complete gradient code. No provision is made in this standard to exceed the subtask requirements.

5. Demonstrate that the complete gradient code reproduces to NASA's satisfaction the NASA-provided sample output(s), when the complete gradient code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). Any discrepancies between the NASA-provided sample output(s) and the Contractor-generated results must be resolved with NASA before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is the execution of a UNIX diff command, or equivalent, for the NASA-provided sample output(s) and the Contractor-generated results. No provision is made in this standard to exceed the subtask requirements.

6. Demonstrate that the complete gradient code produces gradients that can be verified for accuracy by comparison with finite-difference approximations, when the complete gradient code is executed by the Contractor, on the Contractor's computer, for the NASA-provided sample input(s). Any substantial discrepancies between the Adifor3.0-generated derivatives and the finite-difference approximations must be resolved, either by the Contractor alone (to NASA’s satisfaction), or in cooperation with NASA, before proceeding.

Subtask Standard: The standard for meeting the subtask requirement is that the Adifor3.0-generated derivatives and finite-difference approximations are shown to agree to within one percent (1%), for some value of the independent variable step size within the range of independent variable step sizes used for the finite-difference approximations. No provision is made in this standard to exceed the subtask requirements.

7. Demonstrate that the complete gradient code executes in a reasonable amount of time. The execution time of the gradient code is expected to be proportional to the number of independent variables for forward-mode differentiation, and proportional to the number dependent variables for reverse-mode differentiation. Individual gradient code execution times, relative to undifferentiated code execution times, vary from code to code, and with the compiler options and machine types/classes used. A rule of thumb is that forward-mode differentiation may require as much as three times the execution time of the undifferentiated code execution times for each independent variable; reverse mode code may require as much as three times the execution time of the undifferentiated code execution times for each dependent variable. If substantially worse gradient code execution performance than these guidelines is observed, the Contractor may investigate, as time permits, enhancing the gradient code execution performance,

either with advanced compiler options, or modifying the Adifor3.0-generated code (with subsequent revalidation for correctness and accuracy of derivatives) in response to messages from execution performance profiling tools.

Subtask Standard: The standard for meeting the subtask requirement is that the Contractor document the execution time ratio of the gradient code relative to the undifferentiated code, using the compiler options and machine type/class specified by NASA for the NASA-delivered code. The standard for exceeding the subtask requirements is demonstrated execution performance improvements beyond the Adifor3.0-generated code performance, either through the use of additional compiler options, or post-Adifor3.0 code modifications. A lesser standard for exceeding the subtask requirements is that the Contractor simply document, but not implement, the potential for performance improvements beyond the Adifor3.0-generated code performance, either through the use of additional compiler options, or post-Adifor3.0 code modifications.

Differentiation Task Deliverables:

1. All NASA-delivered codes and sample input/output files
2. All final pre-Adifor3.0 code, auxiliary files, and scripts
3. All final Adifor3.0-generated code
4. All final Contractor-generated gradient code driver modules, scripts, and Makefiles
5. All final execution correctness verification results
6. All final derivative accuracy verification results
7. All final execution performance verification results
8. All documentation of attempts, whether successful or not, to exceed subtask requirements, as appropriate.
9. All Contractor-generated gradient code driver modules, scripts, Makefiles needed to achieve improved user application time and/or gradient code execution performance time in excess of the subtask requirements.

Task Schedule:

01/01/01 - NASA receives Authority To Proceed
01/31/01 - NASA Selection of analysis code version, specification of dependent and independent variables, and test case(s) complete
Begin R1 block
~~02/01/01~~ ***09/01/01*** - NASA transfer of codes to Contractor complete; Contractor work begins
~~03/31/01~~ ***10/31/01*** - Test NASA delivered code
~~05/31/01~~ ***12/31/01*** - Contractor non-inertial frame of reference modifications to CFL3Dv6 complete
~~06/30/01~~ ***01/30/02*** - Contractor verification for correctness of modifications complete

	Task Order Number: 27RAE Revision: 1 Date of Revision: 8/24/01 Title: Computational Fluids Laboratory 3-Dimensional (CFL3D) Code Modification

	~~07/31/01~~ ***02/28/02*** – Contractor differentiation and verification of accuracy of derivatives complete **End R1 block** Task Performance Metrics: 1. Subtasks are completed within schedule and within the agreed upon cost 2. Subtasks fulfill the standards to meet or exceed the subtask requirements
3.	Government Furnished Items: Analysis codes and sample input/output files for the differentiation Tasks, training in the use of the Adifor3.0 Automatic Differentiation tool, access to the Adifor3.0 Automatic Differentiation tool, specification of independent and dependent variables for differentiation, formulation and implementation references.
4.	Other information needed for performance of task: 1. The Contractor shall perform all computations on UNIX-based platforms, unless otherwise agreed upon in discussions with NASA. 2. The Contractor agrees that all deliverables will be owned by NASA and can be used and distributed by NASA with no restrictions imposed by the Contractor. The Contractor agrees that all deliverables will be owned by NASA and can be used and distributed by NASA with no restrictions imposed by the Contractor. 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.
	5. Security clearance required for performance of work: None applicable. Some issues with respect to code distribution to the Contractor may need to be addressed.
	6. Period of Performance: Planned start date: 02/01/01 Completion date: R1 ~~08/31/01~~ ***2/28/02***

Task Order Number: 27RAE Revision: 1 Date of Revision: 8/24/01
Title: Computational Fluids Laboratory 3-Dimensional (CFL3D) Code Modification

7. NASA Technical Monitor: Lawrence Green
M/S: 159 Phone: 757-864-2228
NASA Competency/Other Technical Coordinator: Marguerite Verlander
M/S: 327 Phone: 757-864-1944

Task Order Number: 27RBG Revision 8 Date of Revision: 01/07/05

Title: Global Pressure and Temperature Sensing Paints (PSP/TSP)

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

This Task Order represents a continuation of [R1]SAMS NAS1-00135 Task 27RBG and involves the [R1]production of advanced pressure- (PSP) and temperature-sensitive paint (TSP) technology in support of NASA LaRC [R1]advanced diagnostic development and implementation.

For original issued version of SOW, see ETOS file *27RBG.doc*

Revision 1: Extends the period of performance ten months in continuation of NASA's support requirements and redefines the requirements for the new period of performance (see [R1] above and below).

Revision 2: Extends the period of performance twelve months in continuation of NASA's support requirements and continues and/or updates the requirements (including DOD facility support) for the new period of performance (see [R2] below).

Revision 3: Redefines requirements for Subtask 3 and travel.

Revision 4: Extends the period of performance 12 months in continuation of NASA's support requirements and continues and/or updates the requirements for the new period of performance, including the addition of a new Subtask 4 (see [R4] below).

Revision 5: Extends the period of performance 2 months to December 31, 2004, in continuation of NASA's support, adds Subtask 5, and redefines subtask and travel requirements (see [R5] below).

Revision 6: Redefines requirements for Subtask 5, including a schedule omission, and documents the change in technical monitor (see [R6] below).

Revision 7: Extends the period of performance 6 months to June 30, 2005 in continuation of NASA's support requirements (see [R7] below).

Revision 8: Eliminates Subtask 5 (see [R8] below).

2. Description of the Work to be Performed:

This task order encompasses the modification, formulation, development and testing of pressure and temperature sensing paint (PSP/TSP) formulations for global pressure and temperature measurement applications on models in LaRC [R2] and DOD facilities. The Contractor shall perform the following specific subtasks in order to fully characterize luminescent paint sensor materials and instrumentation for global PSP/TSP over the applicable range of operation with regard to temperature and pressure:

1. The Contractor shall [R1]produce PSP and TSP formulations in sufficient quantities for application to models targeted for [R2] wind-tunnel tests [R5]at NASA Langley and other installations. Successful completion of Subtask 1 will require: a) determination of the optimum paint formulation for each test, and b) characterization of the pressure and temperature sensitivity and physical characteristics of each formulation applied to test models.

characteristics of each formulation applied to test models.

Deliverables: The Contractor shall develop and provide:

1. A detailed summary report [R1]that includes: a) paint characterization data from for each wind-tunnel test, and b) SOP (standard operating procedure) for the preparation, application [R1]and removal of each paint system delivered for wind tunnel operations.

Schedule of Deliverables: Subtask 1 shall be completed by [R7R5]~~December 31, 2004~~ June 30, 2005. [R1]Paints shall be provided to meet the yet-to-be-determined wind-tunnel testing deadlines.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 1 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 Deliverables meeting the specifications provided in the Description of Work for Subtask 1 by the completion date specified for Subtask 1.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 1 deliverables [R1]with improvements in paint formulation and/or the development of application techniques that require less than two hours, and meeting all other requirements provided in the Subtask 1 Description of Work by the completion date specified for Subtask 1.

Begin [R1] block requirements redefinition

2. The Contractor shall support the implementation of PSP measurement techniques in the [R5]Transonic Gas Dynamics Facility (TGF*)* at Wright Patterson Air Force Base, OH for a one-week period in [R5]FY 2004 to be determined. Specific subtasks include: a) producing and applying a time-resolved PSP (TR-PSP) on a [R5]wind tunnel model, b) supporting the installation and setup of PSP hardware, and c) [R2]supporting the data acquisition and analyses.

Deliverables: The Contractor shall develop and provide:

3. A detailed summary report that includes: paint formulation preparation and

application protocols and pressure/temperature sensitivity characterization data R2~~and b) fully reduced PSP results from both tests in the LFST~~.

End R1 block requirements redefinition

Schedule of Deliverables: Subtask 2 shall be completed by R5December 31, 2004.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 2 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 2 Deliverables meeting the specifications provided in the Description of Work for Subtask 2 by the completion date specified for Subtask 2.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 2 deliverables with R1 improvement of measurement and analysis techniques that enable near-real time data delivery and meeting all other requirements provided in the Subtask 2 Description of Work by the completion date specified for Subtask 2.

Begin R1 block requirements redefinition

3. The Contractor shall develop, characterize, and implement PSP R3and TSP formulations that exhibit adequate pressure and temperature sensitivity over broad ranges of temperature (-150 - 50°C) and pressure (vacuum – 30 psia) to enable testing in cryogenic R5facilities.

Deliverables: The Contractor shall develop and provide:

3. A detailed summary report that includes: a) paint formulation preparation and application/removal protocols, and b) pressure/temperature sensitivity and surface roughness/thickness characterization data.

End R1 block requirements redefinition

Schedule of Deliverables: Subtask 3 shall be completed by R5December 31, 2004.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 3 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 3 Deliverables meeting the specifications provided in the Description of Work for Subtask 3 by the completion date specified for Subtask 3.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 3 deliverables with [R1]the development of PSP formulations [R3]capable of being rapidly applied and removed with reduced environmental toxicity, and meeting all other requirements provided in the Subtask 3 Description of Work by the completion date specified for Subtask 3.

Begin [R4] block requirements addition

4. The Contractor shall design and integrate PSP [R5]~~and TSP~~ measurement approaches that exhibit adequate pressure and temperature sensitivity over broad ranges of temperature [R5](20 – 200°C) and pressure (vacuum – 30 psia) to support testing in [R5]hypersonic test facilities.

Deliverables: The Contractor shall develop and provide:

4. A detailed summary report that includes: a) paint formulation preparation and application/removal protocols, b) pressure/temperature sensitivity and surface roughness/thickness characterization data, and c) PSP [R5]~~and/or TSP~~ results from [R5]facility tests.

Schedule of Deliverables: Subtask 4 shall be completed by [R5]December 31, 2004.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 4 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 4 Deliverables meeting the specifications provided in the Description of Work for Subtask 4 by the completion date specified for Subtask 4.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 4 deliverables with the development of PSP formulations capable of being rapidly applied and removed with reduced environmental toxicity, and meeting all other requirements provided in the Subtask 4 Description of Work by the completion date specified for Subtask 4.

End R4 block requirements addition
Begin R5 block addition

5. R8 ***(Eliminated)*** ~~The Contractor shall design and support R6elements for the construction of a pressure and temperature calibration apparatus R6capable of measuring dynamic pressure fluctuations~~.

End R5 block addition

3. Government Furnished Items:

Office and laboratory space will be provided in Building 1200. Desk/work areas with specialized desktop computers, printers, and software and supplies will be provided. R1All chemical resources required to produce the PSP formulations and all specialized hardware requirements discussed in the Subtasks will be provided for these efforts.

4. Other information needed for performance of task:

Begin R1 block requirements redefinition
The Contractor(s) will be required to travel to R5the PSP Workshop (Indianapolis, IN, four nights) to interact with experts in the field and to Dayton, OH (six nights) to perform wind tunnel tests at Wright Patterson Air Force Base facilities.
End R1 block requirements redefinition
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.

5. Security clearance required for performance of work:

All work will be unclassified.

6. Period of Performance:

Planned start date:	R1 ~~01/02/01~~	Completion date:	R1 ~~12/31/01~~
	R2 ~~01/01/02~~		R2 ~~10/31/02~~
	11/01/02		R4 ~~10/31/03~~
			R5 ~~10/31/04~~
			R7 ~~12/31/04~~
			06/30/05

Task Order Number: 27RBG Revision 8 Date of Revision: 01/07/05

Title: Global Pressure and Temperature Sensing Paints (PSP/TSP)

7.	**NASA Technical Monitor**: R6 Dr. A. Neal Watkins M/S: 493 Phone: 757-864-4741 **NASA Competency Coordinator:** AAAC/Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 27RDC Revision: 3 Date of Revision: 9/16/02

Title: R1 Biomimetic Wing Configuration Study and Off-axis Supersonic Blowing Analysis

1.	**Purpose, Objective or Background of Work to be Performed:** This work is continuation work to the R1 FY01 27RDC requirements performed by Analytical Mechanics Associates, Inc. R1 The work to be performed under this revision will consist of two subtasks. First subtask is to perform R3 ***vehicle*** configuration studies R3 ***on governement supplied geometries*** using Computational Fluid Dynamics (CFD) methods and high-order panel methods. The objective is to R3 ***evaluate vehicle configurations with unique and non-planar wing designs for performance (lift/drag), dynamic properties (control effectors/dynamic derivatives) and sensitivity to geometry changes.*** Second subtask is to perform analyses of R2 aerodynamic characteristics of the wings of small aircraft flying in close proximity to one another. For original issued version of SOW, see ETOS file *27RDC.doc.* Revision 1: Extends the period of performance one year in continuation of NASA's support requirements, redefines the requirements for the new period of performance, and changes title (see R1 above and below). Revision 2: Extends the period of performance in continuation of NASA's support with updated requirements and new Technical Monitor for FY/CY03 (see R2 above and below). Revision 3: Removes completed task in hypersonic flow, expands task one from wing analysis to vehicle analysis, extends the period of performance one year to 30 Nov 04 (see R3 below).
2.	**Description of the Work to be Performed:** The Contractor shall perform the following R3 ***two*** subtasks: **Begin R1 block requirements redefinition** 1. **Vehicle Configuration Studies:** Perform CFD and panel-method computations to evaluate the performance of government-supplied R3 ***vehicle configurations***. R2 This work includes ***calculation of dynamic derivatives and*** computational examination of the sensitivity of these solutions to variations in wing geometry. The results shall be compared to government supplied experimental data (oil flow, pressure sensitive paint, and coefficient of pressure) R3 ***where available***. **Deliverables:** • Monthly technical reports, • CFD and panel-method solutions for R3 ***vehicle configuration***s provided by government, • R3 ***Archival records of software and grid data used in producing any published results***. **Metrics**: • • - • Panel solution R3 ***with dynamic derivatives for vehicle configuration*** one month after geometry provided by government/exceeds by 2 weeks after receipt of geometry from government.

- [R3]***CFD solution for fixed vehicle configuration within 6 weeks after geometry provided by government/exceeds by 2 weeks after receipt of geometry from government***.

Begin [R2] block addition

2. **Small Aircraft Formation Flying Study:** Perform CFD panel method computations of aerodynamic interactions between wings of closely spaced small aircraft flying in formation for a government-supplied small aircraft geometry. Analyze and estimate uncertainties in aerodynamic coefficients for this geometry with variations in geometrical and other parameters.

   Deliverables:
   - Monthly technical reports,
   - CFD and panel-method solutions for experimental scenarios provided by government,
   - Final report on results of study, [R3]***including documentation of any software generated***.

   Metrics:
   - Final report and compilation of data by 30 Nov. [R3]***04***/exceeds by 30 Sept. [R3]***04***.

End [R2] block addition

3.Off-axis Supersonic Blowing Under Hypersonic Conditions: [R3]*(Completed)*

3. **<u>Government Furnished Items</u>:**

- Access to a government-supplied laboratory workstation with GASP CFD , [R2]PMARC panel-code and USM3D software. Access to multiple-cpu computer cluster for parallel processing. The Contractor does not require ODIN computer.

4. **<u>Other information needed for performance of task</u>:**

- No travel will be required.
- Any information technology (IT) provided under this task must be Year 2000 compliant. To ensure this result, the Contractor shall provide documentation<u>, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance.

5. **<u>Security clearance required for performance of work</u>:**

- No security clearance will be required.

6. **<u>Period of Performance</u>:**

Planned start date: [R1]1 Jan. 02

Completion date: [R1R2]~~31 Dec. 02~~

[R3]~~30 Nov. 03~~

30 Nov. 04

Task Order Number: 27RDC Revision: 3 Date of Revision: 9/16/02

Title: R1Biomimetic Wing Configuration Study and Off-axis Supersonic Blowing Analysis

7.	**NASA Technical Monitor*:*** R2Dave Cox M/S: 161 Phone: 757-864-6658 NASA Competency/Other Technical Coordinator: Anita Thomas M/S: 162 Phone: 757-864-9119

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	
	Task Order Number: 27RFF Revision: ____ Date of Revision: Title: SAGE III ISS Flight Model, Mass Model & GSE Design and Analysis

1.	Purpose, Objective or Background of Work to be Performed: Update existing drawings to reflect changes to the SAGE (Stratospheric Gas and Aerosol Experiment) III/ISS Mass Model and to provide ground support equipment in support of the SAGE III International Space Station (ISS) instrument (RTA 495-40-00-01) currently funded under Earth Observing System (EOS). The specific objective of the work to be performed under the present task is to modify the SAGE III ISS Mass Model and to design fixtures in support of the SAGE III ISS test program.
2.	Description of the Work to be Performed: The Contractor shall modify the existing drawings that were completed for the ISS Mass Model (under SAERS Contract NAS1-96013, Task Order Number RF18). Approved drawings shall be delivered to Chip Holloway or his designee. The drawings shall be completed using the Pro-Engineer CAD source code. Deliverables. Paper and electronic copies of the updated assembly drawings representing the "as-built" configuration of the mass model including drawing card shall be deliverables. Performance: Performance metrics will be based upon the following criteria: (1) The successful modification of drawings that accurately reflect the current "as-built" assembly configuration of the SAGE III/ISS Mass Model. (2) Ability to meet the delivery schedule.
3.	Government Furnished Items: Existing Drawings of the SAGE III/ISS Mass Model
4.	Other information needed for performance of task: None required
5.	Security clearance required for performance of work: None
6.	Period of Performance: Planned start date: March 22. 2001 Completion date: April 16, 2001
7.	NASA Technical Monitor: Chip Holloway M/S: 432 Phone: 757-864-7090

Subtask Order Number: 28RAC Revision: 0 Update 1 Date of Revision: 3/26/02

Title: Advanced Air Traffic Operations Scenarios

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

The air transportation system provides a vital part of the US and global economic infrastructure. In recent years, this system has experienced rapid growth in aircraft operations and passengers carried. This rapid growth in travel demand has not been matched by increases in the ability of the airport and airspace system to handle a greater volume of traffic. As a result, the air transportation system is approaching capacity and in the next 5-10 years will see excessive delays or significant constraints on service unless capacity grows proportionally.

Some advanced and alternative operations concepts have been proposed by many air transportation-related organizations as potential solutions to increase capacity. However, there has been no detailed definition of specific traffic patterns or scenarios and no systematic quantifiable analysis to assess the effectiveness of these proposed alternative operations scenarios at local or national levels.

Update 1: Increases number of trips in Section 4 (see [U1] below).

2. **Description of the Work to be Performed:**

Objective: Develop, simulate, and analyze advanced air traffic operations scenarios that have maximum flexibility for freedom of movement and minimum constraints and restrictions such that they increase the air transportation system capability to transport travelers and cargo.

Subtask 1: Develop multiple traffic flow and air traffic management scenarios for a non-controlled airport and terminal area, and for non-controlled airspace between multiple regional airports. The scenarios shall be 'free flight-type' and should include self-separation, self-sequencing, self-targeting, and combined human and automated monitoring and control of vehicle movements. The scenarios shall be defined such that different encounters, conditions, equipment/technologies, event horizons, and aircraft categories (e.g., single engine general aviation, regional jets, large transports) are considered. Scenarios shall be defined such that, as a minimum, current levels of air transportation safety are maintained. Scenarios should be developed incorporating results of literature searches, consultation with technical area experts, and personal experiential expertise and insight.

Subtask 2: Conduct simulations of the traffic flow and air traffic management scenarios. Output data sets/files shall include parameters that define the airport capacity pareto frontiers (arrivals/departures), airspace volume densities (state vector, targeting, number of aircraft and separations, transit and dwell times, and service rates), number of conflicts per airspace volume, and real-time traffic flow graphical displays. Results shall compare airport capacity and volume density relative to each scenario and to a baseline scenario that corresponds to current National Airspace System operations. Output data sets/files will be used as overall evaluation result outputs and also as input files to analysis algorithms to assess national system-level impacts (economic, delay, throughput) of the scenarios.

Subtask 3: Conduct analyses, corresponding to each of the scenarios in Subtask 2, that extrapolate the simulation results to the total national airspace system. The analyses shall estimate aircraft and volume density parameters for notional and actual airspace sectors that are consistent with the implementation of the advanced scenarios. The analyses shall include approximately 3,000 airports, including major hub and spoke airports, regional airports, and the large number of general purpose airports that are included in the FAA's National Program for an Integrated Airport System. The analyses may use traffic flows and schedules that correspond to Official Airline Guide, current hub-and-spoke operations, segmented user generated/created origin/destination city pairs, demographic forecasts, or any combination thereof. Output data sets/files shall describe, at national system-level, the impacts of the advanced scenarios on the air transportation system including number of operations, enplanements, delays, and economics.

Deliverables:

1) Subtask 1: definition and input data files of scenarios as described in Subtask 1.
2) Subtask 2: output data sets/files and results as described in Subtask 2.
3) Subtask 3: output data sets/files and results as described in Subtask 3.

Schedule:

1) Subtask 1: due July 30, 2002
2) Subtask 2: due September 30, 2002.
3) Subtask 3: due December 30, 2002.

Performance Metrics: The following will be used to determine the quality of Contractor Subtask performance, relative to the Subtask requirements:

Contractor technical status and progress reported monthly, tracked against the scheduled time allotted will be used to monitor the Contractor's performance.

Performance Standards: The following performance standards will apply:

Meets performance defined by Subtasks 1, 2 and 3 delivery by scheduled completion date.

Exceeds performance defined by:

Defines, develops, and graphically displays various correlations and combinations of input/output and/or output/output data from Subtasks 1, 2 and 3 (e.g., delay per airspace volume per scenario) that identifies critical air transportation system performance parameters and trends.

	Subtask Order Number: 28RAC Revision: 0 Update 1 Date of Revision: 3/26/02 Title: Advanced Air Traffic Operations Scenarios

3.	**Government Furnished Items**: A. Access to existing specialized analysis tools required to perform these Subtasks B. Access to existing models and simulations required to perform these Subtasks C. Access to the existing databases required to perform these Subtasks
4.	**Other information needed for performance of task**: It is anticipated that the Contractor will need to travel to U1 ~~two~~ (~~2~~) ***four (4)*** technical interchange meetings as coordinated with the Technical Monitor.
5.	**Security clearance required for performance of work**: Access to the databases and models maintained by the Contractor shall be restricted to parties approved by Systems Analysis Branch.
6.	**Period of Performance**: Planned start date: January 14, 2002 Completion date: December 30, 2002
7.	**NASA Technical Monitor**: Mr. Robert E. Yackovetsky M/S: 348 Phone: 757-864-3844 **NASA Competency/Other Technical Coordinator**: ASCAC/Ms. Rita Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 28RBG Revision: 4 Date of Revision: 09/05/03
Title: Oxidation Catalyst Preparation and Testing

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

This Task Order represents a continuation of R1SAMS NAS1-00135 Task 28RBG and encompasses the fabrication, testing, modification, and development of R1oxidation and reduction catalyst formulations for use in R1the development of internal-combustion engine emission remediation applications. In addition, catalyst samples will be: 1) produced for external customer testing targeted for sensor and air purification applications, and 2) received from external candidate catalyst manufacturers and tested in LaRC facilities to determine performance relative to samples produced in house.

For original issued version of SOW, see ETOS file *28RBG.doc*
Revision 1: Extends the period of performance ten months in continuation of NASA's support requirements and redefines/adds requirements for the new period of performance (see R1 above and below).
Revision 2: Extends the period of performance twelve months in continuation of NASA's support requirements with some anticipated volume reduction in Subtasks 2 and 3 for the new period of performance (see R2 below).
Revision 3: Adds requirements as new Subtask 4 (see R3 below).
Revision 4: Extends the period of performance 12 months in continuation of NASA's support requirements and adds requirements as new Subtask 5 (see R4 below).

2. **Description of the Work to be Performed:**

This task order encompasses the fabrication, testing, modification, and development of low-temperature oxidation catalyst chemical formulations for use in development of R3air purification and gaseous emissions controls systems. The Contractor shall perform the following specific subtasks in order to accomplish these objectives:

1. The Contractor shall provide chemical development and production of R1500-g of LaRC platinized tin oxide on silica gel catalyst for external testing.

Deliverables: The Contractor shall develop and provide by October 31, R2~~2002~~ R4~~2003~~ ***2004***:

1. A detailed summary report of the standard operating procedures for the preparation of R1the individual catalyst formulations designated in Subtask 1 above.
2. R1Test calibration data, when possible, on delivered samples.

Metrics:

Meets standards:

On-time within-cost deliverables meeting specifications provided above by the specified completion date.

Exceeds Standards:

Contractor-suggested process/procedure changes, accepted by the Government, that result in improved process performance and/or findings in the report that recommend alternative concepts for enhancing process performance, reducing costs, or significantly increasing product quality.

2. R1The Contractor shall test and evaluate catalyst samples (< R2~~10~~ 5) made by the LaRC protocol by LaRC/TCPO-solicited companies interested in licensing the manufacturing rights.

Deliverables: The Contractor shall develop and provide by October 31, R2~~2002~~ R4~~2003~~ ***2004***:

3. A detailed summary report of the R1measurement protocols implemented to recover catalytic performance data for samples received from external parties.
4. A detailed summary report of R1the test results from each sample received and tested.

Metrics:

Meets standards:

On-time within-cost deliverables meeting specifications provided above by the specified completion date.

Exceeds Standards:

R1Contractor-suggested process/procedure changes, accepted by the Government, that result in improved process performance and/or findings in the report that recommend alternative concepts for enhancing process performance, reducing costs, or significantly increasing product quality.

Begin R1 block requirements addition

3. The Contractor shall produce and characterize LaRC three-way catalyst formulations that contain the minimum quantities of the elements necessary to effect oxidation of carbon monoxide and hydrocarbons and reduction of nitrogen oxide (NOx) species to EPA-mandated levels.
   a. Produce full-scale prototypes (<[R2]~~10~~ 5) for external engine performance tests.
   b. Produce laboratory-scale prototypes (<[R2]~~10~~ 5) for internal catalyst efficiency testing using in-house LaRC measurement capabilities that include, but are not limited to: Fourier transform infrared (FTIR) spectrometer-based catalytic efficiency and gas adsorption measurement systems.
   c. Determine optimized materials production protocol through internal and external performance testing in terms of precious metal (e.g., Pt, Pd, Ru, Rh, Ir, among others) and reducible metal oxide (e.g., tin oxide, ceria, zirconia) loadings and relative ratios.
   d. Interact with LaRC commercialization partners during program reviews to present and discuss internal and external testing results and their impact on continuing developmental efforts.

Deliverables: The Contractor shall develop and provide by October 31, [R2]~~2002~~ [R4]~~2003~~ ***2004***:

5. A detailed summary report of the standard operating procedures for the preparation of catalyst formulations designated a - c in Subtask 3 above.
6. The delivery of refined and finished cordierite-supported samples configured for testing in both a commercial testing facility and NASA laboratories as requested by our industrial technology commercialization partner.

Metrics:

Meets standards:

On-time within-cost deliverables meeting specifications provided above by the specified completion date.

Exceeds Standards:

Contractor-suggested process/procedure changes, accepted by the Government, that result in improved process performance and/or findings in the final report that recommend alternative concepts for enhancing process performance, reducing costs, or significantly increasing product quality.

Task Order Number: 28RBG Revision: 4 Date of Revision: 09/05/03

Title: Oxidation Catalyst Preparation and Testing

End R1 block requirements addition

Begin R3 block requirements addition

4. The Contractor shall develop a formaldehyde remediation catalytic insert suitable for deployment in industrial smoke stacks.

   Contractor support is required to:

   a. Perform fluid-dynamic calculations to model the stack flow properties to recover architecture-dependent pollutant residency times and determine potential of catalyst system to reduce formaldehyde concentrations from ~40 ppm to less than 12 ppm.
   b. Design catalytic stack insert geometry and in-stack location to optimize efficiency (commercial partner produces sub-scale pilot to accommodate existing catalytic brick substrates).
   c. Receive, setup, and test pilot system for formaldehyde removal.
   d. Interact with LaRC commercialization partners during program reviews to present and discuss internal and external testing results and their impact on continuing developmental efforts.

   Deliverables: The Contractor shall develop and provide by October 31, R4 ~~2003~~ ***2004***:

   7. A detailed summary report of the standard operating procedures for the preparation of catalyst formulations designated a - d above.
   8. The delivery of samples configured for testing in both a commercial testing facility and NASA laboratories as requested by our industrial technology commercialization partner.

   Metrics:

   Meets standards:

   On-time within-cost deliverables meeting specifications provided above by the specified completion date.

   Exceeds Standards:

   Contractor-suggested process/procedure changes, accepted by the Government, that result in improved process performance and/or findings in the final report that recommend alternative concepts for enhancing process performance, reducing costs, or significantly increasing product quality.

End [R3] block requirements addition

Begin [R4] block requirements addition

5. The Contractor shall support development, integration and demonstration testing of the formaldehyde remediation catalytic insert in a West Virginia fiber-glass manufacturing facility.

   Contractor support is required to:

   e. Travel to West Virginia processing plant and support the installation and testing of the catalytic insert.
   f. Interact with LaRC commercialization partners during testing to present and discuss internal and external testing results and their impact on continuing developmental efforts.

   Deliverables: The Contractor shall develop and provide by October 31, 2004:

   9. A detailed summary report of results of the on-site testing activity.

   Metrics:

   Meets standards:

   On-time within-cost deliverables meeting specifications provided above by the specified completion date.

   Exceeds Standards:

   Contractor-suggested process/procedure changes, accepted by the Government, that result in improved process performance and/or findings in the final report that recommend alternative concepts for enhancing process performance, reducing costs, or significantly increasing product quality.

End [R4] block requirements addition

3. **Government Furnished Items:**

Office and laboratory space will be provided in Building 1200. Desk/work areas with specialized desktop computers, printers, and specialized software and supplies will be provided [R1]as well as all specialized laboratory materials and hardware required to effect all Subtasks defined above.

4. **Other information needed for performance of task:**

Task Order Number: 28RBG Revision: 4 Date of Revision: 09/05/03
Title: Oxidation Catalyst Preparation and Testing

	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.
5.	**Security clearance required for performance of work:** All work will be unclassified.
6.	**Period of Performance:** Planned start date: R1 ~~01/02/01~~ R2 ~~01/02/02~~ 11/01/02 Completion date: R1 ~~12/31/01~~ R2 ~~10/31/02~~ R4 ~~10/31/03~~ ***10/31/04***
7.	**NASA Technical Monitor**: Dr. Jeffrey D. Jordan M/S: 493 Phone: 757-864-5067 **NASA Competency Coordinator:** AAC/Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 28RDD Revision: 7 Date of Revision: 11/10/04

Title: ATOL Enhancement and [R4]Simulation Support

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

[R4]The purpose of this task is to enhance the capabilities of the NASA Air Traffic Operations Lab (ATOL), currently located in Building [R5]1220, to support both piloted and batch workstation simulation studies of new air-ground traffic management concepts and of new guidance concepts and procedures for reducing aircraft noise. [R4]This task also involves participating as necessary in the design, performance, and analysis of the simulation studies themselves.

The enhancements of the ATOL include extending and/or modifying the current capabilities of the lab's communications architecture, and integrating new [R4]simulation components supplied by NASA or other contractors into the existing lab [R4]architecture. In addition, this task [R4]will also require specific modifications to individual components of the ATOL to support a particular experiment or series of experiments, and may require assistance with the design of these experiments, the development of experimental scenarios, the actual performance of the experiment with subject pilots, and the analysis of collected data to produce research results.

Many of these activities will be performed in cooperation with other on-site and off-site contractors to NASA. Close coordination with these other contractors will be required, although all direct task guidance will come directly from the NASA Technical Monitor.

In general, the subtasks under this task order are to be completed by [R1]~~September 30, 2001~~ [R3]~~September 30, 2002~~ [R4]~~December 31,2002~~ [R5]~~September 30, 2003~~ [R6]~~September 30, 2004~~ [R7]~~December 31, 2004~~ ***December 31, 2005***.

Revision History

Revision 1: Extends the completion date in the work description to reflect NASA's need for continued support. Specific deliverables and schedule for the coming year will be defined later.

Revision 2: Redefines work with specific deliverables and schedule to accommodate some change in emphasis for FY 02.

Revision 3: Changes task order completion date to December 31, 2002 and adds schedule tracking subtasks.

For details of original, and Revisions 1 through Revision 3 SOWs see ETOS *doc* files *28RDD, 28RDD01, 28RDD02, and 28RDD03*, respectively.

Revision 4: Extends the period of performance through September 30, 2003, in continuation of NASA's support with title update and updated and/or extensively redefined requirements to emphasize new tasks that support both AATT and QAT program goals for the new period of performance (see [R4] above and below).

Revision 5: Redefines and extends work to emphasize additional tasks to support both AATT and QAT program goals for FY 04, especially with respect to the joint Ames/Langley simulation experiment, and extends completion date to September 30, 2004 with travel requirements added (see [R5] above and below).

Revision 6: Extends the period of performance three months to December 31, 2004 to allow completion of work affected by programmatic and other delays external to the task order (see [R6]

	above and below). Revision 7: Redefines work to align tasks with EAS (Efficient Aircraft Spacing) Airborne Separation program goals for FY05, and extends completion date one year to December 31, 2005 (see R7 above and below).
2.	The Contractor shall perform the following subtasks: **Begin R4 block requirements redefinition** 1. Support the integration of the Research Prototype Flight Management System (RPFMS) with successive builds of the NASA-supplied Aircraft Simulation for Traffic Operations Research (ASTOR). This task will require close cooperation with both on-site and off-site contractors working under another contract. **Begin R5block redefinition/extension** *****Begin R7 block redefinition***** 2. Enhance the capabilities of the RPFMS by redesigning the access and use of aircraft performance data so that the RPFMS uses the identical data source as the ASTOR airframe equations of motion. The RPFMS may use existing or modified versions of the LaSRS++ library routines to accomplish this task (thereby ensuring that ASTOR and RPFMS use the same code as well as the same data), but other means may also be used. The intention is to develop sets of detailed performance data for several different aircraft types, including (but not limited to) the Boeing B-777, the Airbus A-330/340 family, and the Boeing B-737 family. 3. Enhance the capabilities of the RPFMS by implementing new simulation mode transition logic (including TRIM mode, which may require adjusting the initial aircraft position to ensure that no lateral or vertical path errors exist). The requirements for this new mode transition logic will be jointly developed with NASA personnel and other contractors working under another contract. 4. Enhance the capabilities of the RPFMS by implementing advanced simulation time management techniques to better support robust real-time operation as well as fast-time batch runs. 5. Enhance the capabilities of the RPFMS by designing and implementing enroute step-climb capability, including the computation of optimum cruise altitudes. **End R5 block redefinition/extension** 6. Enhance the capabilities of the RPFMS by modifying the trajectory generation code to use the predicted EPR (thrust) limit values for each route segment. 7. Enhance the capabilities of the RPFMS by integrating the AMSTAR algorithm for generating paired-dependent speed guidance for merging and spacing operations during the arrival and approach phases of flight. The AMSTAR algorithm is currently imbedded within another component (called PDS) of the ASTOR simulation; the intent of this subtask is to bring the PDS capability within the RPFMS process. 8. Review the RPFMS code base and perform "code cleanup" tasks, such as eliminating duplicate structure or class definitions, using a single set of common global constants,

substituting enumeration types for numeric values where appropriate, and restructuring the code to better prepare it for the implementation or integration of known future capabilities.

****End R7 block redefinition****

9. Design and implement software to support the simultaneous execution of up to five PCPlane/RPFMS combinations, each of which can be individually accessed and controlled by a single set of flight deck displays and controls (e.g., PFD, ND, EICAS, MCP, EFISCP, R7***XCP***, ***ACP***, and MCDU). The purpose of this task is to create a pseudo pilot station on which a researcher can run multiple aircraft simultaneously on the same machine, and can switch his displays/controls from communicating with one simulation to another and back again as needed.

.**End R4 block requirements redefinition**

****Begin R7 block redefinition****

10. Provide to the NASA Technical Monitor a detailed schedule for the work under Subtasks 1 through 9, including expected start date and duration for the individual tasks that make up each Subtask. The individual tasks for each Subtask shall be identified on the basis of their duration (e.g., more than a day or so of effort) or their level of importance to the completion of the Subtask (e.g., critical capabilities that impact the progress of other tasks).
11. Report to the NASA Technical Monitor brief weekly updates of the schedule provided in Subtask 10, showing any changes, additions, or deletions to the individual tasks within each Subtask and any changes in the completion status of the individual tasks within each Subtask.
12. Contribute to the development of simulation and in-flight evaluation research plans, including conceptual algorithm development, statistical experiment design, scenarios for the experimental runs, selection criteria for test subjects, performance of the experimental runs with test subjects, and recommendations for modifications to ATOL or onboard flight system software to support the research goals.
13. Design and implement modifications to individual components of the ATOL as specified in any NASA-approved *Experiment Requirements Documentation* or *System Modification Documentation* supplied by the NASA Technical Monitor.
14. Report to the NASA Technical Monitor, by experiment or modification, the estimated cost and schedule for completing the work under Subtasks 12 and 13.
15. Report to the NASA Technical Monitor, by experiment or modification, the cost of Subtasks 12 through 14.

****End R7 block redefinition****

Deliverables:

(1) Software developed.
(2) Concepts, algorithms, and scenarios developed, and other experimental support provided.
(3) Schedule and requirements documentation.

(4) Documentation for architecture design and operational use of software.
(5) Report of estimated costs by experiment from R7***Subtask 14.***
(6) Report of costs by experiment from R7***Subtask 15***.

Begin R4 block schedule redefinition

*****Begin R7 block schedule redefinition*****

Schedule:

(a) Subtask 1 is expected to be an ongoing task, and shall end on ***December 31, 2005***.
(b) Subtask 2 shall be completed by ***February 28, 2005***.
(c) Subtask 3 shall be completed by ***March 31, 2005***.
(d) Subtask 4 shall be completed by ***March 31, 2005***.
(e) Subtask 5 shall be completed by ***June15, 2005***.
(f) Subtask 6 shall be completed by ***June 31, 2005***.
(g) Subtask 7 shall be completed by ***August 31, 2005***.
(h) Subtask 8 ***is expected to be an ongoing task, and shall end on December 31, 2005***.
(i) Subtask 9 shall be ***completed by September 30, 2005***.
(j) ***Subtask 10 shall be delivered within 2 weeks from the start of this revised Task Order***.
(k) ***The brief weekly schedule updates described in Subtask 11 shall be*** delivered by 4:00 p.m. Eastern Time on the last scheduled workday of each week.
(l) Subtask ***13*** shall be delivered in the timeframe indicated in the *Experiment Requirements Documentation* or *System Modification Documentation*.
(m) Subtask ***14*** shall be delivered within 2 weeks after the *Experiment Requirements Documentation* or *System Modification Documentation* is received by the contractor.
(n) Subtask ***15*** shall be delivered within 1 month after the experiment or modification is completed.

*****End R7 block schedule redefinition*****

End R4 block schedule redefinition

Metrics and Standards:

a. Delivery of the schedule and requirements documentation for Subtasks 1-R7***9***.
MEETS if delivery is 2 weeks from time the contractor receives the task order.
EXCEEDS if delivery is less than 2 weeks from time the contractor receives the task order.
b. Adherence to the software delivery schedule for Subtasks 1-R7***9***.
MEETS if required software delivered as specified in schedule.
EXCEEDS if delivered as specified in expedited delivery schedule.
c. Adherence to the software documentation delivery schedule for Subtasks 1-R7***9***.
MEETS if software documentation delivered within 2 weeks of software.
EXCEEDS if delivered as specified in expedited delivery schedule.
d. Delivery of the schedule and requirements documentation for R7***Subtasks 12 and 13***.
MEETS if delivery is 2 weeks from time the Contractor receives the *System*

	Modification or Experiment Requirements Documentation. EXCEEDS if delivery is less than 2 weeks from time the Contractor receives the *System Modification or Experiment Requirements Documentation*. e. Delivery time of cost estimate report for R7***Subtasks 12 and 13***. MEETS if delivery is 2 weeks from time the contractor receives the *System Modification* or *Experiment Requirements Documentation*. EXCEEDS if delivery is less than 2 weeks from time the contractor receives the *System Modification* or *Experiment Requirements Documentation*. f. Time to deliver the required software as specified in *System Modification or Experiment Requirements Documentation* supplied by the *NASA* for R7***Subtasks 12 and 13***. MEETS if required software delivered as specified in schedule. EXCEEDS if delivered as specified in expedited delivery schedule. g. Delivery time of cost report for R7***Subtasks 12 through 14***. MEETS if report is received 1 month after an experiment is completed. EXCEEDS if report is received 2 weeks after an experiment is completed.
3.	**Government Furnished Items**: 1. Air Traffic Operations Lab (ATOL), including multi-monitor Windows NT/2000/R4XP Workstations, peripheral hardware, and lab space for facility configuration and operation 2. Aircraft Simulation for Traffic Operations Research (ASTOR) software 3. NASA-supplied FastWin (CDU/FMS/PCPlane) software with integrated merging/self-spacing algorithms 4. NASA-supplied Autonomous Operations Planner (AOP) software 5. *Experiment requirements documentation* or *system modification documentation* supplied by the NASA Technical Monitor
4.	**Other information needed for performance of task**: R5Travel a) Possible Locations: NASA Ames Research Center (Mountain View, CA), United Air Lines Training Facility (Denver), Other AATT contractor locations (Boston Area) b) Purpose of travel: To obtain information and/or training related to performance of task c) Expected duration: Typically 1-2 days on site per travel. 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.
5.	**Security clearance required for performance of work**:

	All work will be unclassified; however, personnel may be required to complete nondisclosure agreements with NASA, industry, or airlines.
6.	**Period of Performance:** **Planned start date:** January 2, 2001 **Completion date:** R1~~September 30, 2001~~ Revision 2 start, October 1, 2001 R3~~September 30, 2002~~ Revision 3 start, October 1, 2002 R4~~December 31,2002~~ Revision 4 start, January 2, 2003 R5~~September 30, 2003~~ Revision 5 start, October 1, 2003 R6~~September 30, 2004~~ Revision 7 start January 1, 2005 R7~~December 31, 2004~~ ***December 31, 2005***
7.	**NASA Technical Monitor:** Michael T. Palmer M/S: 156A, Phone: 757-864-2044 **NASA Competency/Other Technical Coordinator:**

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	
	Task Order Number: 28RFM Revision: ____ Date of Revision: Title: Performance Evaluation of Pyrotechnic Devices

1.	Purpose, Objective or Background of Work to be Performed: The purpose of this effort is to evaluate the functionality and performance characteristics of pyrotechnic devices currently stored in Building 1158.
2.	Description of the Work to be Performed: Subtask 1. The Contractor shall test fire excess pyrotechnic devices listed on the Pyrotechnic Inventory and currently stored in the dedicated Pyrotechnic Storage Facility (Building 1158). Evaluate pyrotechnic device functionality and nominal performance characteristics, noting degraded performance due to accumulated shelf life. Deliverables: Quarterly report indicating: (1) number of attempted vs. number of successful test firings; (2) determination of pyrotechnic device nominal performance; and, (3) degradation of device performance due to extended shelf storage. Metrics: Progress will be evaluated based upon the number of test firings and performance evaluations completed Standards: Meets: Completion of evaluations by September 30, 2002. Exceeds: Completion of evaluations by May 31, 2002.
3.	Government Furnished Items: NASA will provide all materials, the explosives, the facilities for assembly and test, and the machine work needed for evaluation.
4.	Other information needed for performance of task: Langley safety procedures shall be used in the handling and testing of all pyrotechnic components. 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.
5.	Security clearance required for performance of work: None
6.	Period of Performance: Planned start date: August 13, 2001 Completion date: September 30, 2002

	Task Order Number: __28RFM_____ Revision: ____ Date of Revision: Title: Performance Evaluation of Pyrotechnic Devices

7.	NASA Technical Monitor: Richard A. Foss M/S: 424 Phone: 757-864-7049 NASA Competency/Other Technical Coordinator (*above branch level*): Dr. Thomas Shull, Assistant for Flight Systems Programmatic Implementation Systems Engineering Competency Mail Stop 430, Phone 757-864-1837

	Task Order Number: 29RAA Revision: 1 Date of Revision: 1/8/02 Title: Advanced Space Systems (Multibody Vehicle Separation Simulation)

1. **Purpose, Objective or Background of Work to be Performed:** (Originally added as Subtask 8.0 of Task Order 15RAA – now separated for technical management considerations)

The NASA Langley Research Center Vehicle Analysis Branch (VAB) develops and applies computer-aided tools in the systems analysis of advanced space transportation concepts and planetary exploration spacecraft. Engineering disciplines applied include geometry, weights and sizing, aerodynamics, aeroheating, propulsion, trajectories, structures, radiation shielding, costs, operations, and mission risk analysis. Contract support is needed, primarily:
(a) to provide improvements in the computer-aided tools and methods needed for modeling, conceptual design, analysis, and optimization of advanced transportation vehicles, systems, and subsystems,
(b) to perform analyses in selected disciplinary areas and,
(c) to provide computer software support for NASA flight projects supported by VAB.

Products from these efforts include study results, analysis method and code enhancements, user interface and visualization methods, code maintenance procedures, and distribution and porting of software to other computer systems.

Currently, the primary computational platforms are Silicon Graphics (SGI) workstations. Sun workstations, Apple Macintosh, and IBM PC or clones also host a few engineering codes critical to the systems analysis work. Specific requirements, deliverables with dates, metrics, and furnished materials are described below.

Reporting Requirements

Monthly reports are requested for all work under this task including statements of progress, problems, and resources expended.

Exceeding Minimum Performance

The "metrics" included in the task descriptions below describe minimum acceptable performance. To exceed minimum performance, the Contractor may:
(a) improve, during the course of performing a task, existing procedures and/or tools leading to increased understanding, accuracy, productivity, or reduced costs of conducting studies, or
(b) suggest innovative approaches to achieving the task goals that result in time and/ or cost savings or an improved product.
Revision 1: Adds test cases and extends the period of performance (see R1 below).

2. **Description of the Work to be Performed:**

1. Multi-body Vehicle Separation Simulation and Validation of POST II

The Contractor shall:

1. Develop multi-body simulations for a launch vehicle separation system having various

vehicle configurations using the ADAMS program.

2. Develop ADAMS test cases as needed to include all major models (aerodynamics, mass, atmosphere, etc.) and vehicle configurations (two-body, three-body, etc.). When POST II simulations are provided by government, compare ADAMS test cases with POST II simulations, and ensure that the test cases produce results consistent with the POST II simulations;
3. Provide suggestions for the improvement of modeling of the POST II simulations and the ADAMS simulations based on comparisons made;
4. Determine sources of computational inefficiencies, recommend solutions, and suggest modifications to implement that would improve efficiencies of the POST II software.

Deliverables

1) Minimum of one test case for bimese vehicle stage separation with multiple attachment points by 15 October 2001.
2) Minimum of one test case for three-body stage separation with multiple attachment points by 15 December 2001.
3) [R1] ***Minimum of one test case for crew-transfer-vehicle (CTV) mounted (a) at the nose of the orbiter, and, (b) in-tandem on the top of the orbiter vehicle by 30 January 2002.***
4) Fully functioning multi-body simulation with no known software bugs delivered on or before 15 February 2002.
5) Documentation describing the ADAMS test cases developed, and indicating the comparison between the ADAMS and POST II simulations. Monthly progress report outlining work performed – no later than one month after code delivery.
6) Documentation describing the suggestions for enhancement of the modeling of the various test cases and recommend solutions for improving computational efficiencies – no later than one month after code delivery.

Metric

1. Thoroughness of the effort as measured by inclusion of all requirements described above and by successful validation of modifications as defined above.

3. **Government Furnished Items:**

1) Access to SGI workstations, personal computers (Apple and PC's) with specialized software, and ADAMS software.

4. **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,

	Task Order Number: 29RAA Revision: 1 Date of Revision: 1/8/02 Title: Advanced Space Systems (Multibody Vehicle Separation Simulation)

	describing how the IT items demonstrate Year 2000 compliance.
5.	**Security clearance required for performance of work:** Secret clearance is not required.
6.	**Period of Performance**: Planned start date: 7/16/01 Completion date: R1 ~~1/15/02~~ ***2/15/02***
7.	**NASA Technical Monitor:** Bandu N. Pamadi M/S: 365 Phone: 757-864-9483 **NASA Competency Coordinator:** M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 29RBG Revision: 11 Date of Revision: 02/16/05

Title: Nanotechnology-Based Systems Development

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

This Task Order encompasses [R5]three nanotechnology-based activities: [R1]a) production and characterization of carbon nanotube (CNT)-based architectures, structures, and devices, b) development of electronics techniques capable of exciting and measuring micro- and nanofabricated circuit elements and complete device systems, and c) production and characterization of [R5]sensor skin technologies that contribute to vehicle autonomy.

For original issued version of SOW, see ETOS file *29RBG.doc*

Revision 1: Extends the period of performance ten months in continuation of NASA's support requirements and redefines/adds requirements for the new period of performance (see [R1] above and below).

Revision 2: Extends the period of performance twelve months in continuation of NASA's support requirements with changes in Subtasks 2 and 4 for the new period of performance (see [R2] below).

Revision 3: Redefines requirements in Subtask 1 (see [R3] above and below).

Revision 4: Extends period of performance 12 months in continuation of NASA's support requirements and adds new Subtask 5 (see [R4] below).

Change 1: Adds travel requirement omitted earlier (see [R4.1] below).

Revision 5: Extends the period of performance 2 months to December 31, 2004, in continuation of NASA's support, identifies completed subtasks, and redefines/adds requirements for the new period of performance (see [R5] above and below).

Revision 6: Redefines/adds requirements in Subtask 5 and documents technical monitor change (see [R6] below).

Revision 7: Redefines/adds requirements (deliverables) in Subtask 5 (see [R7] below).

Revision 8: Extends the schedule and period of performance 6 months to June 30, 2005 with requirements added to Subtask 2 (see [R8] below).

Revision 9: Adds new requirements as Subtask 6 (see [R9] below).

Revision 10: Descopes work elements in Subtask 5, Deliverable 4, from five (5) sensors to two (2) sensors (see [R8] below)..

Revision 11: Redefines requirements by identifying Subtask 3 as removed and extending the task period of performance and schedule for Subtasks 2 and 5 to September 30, 2005 (see [R11] below).

2. Description of the Work to be Performed:

The Contractor shall perform the following specific subtasks.

Begin [R1] block requirements redefinition

1. [R5]Completed

Begin R1 block requirements redefinition

2. The Contractor shall develop methodologies for the production and characterization of carbon nanotube (CNT)-based and/or other nano- and microsensor-element architectures, systems, and devices suitable forrecovering structural health information such as pressure, temperature, stress/strain, and/or deformation R5via methodologies that include, but are not limited to, conventional lithography; UV, electron-beam and dip-pen nanolithography, and microcontact printing. R8After successful demonstration of single devices, the Contractor shall develop methodologies to extend the architecture to arrays of single devices manufactured on flexible and rigid substrates for possible inclusion in an integrated vehicle health monitoring system.

   Deliverables: The Contractor shall develop and provide:

   1. A detailed report summarizing the methodologies developed and employed to produce CNT-based device architectures, and characterization data for the architectures produced to include scanning-electron (SEM) and atomic-force microscopy (AFM).
   2. R8Construction and delivery of 5 carbon nanotube based sensors capable of measuring strain applied to an aluminum test piece.

End R1 block requirements redefinition

Schedule of Deliverables: Subtask 2 shall be completed by R5~~October 31,~~ R2~~2002~~ R4~~2003~~ R8~~December 31, 2004~~ R11~~June 30, 2005~~ ***September 30, 2005***.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 2 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 2 Deliverables meeting specifications provided in the Description of Work for Subtask 2 by the completion date specified for Subtask 2.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 2 Deliverables with the development of a R1nanofabricated sensor with R2~~potential~~ demonstrated sensitivity to light, pressure, temperature, strain, stress, and/or deformation and meeting all other requirements provided in the Subtask 2 Description of Work by the completion date specified for Subtask 2.

Begin R1 block requirements redefinition

~~3.~~ [R11] ***Removed***

Begin [R1] block requirements addition

4. [R5]Completed

End [R1] block requirements addition

Begin [R4] block requirements addition

5. The Contractor shall develop methodologies for the production of [R5]sensor skin technologies that contribute to vehicle autonomy [R6]and electronics systems and algorithms to interrogate potential sensor skins.

   Deliverables: The Contractor shall develop and provide:
   1. A detailed summary report characterizing the new systems in terms of sensitivity to induced strain, [R5]humidity and temperature.
   2. A detailed written SOP for preparing and implementing the sensor elements.
   3. [R6]A detailed written report for electrical interrogation of sensor skin elements.
   4. [R7]Construction and delivery of [R10]~~five (5)~~ two (2) sensors capable of measuring gaseous analytes such as ammonia (NH_3), humidity, etc

   Schedule of Deliverables: Subtask 5 shall be completed by [R5]~~April~~ [R11]~~December 31 2004~~ ***September 30, 2005***.

   Metrics for Deliverables: Evaluation of Contractor performance for Subtask 5 will be based on the following:

   Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 5 Deliverables meeting the specifications provided in the Description of Work for Subtask 5 by the completion date specified for Subtask 5.

   Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 5 Deliverables with the development of sensor elements sensitive to shear and meeting all other requirements provided in the Subtask 5 Description of Work by the completion date specified for Subtask 5.

End [R4] block requirements addition

Begin [R9]block addition

6. [R9]The Contractor shall develop and maintain capabilities to transfer nanotechnology from university-based researchers to the NASA community.

Deliverables: The Contractor shall develop and provide:

1. A website facilitating technology transfer between university researchers and NASA researchers in the area of nanotechnology.
2. Maintenance of the created website to insure information is current.

Schedule of Deliverables: Subtask 6 shall be completed by June 30, 2005.

Metrics for Deliverables: Evaluation of Contractor performance for Subtask 6 will be based on the following:

Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 6 Deliverables meeting the specifications provided in the Description of Work for Subtask 6 by the completion date specified for Subtask 6.

Significantly Exceeds Minimum Acceptable Performance standards shall be deemed as having been met with the on-time within-cost Subtask 6 Deliverables with the development of the website with database interface capabilites and meeting all other requirements provided in the Subtask 6 Description of Work by the completion date specified for Subtask 6.

End [R9]block addition

3. **Government Furnished Items**:

Office and laboratory space will be provided in Building 1200. Desk/work areas with specilized desktop computers, printers, and specialized software and supplies will be provided [R1]in addition to all specialized laboratory-based equipment, materials, and supplies.

4. **Other information needed for performance of task**:

The Contractor(s) will be required to travel to the [R1]Materials Research Society Meeting (location Boston, MS, March [R2]~~2002~~ [R5]~~2003~~ 2004, 4 nights and [R5]and one other nanotechnology conference in Monterey, CA in September 2004 (4 nights) to present results from developmental efforts, interact with researchers within the field, and investigate state-of-the-art measurement science instrumentation.

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.
5.	**Security clearance required for performance of work:** All work will be unclassified.
6.	**Period of Performance:** Planned start date: [R1] ~~01/02/01~~ [R2] ~~01/02/02~~ 11/01/02 Completion date: [R1] ~~12/31/01~~ [R2] ~~10/31/02~~ [R4] ~~10/31/02~~ [R5] ~~10/31/04~~ [R8] ~~12/31/04~~ [R11] ~~6/30/2005~~ ***09/30/2005***
7.	**NASA Technical Monitor:** [R6]Dr. A. Neal Watkins M/S: 493 Phone: 757-864-4741 **NASA Competency Coordinator:** AAAC/Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2 Statement of Work

Task Order Number: 29RDD Revision: R^0C^1 Date of Revision: 8/27/02

Title: Update of Operational Performance of Sensor Systems Used to Determine Atmospheric Boundary Layer Properties

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

In support of the NASA Aircraft VOrtex Spacing System (AVOSS) project, a contractor report entitled "Operational Performance of Sensor Systems Used to Determine Atmospheric Boundary Layer Properties as Part of the NASA Aircraft Vortex Spacing System Project" (CR-2001-210835, Dr. Allen Zak, 1st author) was published. The report provides a description of the various weather sensors used in the AVOSS deployments, the assumed requirements of the sensors, the sensor performance and limitations, and recommendations for a minimum sensor suite for future AVOSS implementations. The data in the report is at least 1 year old. In support of the NASA Virtual Airspace Modeling and Simulation (VAMS) program, an updated survey of the current commercial-of-the-shelf (COTS) weather sensors needs to be performed. The sensor operational specifications will be used to define simulation models of these systems for in-house Langley concept development efforts. The survey will also support near-term field data collection efforts as part of a joint NASA/FAA wake vortex research program. In this program, a minimum common wake and weather data collection platform will be defined, and Langley will use the field data to support wake model development and operational concept investigation in support of the VAMS project. This task includes a solicitation of recommendations for field tests that would verify a minimum sensor suite, if necessary. This task requires extensive technical knowledge of weather sensor systems and the NASA AVOSS program to determine the implications of the sensor performance on follow-on programs to AVOSS. **Note:** It is anticipated that this 3-month-plus task would be considerably less expensive for NASA if Dr. Zak (ViGYAN, Inc) were available to perform the work especially in light of the required schedule.

Revision 0, Change 1: To accommodate unanticipated delays in NASA's coordination and funding, Contractor's proposed period of performance extension by 1.5 months is noted (see R0C1 below).

2. **Description of the Work to be Performed:**

An up-to-date capabilities/specifications survey of the weather sensor systems described in CR-2001-210835 shall be performed. Any significant advances in sensor technology since the information in the report was collected shall be captured. If recent advances include a sensor system not previously characterized, the specifications of this new system shall be included. The specifications/capabilities shall be reported within the context of using the sensors in a future active wake vortex avoidance solution, such as AVOSS. CR-2001-210835 also includes recommendations for a minimum weather sensor suite in a future AVOSS implementation. Some of these recommendations involve using sensors in experimental configurations or applications. Examples of this are mounting sonic anemometers on existing low-level windshear alert system (LLWAS) towers or using a pulsed lidar to measure winds for generating turbulence profiles. The results of the survey,

	recommendations for a minimum sensor suite, and suggestions for field experiments to verify and characterize the performance of these experimental suggestions shall be presented in a draft report. Deliverables: Draft report. Schedule: Draft report delivered R0C1 ~~September 15~~ ***October 31***, 2002 Metrics: Standards (meets, exceeds): Contractor meets the requirements of this SOW by delivering the draft report described above on schedule.
3.	**Government Furnished Items:** Office space. Personal computer negotiable if necessary to allow timely performance.
4.	**Other information needed for performance of task:** *May require up to four domestic trips to various vendor sites or vendor conferences*
5.	**Security clearance required for performance of work:** *none*
6.	**Period of Performance:** present – R0C1 ~~September 15~~ ***October 31***, 2002 Planned start date: ASAP Completion date: R0C1 ~~September 15~~ ***October 31***, 2002
7.	**NASA Technical Monitor:** David Rutishauser M/S: 156A Phone: 757-864-8696 **NASA Competency/Other Technical Coordinator:** AirSC/Anita Thomas M/S: 162 Phone: 757-864-9119

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 29RFJ Revision: ____ Date of Revision:

Title: GAMS SAC-D Radiation Testing Hardware

1.	Purpose, Objective or Background of Work to be Performed: The Gas and Aerosol Monitoring Sensor/Scientific Applications Satellite – D (GAMS/SAC-D) Mission combines innovative instrument design for solar occultation measurement systems and algorithms to make geophysical measurements that will contribute to NASA's Earth Science Enterprise (ESE) goals. The primary focus is on measurements of ozone (O_3), water vapor (H_2O), carbon dioxide (CO_2), aerosols, thin clouds, temperature, and pressure. Additionally, GAMS/SAC-D will directly observe the height of the tropopause so that the species measurements can be placed in context relative to the tropopause. Other measurements include the oxygen dimmer ($(O_2)_2$) and nitrogen dioxide (NO_2) for use in retrieval process and science investigations. Operational lifetime for GAMS/SAC-D is a minimum of 30 months with design lifetime specified as four years.
2.	**Description**: The Contractor shall modify, re-layout, and submit for fabrication a test board based on the GAMS IIP "photons-to-bits" board using LaRC provided hardware, including candidate CCDs (charged-couple devices) and op-amps (operational amplifiers) for the GAMS instrument. The Contractor shall functionally test the board and determine radiation test specifications based on knowledge of the planned SAC-D spacecraft radiation protection and the proposed orbit environment. The Contractor shall prepare the populated boards for radiation testing and send them to the designated sites. The Contractor shall receive reports on the progress of the testing and receive the boards back at LaRC after testing is complete. The performance measurements shall include functional tests, radiation test specifications, and progress of radiation test reports. The measurement data shall include results from the functional and radiation tests. **Schedule:** This task shall be completed by 12/31/01 and is contingent upon the timely delivery of all necessary components needed for completion of the task. Delivery of the required components is the responsibility of NASA. **Deliverables:** A report containing the measurement data from the functional and radiation tests. The Contractor is not responsible for the unit meeting the GAMS requirements but is responsible for providing the data that demonstrate the actual performance. **Performance Criteria**: The Contractor meets the minimum success criteria with procedures detailed in bullet format and component performance data that is acquired by using a single measurement technique. The Contractor exceeds the minimum criteria for procedures with comments and explanations of the rationale behind each step that would enable someone else to perform these tasks. Performance data on the system that is acquired using more than one technique and which give similar results will exceed the minimum success criteria.
3.	Government Furnished Items: Use of a lab and specialized test equipment located in Building 1202

	Task Order Number: 29RFJ Revision: ____ Date of Revision: Title: GAMS SAC-D Radiation Testing Hardware

4.	Other information needed for performance of task: Some travel to test sites will be required.
5.	Security clearance required for performance of work: None
6.	Period of Performance: Planned start date: 10/01/01 Completion date: 12/31/01
7.	NASA Technical Monitor: Bill Luck M/S: 468 Phone: 757-864-1857 NASA Competency/Other Technical Coordinator: Clayton Turner M/S: 468 Phone: 757-864-7103

Task Order Number: 30RAC Revision: 1 Date of Revision: 6/21/02

Title: Small Supersonic Transport Conceptual Design

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

This task supports the NASA Quiet Supersonic Flight Activities. In these activities, NASA is developing technology that will overcome the barriers to sustained supersonic cruise flight. The activity requires the development of innovative configurations that employ technologies that reduce sonic boom while increasing aircraft performance. The development of these configurations requires that significant configuration detail be incorporated to allow analysis at a deeper level than typical systems trades studies. This task will focus on the development and application of CAD software tools to the layout of small supersonic cruise aircraft.

Revision 1: Extends Subtasks 2 and 3 schedule and the overall period of performance four months in modification of NASA's support requirements with no increase in requirements (see [R1] below).

2. Description of the Work to be Performed:

Subtasks

- Subtask 1: Select a CAD tool

  There are a number of CAD software tools available to the Systems Analysis Branch. Other CAD tools are available from other NASA Langley organizations. The Contractor shall evaluate these tools for their suitability for the development of aircraft geometry. The Contractor may evaluate other CAD tools as well. If a superior product is identified that is not currently in use at NASA, the Contractor shall submit a statement recommending procurement of this product. A backup selection of a product already available to the NASA Systems Analysis Branch will be made to provide a viable option if procurement of the recommended product is not possible.

- Subtask 2: Develop aircraft modeling processes and primitives

  The Contractor shall use the capabilities of the selected CAD software to develop processes and component primitives that facilitate the development of aircraft geometry. The primary elements of geometry that are to be considered are external lofted lines and basic internal layout. The external loft shall be sufficient in detail and smoothness to serve as the basis for Euler CFD analysis. The components to be included are wings, fuselages, tails and fins, control surfaces, inlets, diverters and nacelles. Facility for generating models for analysis using linear aerodynamics tools shall be provided. The internal layout shall include all principal components such as basic structure, flight deck/cockpit, payloads and accommodations, fuel tanks, engines, landing gear, and major subsystem elements. Facility for extracting component locations for use in balance, inertia and structural analysis shall be provided.

- Subtask 3: Supersonic business jet model development

  The Contractor shall demonstrate the capability modeling processes and primitives described above by generating a CAD model of a supersonic business jet performance baseline configuration. Include lofted external lines and internal layout.

Deliverables:

- Subtask 1:
  - Recommendation for CAD software package. Backup recommendation for a CAD software package currently available to NASA Systems Analysis Branch if a new procurement is required for the former.
- Subtask 2:
  - Initial set of procedures and primitives for development of aircraft geometry
  - Final set of procedures and primitives for development of aircraft geometry
- Subtask 3:
  - Electronic data files for CAD description of supersonic business jet geometry

Deliverable due dates:

Subtask 1: 1 month after task start

Subtask 2: Initial set of procedures: 6 months after task start
Final set of procedures: [R1] ~~9 months after task start~~ ***10/31/02***

Subtask 3: [R1] ~~9 months after task start~~ ***10/31/02***

Metrics/Standards:

Meets: Deliverables on time.

Exceeds: Initial set of procedures and primitives contains linear geometry.
CAD geometry delivered one month early.

3.	<u>Government Furnished Items</u>: NASA will furnish CAD software NASA will furnish description of geometry for supersonic business jet NASA will furnish access to computer workstations loaded with CAD software.
4.	<u>Other information needed for performance of task</u>: None
5.	<u>Security clearance required for performance of work</u>:

	Task Order Number: 30RAC Revision: 1 Date of Revision: 6/21/02 Title: Small Supersonic Transport Conceptual Design

	Unclassified. Proprietary Data.
6.	Period of Performance: Planned start date: 9/1/01 Completion date: R1 ~~6/30/02~~ ***10/31/02***
7.	NASA Technical Monitor: Peter G. Coen M/S: 348 Phone: 757-864-5991 NASA Competency Coordinator: (TBD) M/S: Phone:

Task Order Number: 30RBJ Revision: 9 Date of Revision: 2/17/04

Title: Research Facilities Branch Test Support (Multiple Tunnels)

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

The Research Facilities Branch (RFB) is responsible for the operation of and testing in a variety of different wind tunnels and facilities at Langley Research Center. The Contractor will be expected to provide test engineer support to RFB wind tunnel facilities. These facilities include:

i. The National Transonic Facility
ii. The 16 Foot Transonic Wind Tunnel
iii. The 14 x 22 Subsonic Wind Tunnel
iv. The 0.3 M Transonic Cryogenic Wind Tunnel
v. The Unitary Plan Wind Tunnel
vi. The Low Turbulence Pressure Wind Tunnel
vii. Jet Exit Facility

Responsibilities will include any and/or all of the following activities to support wind tunnel tests at the facilities:

i. Review configuration fidelity and documentation of wind tunnel model.
ii. Oversee model build up: assembly, last minute modifications, instrumentation installation and instrumentation check out.
iii. Lay out instrumentation hookup sheets, providing them to technicians and data reduction specialists for test setup.
iv. Conduct calibrations and/or document calibration constants for all test instrumentation. This could include sting deflections, AOA calibrations, ESP calibrations and balance loading checks.
v. Conduct test documentation responsibilities including the writing of test plans, run logs, shift notes, and uploading test information to facility world wide web sites.
vi. Coordinate facility meetings to plan for tunnel entry, safety assurance and satisfy LaRC LMS requirements.
vii. Provide on sight test engineering support while conducting a wind tunnel test. [R4]This includes insuring that the customer specified configurations are set correctly for the test. This also includes being responsible for ensuring that the wind tunnel conditions are within specified tolerances to the customers requirements. This also includes monitoring of loads and safety display instrumentation to insure that the tunnel and the models are operated within the specified limits
viii. [R5]~~Provide wind tunnel data statistical quality control and measurement uncertainty analysis~~.
ix. [R4]Provide data quality assessment, and be responsible for obtaining and providing

acceptable quality data to customer for test.

Begin R6block addition

x. To augment the capabilities of the Research Facilities Branch Wind Tunnel capabilities, Langley Research Center is exploring possibility of establishment of a new versatile *Compressible Aerodynamic Research Tunnel* (CART) to study basic flow physics, flow control studies in the compressible flow range. This task is to incestigate a preliminary design of the facility. Some of the basic requirements of the facility are

1) Approximately 4'x5' test section with dry air as test medium with continuous flow
2) Mach range of M=0.1 to 1.5
3) Low turbulence with p`=0.001 to 0.0025
4) Good acoustic characteristics
5) Either Atmospheric test section at all Mach numbers or atmospheric Pt.
6) Test section configurable to
   - -Open jet acoustic anechoic tests up to M=0.4
   - -Subsonic closed test section
   - -Transonic testing with ventilated plenum
   - -Supersonic capability
   - -Large optical axis freedom on all four walls with seeding capability
   - -Semi-span testing capability
   - -Flexible model attitude control
7) The facility is expected to have autonomous operations
8) The facility must be able to tolerate loss of test article without sustaining significant damage to facility or drive system

End R6block addition

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments and facility scheduling. As these specific support requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. Although subject to COTR review, the Contractor shall proceed with performing NORs that are within scope and/or estimated cost of the work described below without waiting for the COTR's concurrence and/or approval. If the requirements tend to exceed the work scope and/or estimated cost, the Contractor will be expected to initiate a proposed revision to maintain a current status in the total task order. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Rolls in work previously described separately under Task Orders 08RBJ, 17RBJ, 21RBJ, changes the overall task Technical Monitor, and rewords NOR note.
Revision 2: Extends the task period of performance and all Subtask completion dates to October 31, 2002 in continuation of NASA's support requirements, re-estimates anticipated quantities of tests for Subtasks 4 and 6, and rolls in work previously described separately under Task Order 16RBJ.
(For details of issued original, revision 1, and revision 2 SOWs see ETOS files *30RBJ.doc, 30RBJ01u.doc, and 30RBJ02.doc*, respectively)
Revision 3: Marks subtask 2 as complete. Describes Additional Test Engineer requirements and changes basic subtask title for a Test Engineer. Combines subtasks 1, 4 and 6 (Test Engineering Tasks) into a single subtask with subtasks by facility (see [R3] below).
Revision 4: Extends the task period of performance and all (on-going) subtask completion dates to October 31, 2003 in continuation of NASA's support requirements, adds wind tunnel and model safety monitoring and data quality assessment to test engineer requirements, and redefines work to be done in subtasks 2 and 3 (see [R4] below).
Revision 5: Adds Test Engineering Support at 16' TT and initiates support at the 14x22 Subsonic Tunnel for a Test Engineer/ Data Quality Engineer. (3/14/03) Adds some clarifications to Subtask 1. Removes requirement for statistical quality control analysis by test engineer (see [R5] above and below).
Revision 6: Adds Subtask 9, Conceptual analysis and sizing study of Compressible Aerodynamic Research Tunnel (CART) (see [R6]above and below).
Revision 7: Extends the period of performance to Feb 29, 2004, in continuation of NASA's support requirements (see [R7] below).
Revision 8: Reduces requirements for Test Engineer support at the 16 Foot transonic Tunnel and the Unitary Plan Wind Tunnel (see [R8] below).
Revision 9: Extends the period of performance two months to April 30, 2004, in continuation of NASA's support with no changes in detailed requirements (see [R9] below).

2. Description of the Work to be Performed:

[R3]*Original subtasks 1, 4, and 6 rolled into new subtask 1, February 14, 2002.*

Technical Monitor for Subtask 1: [R3]Jeff Viken, M/S: 267, Phone: 757-864-2875

1. **(NOR) Conduct and document pre- and post-test activities and Test Engineering duties for each test supported.** The Contractor shall provide oral status reports as necessary to RFB Engineers on the progress of each of the individual test activities and processes to be supported.

processes to be supported.

The Contractor will be expected to support approximately [R4]***5*** tests (on an annual basis), each of four weeks duration in each of the following facilities:

Begin [R3] block requirements redefinition

Facility	[R4]***5* Tests Annually**
16-Foot Transonic Tunnel (16'TT) & Jet Exit Facility:	[R1]~~5~~ [R2]~~25~~ [R3]~~30~~ [R4]~~35~~ [R5]~~40~~ [R8]***35***
Unitary Plan Wind Tunnel (UPWT):	[R1]~~5~~ [R2]~~10~~ [R3]~~15~~ [R4]~~20~~ [R8]***15***
National Transonic Facility (NTF):	[R1,R2]~~5~~ [R3]10
Low Turbulence Pressure Tunnel (LTPT):	[R1,R2] 0
0.3 Meter Transonic Cryogenic Tunnel (0.3M TCT):	[R1,R2]~~0~~ [R3]5
14x22 Subsonic Wind Tunnel (14x22):	[R1,R2]~~0~~ [R5]5

End [R3] block requirements redefinition

The projected distribution of support among various RFB facilities is subject to change in response to individual facility test schedules. It is expected that some test engineers will possess/acquire skills and support tests in more than one facility, and that test engineers with considerable experience in a facility will participate in mentoring less experienced test engineers.

The components which may be supported are listed below:

1. Wind tunnel or facility model and instrumentation check out, assembly, and installation. [R5]This includes overseeing model build-up from start to finish either in the model preparation area (MPA) or in the wind tunnel test section. Each test engineer will have the ability to manage, direct and technically understand all phases of model build-up.
2. Derivation of instrumentation calibration constraints from sting/balance deflection, accelerometer, and pressure transducer calibrations leading to the development of instrumentation hook-up sheets and data reduction constants
3. ~~[R5]Perform statistical quality control analysis of data from wind tunnel test~~
4. Data acquisition process setup, monitoring, and operation
5. Flow visualization and quantitative flow measurement test techniques setup and operation
6. Conduct test documentation responsibilities including the writing of test plans, run logs, shift notes, and uploading test information to facility world wide web sites.
7. Support the design and fabrication of model systems and model support hardware and the identification and calibration of primary instrumentation (balances, ESP modules, etc.)
8. Coordinate facility meetings to plan for tunnel entry, safety assurance , and satisfy LaRC LMS requirements.

Task Order Number: 30RBJ Revision: 9 Date of Revision: 2/17/04

Title: Research Facilities Branch Test Support (Multiple Tunnels)

9. R4Provide on sight test engineering support while conducting a wind tunnel test. This includes insuring that the customer specified configurations are set correctly for the test. This also includes being responsible for ensuring that the wind tunnel conditions are within specified tolerances to the customers requirements. This also includes monitoring of loads and safety display instrumentation to insure that the tunnel and the models are operated within the specified limits.
10. Tunnel test shift support
11. Perform pre-test uncertainty prediction
12. R4Provide data quality assessment, and be responsible for obtaining and providing acceptable quality data to customer for test.
13. R5Derivation / correction of data reduction algorithms and equations. At times either bugs are found or enhancements are needed to reduce data acquired from a specific test. The test engineer can take the responsibility to derive these corrections and/or enhancements and, in collaboration with the research engineer, provide them to the data system manager for programming.

Deliverables:

Oral reports and documentation for the supported test activities in any of the following locations:

1. Test plan
2. Facility web based test documentation library
3. Informal report to RFB engineers
4. R5~~Statistical Quality Control analysis report~~

Minimum Acceptable Performance for activities to be supported:

a) Test setup including model and instrumentation installation and calibration and the derivation of data reduction constants prior to test scheduled start date

c) Complete documentation of test process and procedures in run logs, shift notes, and electronic websites within one calendar month after end of test

d) R5~~Wind tunnel or facility statistical quality control data analysis complete within 2 week of end of test~~

e) Preliminary test plan 2 weeks prior to test, final version before conducting test

f) Participate in facility daily test status meetings

Exceeds Acceptable Performance:

a) Support activity completed prior to scheduled date for minimum acceptable performance

b) Support activity completed independently with all initiative shown by the Contractor

c) R4Provide independent data quality assessment and provide error-free and good quality data to the customer during and after a test.

d.) [R5]Finds bugs or creates enhancements for the data reduction algorithms for a test in the RFB facilities.

2. NTF Tunnel and Model Dynamics: [R3] ~~(Completed February 14, 2002)~~

Begin [R4] block requirements redefinition

[R4] The Contractor shall continue to provide analysis of the tunnel and model dynamics at the NTF. As part of this analysis the Contractor shall identify the data required for analysis, evaluate the data for dynamic structural interactions and provide recommendations of possible solutions to minimize the impact to data quality and tunnel operations. The analysis and recommendations shall be in the form of written reports presented to the Facility Manager and archived in the Facility Library under the TTR (Task/Test Request) requesting the analysis. Each delivery/completion date will be established when the TTR is approved and issued. The Contractors performance will be measured by meeting the TTR delivery date, providing realistic and effective solutions that will improve data quality and tunnel operations.

Deliverables

A final dynamics status summary report will be provided September 2003.

End [R4] block requirements redefinition

3. Existing NTF Tunnel Modifications: The Contractor shall work with the facility staff (Civil Servants and Contractor) in developing action plans, solutions and procedures to overcome unforeseen problems during the existing scheduled modifications at the NTF. These existing scheduled modifications include:

A) Installation of the Plenum Heating/Cooling System

B) Cooling Coil System Assessment

C) Automatic Test Sequence System Enhancement

D) Model Protection Safety System

End [R4] block addition

E) Cooling Coil Modifications

F) Improved NTF Air Operations Performance

G) Sidewall Support Mechanism Modifications

End [R4] block addition

H) Task Specific Engineering Analysis and Assessment

During the course of this Subtask, the Contractor may have additional or new ideas that produce significant cost savings to the NTF. The Contractor is encouraged to formally submit these ideas to the Subtask Technical Monitor. These new ideas will contribute to the Performance Standard ratings.

Subtask 3 Deliverables for all modifications:

The Contractor will attend weekly project status/planning/review meetings for these existing tunnel modifications (~1 hour) and provide status information, comments and recommendations on project activities. All drawings from the Contractor shall be prepared on E-size drawing sheets with NASA Langley drawing numbers and in accordance with NASA Langley drawing standards. The Contractor shall red-line all existing drawings as necessary. Additionally all work performed by the Contractor shall comply with NASA Langley Safety standards.

Other Subtask 3 requirements:

Note: Previous Subtask 3A-D Requirements defined through Revision 3 were completed September 30, 2002.

Begin [R4] block requirements redefinition

D) Model Protection Safety System (MPSS)

The NTF recently installed an MPSS to provide an autonomous balance load monitoring system. As operational experience is gained with the MPSS several enhancements will be desired to expand its capability and user interfaces. The Contractor shall provide these enhancements working with other Contractors as required through the TTR system. All requests with requirements and delivery dates will be issued and documented using the NTF TTR system.

Deliverables

A final Model Protection Safety System status summary report will be provided September 30, 2003.

E) Cooling Coil Modifications

The NTF is currently scheduled to implement a previous recommendation from the Contractor to replace and re-run the cooling coil supply water piping. This work will take place December 2002 and January 2003. At the conclusion of this work the Contractor shall provide a detailed analysis of the modified cooling coil performance. To complete this analysis the Contractor shall provide a testing plan that includes identification of required instrumentation, data reduction needs and tunnel operating conditions. The final analysis of the Cooling Coil Performance shall be provided in a written summary report presented to the Facility Manager and archived in the Facility Library under the TTR requesting the analysis. The Contractor shall continue to provide analysis of the cooling coil performance and recommendations for further performance enhancements to the cooling coil and associated systems.

Deliverables
A final cooling coil status summary report shall be provided September 2003.

F) Improved NTF Air Operations Performance
The NTF is current scheduled for several major improvements to the tunnel air operations performance; several of these improvements are recommendations from this Contract. One major improvement is to increase the maximum Mach No. obtained at the NTF during air operations. The current maximum Mach No. is 1.095. The Contractor shall continue to develop the concept of using test sections inserts to obtain a maximum Mach No. of 1.20. The development of the concept shall include the following information in a written report presented to the Facility Manager and archived in the Facility Library under the TTR requesting the analysis:
Aerodynamic analysis to obtain the desired Mach No. (locations, size and surface contours)
Loads analysis on the insert at the maximum tunnel air dynamics pressures
Fabrication, mounting and installation drawings
Fabrication cost estimations
After the implementation of these test section inserts the tunnel will be operated to establish the new maximum Mach No. performance.

Deliverables
The Contractor shall provide a summary report due April 2003.

G) Sidewall Support Mechanism Modifications
The NTF is currently scheduled to perform a Semi-span Testing in April of 2003 using the Sidewall Support Mechanism. Several improvements of the mechanism are currently underway that were originally proposed under this contract. The Contract is currently responsible for providing a complete design for a re-circulating heater system. This design includes drawing that include mechanical, electrical and controls systems. Additionally the design shall include all new mechanism assembly drawings and procedures and the development and checkout of the controls systems. All design documentation, analysis and control codes shall be presented in a written report to the

Facility Manager and archived in the Facility Library under the TTR requesting the work.

Deliverables

The Contractor shall provide a summary report due April 2003.

End R4 block requirements redefinition

H) Task Specific Engineering Analysis and Assessments

This part of the Task Order is designed to allow for the Contractor to perform specific engineering analysis and/or assessments for a Specific Task. The following Tasks are currently identified by the Facility using the Task/Test Request (TTR) System to identify the work required.

H.1 Focus Schlieren Video System (TTR s16-006-01)

Completed September 30, 2002

4. (NOR) Conduct and document pre- and post-test activities and data reduction and analysis processes for each test supported. R3*(Subtask 4 rolled into new subtask 1, February 14, 2002.)*

Technical Monitor for Subtask 5: E. Ann Bare M/S: 280, Phone: 757-864-3036

5. (NOR) Support the development and implementation of improved dynamic data acquisition system for the RFB tunnels.

Deliverables:

a) Hardware and software recommendations for a new dynamic data acquisition and analysis system per requirements.

b) Implementation of the new dynamic data acquisition and analysis system

Minimum Acceptable Performance for activities to be supported:

a) Documentation of recommendations and a written plan for system implementation 2 months after receipt of requirements.

b) Demonstration of all capabilities of new system 5 months after delivery of hardware and software.

Exceeds Acceptable Performance:

a) Reports and documentation provided prior to scheduled date for minimum acceptable performance.

b) Implementation activity completed solely by the Contractor.

6. (NOR) <u>Conduct and document pre- and post-test activities and data reduction and analysis processes for each test supported</u>. R3*(Subtask 6 rolled into new subtask 1, February 14, 2002.)*

Technical Monitor for Subtasks 7 and 8: Michael J. Hemsch, M/S: 280, Phone: 757-864-2882
The Contractor will be expected to provide **Data Quality Assurance** support in approximately 12 tests, each of 4 weeks duration in each facility within RFB.

7. <u>(NOR) Wind Tunnel Data Statistical Quality Control and Measurement Uncertainty Analysis</u>.

Deliverables:

a) Training for customer test data quality assurance procedures
b) Quick-look plots for check standard testing
c) Post-test updating of check standard and customer scaling control charts upon request

Minimum acceptable performance:

a) Training for customer test data quality assurance within one week of NOR
b) Preparation of check standard quick-look plots within two weeks of test completion
c) Post-test updating of check standard and customer scaling control charts within four weeks of NOR

Exceeds acceptable performance:

a.) Training for customer test data quality assurance within two days of the NOR
b.) Preparation of check standard quick-look plots within one week of test completion
c.) Post-test updating of check standard and customer scaling control charts within two weeks of NOR
d.) DQA support for non-RFB facilities
e.) DQA support other than the deliverables described

Task Order Number: 30RBJ Revision: 9 Date of Revision: 2/17/04

Title: Research Facilities Branch Test Support (Multiple Tunnels)

8. **(NOR) Improvement Activity for the DQA Process**. This activity shall include any relevant practices, experiments, analyses and tool development.

Deliverables:

a) Training in data quality assurance, statistical quality control, and measurement uncertainty processes and procedures

b) Documentation of procedures for DQA for customer and check standard testing

c) Maintenance of electronic logbooks for posting methodology and check standard activities to the world-wide web.

d) Documentation of Langley Management System procedures for data quality assurance for customer and check standard testing

Minimum acceptable performance:

a) Training, maintenance and documentation provided within one month of NOR

Exceeds acceptable performance:

a) Training, maintenance and documentation provided within two weeks of NOR

Begin R6block addition

9. Conceptual analysis and sizing study of 'Compressible Aerodynamic Research Tunnel (CART)

Langley Research Center is exploring possibility of establishment of a new versatile Compressible Aerodynamic Research Tunnel (CART) to study basic flow physics, flow control studies in the compressible flow range. This task is to conduct a preliminary design study for this wind tunnel. Some of the basic requirements of the facility are

1. Approximately 4'x5' test section with dry air as test medium with continuous flow
2. Mach range of M=0.1 to 1.5
3. Low turbulence with p`=0.001 to 0.0025
4. Good acoustic characteristics
5. Either Atmospheric test section at all Mach numbers or atmospheric Pt.
6. Test section configurable to
    a. Open jet acoustic anechoic tests up to M=0.4
    b. -Subsonic closed test section
    c. -Transonic testing with ventilated plenum
    d. -Supersonic capability
    e. –Large optical axis freedom on all four walls with seeding capability
    f. -Semi-span testing capability
    g. -Flexible model attitude control
7. The facility is expected to have autonomous operations

8. The facility must be able to tolerate loss of test article without sustaining significant damage to facility or drive system

Task

The goals of the task is to propose economical tunnel configurations detailing various elements necessary for the CART based on requirements, such as

1) Closed circuit tunnel configuration including settling chamber, high speed diffuser, fan return leg duct, fan system, flow return to settling chamber via rapid diffusers, cooling coil, and screens/ventilated honey comb
2) Fan drive speed, power, pressure ratio, number of fan stages, lubrication systems etc
3) Drive motor sizing and speed control issues
4) Test section configuration concepts for Transonic work, Subsonic work, Acoustic work
5) Model attitude system concepts
6) Process air control concepts
7) Turbulence reducing concepts
8) Acoustic noise reduction concepts
9) First cut cost estimates

Deliverables:

The deliverables for the task are design and analysis documents, rough cost estimates and performance/cost trade offs as a function of Mach number, Atmospheric test section vs atmospheric Pt.

Minimum acceptable performance

- Wind tunnel design achieves speed conditions from Mach 0.4 to Mach 1.2 in the test section.
- Wind tunnel design can achieve a polar at maximum Mach number conditions before heating beyond specified limits.
- Test section has unlimited optical access on both sides.
- Tunnel design has turbulence level between p`=0.0015 to 0.0025

Exceeds acceptable performance

- Wind tunnel design achieves speed conditions from Mach 0.1 to Mach 1.5 in the test section.
- Wind tunnel design can run continuously at highest power setting.
- Test section has unlimited optical access on all 4 sides.
- Tunnel design has turbulence level between p`=0.0010 to 0.0015

End R6 block addition

Task Order Number: 30RBJ Revision: 9 Date of Revision: 2/17/04

Title: Research Facilities Branch Test Support (Multiple Tunnels)

3.	**Government Furnished Items:** Access to Bldg. 1236 (the NTF), R3Bldg. 1146 (16' TT), Bldg. 1251 (UPWT), Bldg. 582 (LTPT) Bldg. 1243 (0.3M TCT) R4Bldg. 1212 (14x22): 1) Office space 2) Model build up area area, wind tunnel model hardware and documentation 3) Access to wind tunnel support hardware and documentation, wind tunnel test instrumentation and documentation 4)Terminal to access the NTF's Dynamic Data Acquisition Unit., uncertainty analysis software and documentation, MatLab Software from Mathwork for data analysis.
4.	**Other information needed for performance of task:** **Applicable documents available at the NTF Archive Center:** Data Analysis Report – NTF Operational Data from Test 100, 107 and 111, Final Report Part A; S. Balakrishna; February 24, 2000 NTF Structural Modifications proposal based on NTF Operational Data Analysis, Final Report Part B; D. Butler; February 2000 NTF Cooling Coil System Study Report; D. Butler; December 2000 Additional specific NTF test reports, equipment manual and facility related documents will be provided by the Government as requested by the Contractor. **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.
5.	**Security clearance required for performance of work:** Work on classified projects may be required.
6.	**Period of Performance:** Planned start date: 08/1/01 Completion date: R4~~10/31/02~~ R7~~10/31/03~~ R9~~2/29/04~~ ***4/30/04***

7.	**NASA Technical Monitor:** Jeff Viken M/S: 267 Phone: 757-864-5116 **NASA Competency/Other Technical Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2

Task Order Number: 30RDA Revision: ____ Date of Revision:

Title: Using Software Engineering Methods and Techniques to Improve V&V in the Simulation Environment

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

Under a previous contract (Task Order RD02, NAS1-96014) the Contractor was tasked to research software engineering techniques, processes, and tools to determine methods that may facilitate effective translation of test data to simulation databases. Additionally, candidate approaches to validate a simulation database with respect to the test database, and with respect to consistency within the simulation aerodynamic database shall be evaluated. Funding for this task was cut in the second of a three year effort. The purpose of this task is to close out this work and to provide an interface that can be used to identify anomalies in a database. Hopefully in the future additional funds can be identified to continue this work.

Revision 1: Adds requirement for software users manual and extends the completion date (see [R1] below).

2. Description of the Work to be Performed: During the previous year the wavelets approach to the simulation problem was developed and evaluated, however the interface is not user friendly. In this task the contractor will investigate test cases to determine the fineness with which the code can identify anomalies. In addition, the interface will be improved to make the software more user friendly.

Deliverables:

1) Report summarizing the findings on the abilities of the wavelets software tool to detect the location of discontinuities and anomalies
2) Quick reference guide for use of the software
3) Executable of the software to identify the discontinuities and anomalies
4) ***[R1] Users Manual for software.***

Performance Metrics: Schedules are met and interface is user friendly.

Performance Standards: Meets: documentation is complete and accurate. Exceeds: 'Meets' and delivered ahead of schedule.

3. Government Furnished Items: Access to the VDB server for installation and check out of the software

4. Other information needed for performance of task: See Software Acquisition Plan in Appendix.

5. Security clearance required for performance of work:

6. Period of Performance:

Planned start date: February 15, 2001 Completion date: [R1] ~~July 31, 2001~~ ***October 31, 2001***

Task Order Number: 30RDA Revision: ____ Date of Revision:

Title: Using Software Engineering Methods and Techniques to Improve V&V in the Simulation Environment

7. NASA Technical Monitor: Norma Campbell
M/S: 406 Phone: 757-864-1131

NASA Competency Technical Coordinator: Anita Thomas
M/S: 162 Phone: 757-864-9119

Low Control Software Acquisition Plan for SAMS task
Using Software Engineering Methods and Techniques to Improve V&V in the Simulation Environment

Software Project Title: Using Software Engineering Methods and Techniques to Improve V&V in the Simulation Environment	
File Name/Ver SimImprovAcqPlan.doc **Date of Issue:** 1/12/01	**Software Class:** Low
Supervisor: Dana Dunham	**Software Manager & NASA Point of Contact:** Norma Campbell VDB/AisSC **Percentage of time allocated to this role:** 5%
Contractor: ViGYAN as subcontractor to Swales **Contract:** NAS1-00135	**Requester :** Norma Campbell

1. Scope of Acquisition Plan
The software provided shall provide an interface to the Wavelets tool that will allow the user to identify discontinuities and anomalies the a data base

2. Requirements
2.1 Requester Requirements
(a) The software shall provide a user interface to facilitate the identification of discontinuities and anomalies in a data base.

2.2 Constraints:
(a) All documents shall be delivered in Microsoft Word.
(b) All products shall be delivered on the VDB Branch Server, *baloo*, under the directory /CONFIG_MAN/SIM_IMP/DELIVERABLES/. This directory contains two subdirectories (i.e. Draft, and Final). Upon completion, deliverables shall be placed in the appropriate directory with a file name containing the acronym for the project name and the abbreviated name of the deliverable item (see Section 4 for the Deliverable Items list). ViGYAN shall notify the Software Manager via e-mail once deliverables are transferred to the VDB Server.

2.3 General Requirements
(a) The LaRC functions and products required of the contractor for Low-control software class are as follows:
-That the contractor must deliver a Software Project Management Plan (SPMP) addressing the requirements given in LMS-CP-5528 Section 3, excluding paragraph 3.1.2 (LMS-CP-5528 will be provided upon request)
-That the SPMP must be baselined following the contractor's Configuration Management Plan
-That start and end dates of the SPMP schedule elements must be updated and reported to the Software Manager as the schedule changes

-That a Software Version Description must be documented and submitted to the Software Manager with each delivery that contains the following information; project title, date of delivery, point of contact, inventory of all baselined configuration items to be delivered, including unique configuration item identifier and description, instructions for reading and installing configuration items, and a description of all changes incorporated in this delivery
-That the contractor must deliver information required to complete the Software Metrics Collection Sheet, located at:
http://sw-eng.larc.nasa.gov/process/forms.html

(b) The SPMP shall cover all activities required to complete the project. All planning information (including a schedule and maintenance plan) shall be included in the SPMP or rolled out as separate documents.

(c) At a minimum, the following information shall be included in the Software Qualification and Acceptance Test Procedure: (1) Project title, (2) Date, (3) Issuing organization, (4) References, (5) Identification of test configuration, (6) Test preparations (hardware, software, other) for each test, (7) Test descriptions [including a) Test identifier, b) Requirements addressed, c) Prerequisite conditions, d) Test input, e) Expected test results, f) Criteria for evaluating results, g) Instructions for conducting procedure], and (8) Requirements traceability.

(d) At a minimum, the following information shall be included in the Software Qualification and Acceptance Test Results Report: (1) Project title, (2) Date, (3) Issuing organization, (4) References, (5) Detailed test results [including a) Test identifier, b) Test summary, c) Problems encountered, d) Deviations from test procedures], and (6) Test log.

(e) At a minimum, the following information shall be included in the Software Version Description Document *(i.e., Software Configuration Index Record)*: (1) Project title, (2) Date of delivery, (3) Issuing organization, (4) An inventory of all delivered items *(i.e., filenames, description, location on the "VDB Branch Server", date and time file last saved, version number if not included in the file name, file location)*, (5) Identification of changes incorporated, (6) Identification of all known problems, (7) the file name and location of the associated Software Requirements Description and Software Qualification Test Procedures.

(f) At a minimum, the following information shall be included in the Monthly Status Report: dates that the report covers, Action Items, person assigned, status of Action Items, summary of status of products/deliverables, baselines, and verification activities, problems encountered, and deviations from the SPMP.

3. Life Cycle and Approach

At a minimum, life cycle "D" as defined in Guidance on LMS Software Procedures (URL: http://sw-eng.larc.nasa.gov/process/) shall be used by the contractor on this project. The contractor may choose to add additional phases to life cycle D. The contractor may choose the development approach deemed most appropriate for this project.

4. Deliverables Record:

The following table specifies the software project deliverables.

Deliverable Item	Schedule for Delivery
1. Proposed SPMP[1]	· Within 2 weeks after receipt of this Software Acquisition Plan

2. Revised SPMP[1]	· Concurrent with delivery of the Software Requirements Description · As required to keep the SPMP current
3. Help Files[1]	· Prior to Qualification Test Phase · At the completion of Qualification Testing of each maintenance event if changes occur
4. Software Qualification and Acceptance Test Procedures[1]	· Prior to Qualification/Validation Testing · Whenever qualification test procedures are changed
5. Source Code Files for VDB Branch Only	· After completion of Qualification/Validation Tests
6. Executable Files	
7. Software Version Description Document	· With each software delivery to the requester · At completion of maintenance effort
8. Software Qualification and Acceptance Test Results Report	· With each delivery of the source code, after Acceptance Testing is complete
9. Findings report	· August 31, 2001
10.Quick reference quide	· August 31, 2001
9. Review Agendas	· Two working days prior to the review
10. Review Minutes	· Within 3 working days after the reviews
11. Monthly Status Report	· Regular contractor report
12. Metrics Collection	· Original estimates for the following shall be provided for the project: Estimated Start Date, Estimated Completion Date, Estimated Total Staff Hours, and Estimated Total Cost. · Actuals for the following shall be provided at project completion, prior to the start of maintenance: Actual Start Date, Actual Completion Date, Actual Total Staff Hours, Actual Total Cost, Total Executable Source Lines of Code for Each Language Used, COTS or GOTS Tool(s) Used and Comment on Satisfaction, Platforms · Six months after project completion the following shall be provided: number of approved problem reports implemented and the hours spent performing the corrections. For further explanation of specific metrics see: http://sw-eng.larc.nasa.gov/process/sheets.html

5. Trade Study

A trade study was done under a previous task and it was determined that in the industry there is not a good process available to determine discontinuities and anomalies in a data base. There is no known software that is available "off-the-shelf" for this application. Therefore this task was initiated.

6. Reviews, Verification, and Validation

6.1 Reviews

The contractor shall provide the agenda and all documents to be reviewed as draft copies to the Software Manager a minimum of 2 days before the scheduled review of that product. The actual schedule dates for reviews will be negotiated with the contractor and included in the SPMP.
The contractor shall conduct the following reviews:

(a) Review of the Proposed SPMP.
(b) Review of the draft Software Qualification Test Procedures to ensure they cover all user and software requirements.
(c) Review of the Software Configuration Index Record *(i.e. Software Version Description Document)*, Help Files, and Software Qualification and Acceptance Test Results Report.

At a minimum, the following information shall be included in the review agendas: technical, cost, staffing, and schedule performance against the SPMP; status of action items, products/deliverables, and problems encountered; requested changes to the SPMP; and draft deliverables to be reviewed.

Minutes shall be delivered to the VDB Branch Server under the directory /CONFIG_MAN/SIM_IMP/DELIVERABLES/. and an e-mail message shall be sent to the Software Manager when they are delivered.

6.2 Verification and Validation

Verification and Validation activities shall be performed by the contractor. Results of those activities shall be covered at Monthly Status Reports.

7. Development Schedule

The requested completion date is October 31. Initial scheduling information is specified in section 4.

8. Acceptance Procedure and Criteria

The following defines the acceptance procedure and criteria that shall be used:

(a) The Software Manager or representative will perform “hands on” testing by exercising the software as a user for a period of five-days.
(b) Documentation shall be complete and accurate and must be reviewed and approved by the Software Manager.
(c) Errors or problems observed will be recorded by the contractor and shall be corrected before acceptance. The Software Manager will witness the contractor retest of the software corrections before acceptance.
(d) Upon completion of the Acceptance testing phase, the Software Manager will generate an acceptance e-mail that will serve as a record of software acceptance.

9. Risk Management

Since this is a small interface project done under low control, there will be no formal risk management.

10. Installation and Operations
There are no requirements under this software acquisition plan for installation beyond those to support acceptance testing. There is no requirement under this software acquisition plan for operation support of the software.

11. Maintenance
The contractor's maintenance activities shall include the following:
(a) Maintenance will be limited to fixing logic errors for the first six-months after software delivery.

12. Configuration Management
The contractor shall configuration manage all products according to the requirements specified in LMS-CP-5529. The configuration management plan may be included in the SPMP or rolled out as a separate document.

14. Changes to the Software Acquisition Plan
If changes to the Software Acquisition Plan are needed, they will be performed by the Software Manager and configuration controlled according to the Configuration Management Plan before release.

15. Government Furnished Items
(a) The government shall provide access to the VDB server for installation and check out of the software

Task Order Number: 30RFH Revision: ____ Date of Revision:

Title: Acoustic and Dynamics Monitoring System

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

The purpose of this work is to develop, integrate, and test a miniature, self-contained, flight qualified, acoustic and dynamics monitoring system for use on commercial airplanes. The acoustic and dynamics monitoring system shall include tri-axial accelerometers and one audio channel sampled at a rate of 8K samples per second and will initially be used to collect aircraft brake system data from the landing gear of an aircraft and transmit the data to a data collection system mounted in the interior of the plane. *The first objective of this task is to take a NASA LaRC developed acoustic and dynamics monitoring system concept and develop a miniature, self-contained, flight qualified acoustic and dynamics monitoring system, test it, install it on the NASA LaRC B-757 aircraft, and use it to acquire brake system data during B-757 flight.* ***The second objective is that once the brake monitoring system is fully developed and proven it shall be easily modified for monitoring multiple aircraft areas. Therefore, creating an aircraft health monitoring system network capable of augmenting the black box capability.***

Revision Record:

Revision 1: Completion date extended to 12/15/01 due to delayed initial funding (see [R1] below).

2. Description of the Work to be Performed:

2.1 Subtask 1 ***Revise the following LaRC drawings:***

1169974 Rev. A Dated: 5/19/00 – To illustrate a new cover top.

1169978 Dated: 5/22/00 – To illustrate new microphone enclosure.

The engineering design drawings shall be prepared with ANVIL CAD source code. Paper and electronic copies of engineering and assembly drawings representing 'as-built' condition of deliverable hardware shall also be deliverables. The Contractor shall be responsible for design related issues during fabrication and installation of the hardware.

DELIVERABLES:

2.1.1 Revised ADMS engineering drawings. October 15, 2001 (or one week from start).

2.1.2 Biweekly verbal status report to the TM.

2.2. METRICS:

Meets: ***The Contractor delivers the drawing package with minor or no modifications requested by the deadline.***

Exceeds: ***The Contractor delivers the drawing package with no modifications requested***

	Task Order Number: 30RFH Revision: ____ Date of Revision: Title: Acoustic and Dynamics Monitoring System

	two days prior the deadline. ***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.	**Government Furnished Items**: 1. Government Furnished Property and software will be furnished for the design, fabrication and testing of the deliverable items. *2.* LaRC Drawings: 1169974 Rev. A Dated: 5/19/00 1169978 Dated: 5/22/00
4.	**Other information needed for performance of task:** Contractor shall have access to Government facilities to support this task, but not limited to fabrication, design and testing facilities. Contractor will interface with research, testing, design and fabrication organizations.
5.	**Security clearance required for performance of work:** None.
6.	Period of Performance: Planned start date: October 9, 2001 Completion date: R1 ~~October 30~~, December 15, 2001
7.	NASA Technical Monitor: *Guillermo A. Gonzalez* M/S: *448* Phone: 757-864-*7107* NASA Competency/Other Technical Coordinator (*above branch level*): *name* M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 31RAC Revision: ___ Date of Revision:

Title: Mach 0.98 Transport Design Study

1.	**<u>Purpose, Objective or Background of Work to be Performed</u>:** As the maximum range capability of subsonic commercial transports has significantly increased in recent years, there has been no corresponding increase in the cruise Mach number. The 747 is still the fastest in the fleet (M=0.86), with new airplanes such as the B-777 and A-340 only approaching the 747 in cruise Mach number – about 0.85. Demand for premium travel is also increasing as more companies are buying business jets or purchasing partial ownership in these types of aircraft. Therefore, a long-range transport with a significantly higher cruise Mach number (i.e., 0.98) could save passengers considerable time for long-range routes. This type of aircraft also has the potential for higher utilization and more flexibility on long-range routes, and could also provide the airlines with an alternative to business jets that they could use to attract more high-level business travelers. The aerodynamic design will be based on the high-speed, transport-type supercritical wing that was flight-tested on an F-8 in the early 1970's. This flight test validated the M=0.98 cruise Mach-number capability for the supercritical wing. The subsequent Advanced Technology Transport Program used this supercritical wing as the basis for a series of transports that were designed to cruise at Mach numbers from 0.95 to 0.98. Boeing, Lockheed, General Dynamics, the U.S. engine companies and several airlines were involved in this program.
2.	**Description of the Work to be Performed:** Contractor shall conduct a conceptual design study of a subsonic commercial transport that has a cruise Mach number of 0.98 and a maximum design range between 7500nmi. and 9000nmi. and a payload between 175 and 225 passengers. Final design range and payload will be determined in the study. The current design study shall focus on a very long-range transport with a cruise Mach number of 0.98, and will utilize engine technology from the current NASA UEET Program (~2015 EIS) and advanced composite structures for both the wing and fuselage. The original F-8 supercritical wing was actually designed with enough sweep for a cruise Mach number of 1.0 which proved impractical to achieve. Therefore, about two degrees less wing sweep is required for the 0.98 design point. A blunt-noise, body of revolution with a fineness ratio of 9 and a drag-rise Mach number of 0.98 was used as the reference in developing the area-ruling for the previous transport configurations and the F-8 SCW flight-test vehicle. This body of revolution should also serve as the guide in developing the area-ruling for the current transport configuration. The Contractor shall perform the following requirements: 1.0 Conduct fuselage-layout studies to determine the payload that is most compatible with the fineness-ratio 9 body of revolution. Examine payloads between 175 and 225 passengers (~ 757 to 767 size, single isle verses twin isle), to determine if a twin-isle aircraft is feasible for this size payload and fineness ratio. A twin-isle aircraft is highly favored for long-range

	routes, but larger payloads may be required to achieve a fineness of 9 with a twin isle. 2.0 Conduct design trade studies to determine optimum engine by-pass ratio, design range and initial cruise altitude. Design range should be a minimum of 7500nmi, but preferably longer, and the initial cruise altitude should be higher than the maximum cruise altitude of current aircraft(~41k ft.,) so the higher cruise Mach number capability can be immediately used without causing conflicts with other aircraft. 3.0 Develop a final M=0.98, transport design concept with sufficient geometry detail to enable higher-order, CFD analysis of the configuration. The concept shall be based on the F-8 Supercritical Wing, the fineness-ratio 9 body of revolution, UEET engine technology and composite structures. Reporting Requirements: 1. Monthly progress report 2. Biweekly status meeting conducted with the task monitor. Deliverables: 1. Final report that documents the design evolution of the final concept, including geometry, drawings, and performance predictions. 2. Electronic geometry file that is sufficient in detail to allow higher-order CFD analysis to be conducted on the final concept. Metrics: Meets: All deliverables completed on time. Exceeds: Summary and electronic data delivered one month prior to specified date.
3.	**Government Furnished Items**: 1 F-8 SCW coordinates 2 Fineness-ratio 9 body of revolution geometry and area distribution 3 Engine input file for FLOPS
4.	**Other information needed for performance of task:**
5.	**Security clearance required for performance of work:**
6.	**Period of Performance:** **Planned start date:** 12/10/01 **Completion date:** 10/31/02
7.	**NASA Technical Monitor:** Dennis W. Bartlett M/S: 248 Phone: 757-864-1916 **NASA Competency Coordinator**: ASCAC/M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 31RBJ   Revision: 5 Date of Revision: 3/9/04

Title: Theory Of Constraints (TOC)-compliant Planning, Schedule Management, and Reporting for the Research Facility Branch

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

The objective of this Task Order is to deliver Critical Chain Project Management (CCPM) based networks, reports and training to the Research Facilities Branch (RFB) for the following locations:

- RFB Office
- 0.3-Meter Transonic Cryogenic Tunnel (0.3M TCT)
- Unitary Plan Wind Tunnel (UPWT)
- Low Turbulence Pressure Tunnel (LTPT)
- National Transonic Facility (NTF)
- 16-Foot Transonic Tunnel (16-Ft. TT)
- 14-by-22-Foot Subsonic Tunnel (14-by-22-Ft. ST)
- [R4R2]~~Jet Exit Test Facility (JETF)~~
- [R4]***8-Foot High Temperature Tunnel***

NOTE: Due to fiscal constraints imposed by the Center's budget, every RFB Facility may not operate for the entire fiscal year. The RFB Office may decide to combine facility operations at a later time during the year.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements (see [R1] below).
Revision 2: Adds JETF to facility list, removes dependency on software vendor for implementation of CCPM, adds some special project support description, and updates GFI (see [R2] above and below).
Revision 3: Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements and documents the change in Technical Monitor for the new period of performance (see [R3] below).
Revision 4: Removes Jet Exit Test Facility from Task Order and add 8-Foot High Temperature Tunnel. Extends the period of performance one year in continuation of NASA's support with no change in detailed requirements (see [R4] above and below, Section 6).
Revision 5: For NASA's convenience the period of performance is moved up 8 months to April 30, 2004 with no other changes in detailed requirements (see [R5] below, Section 6)

2. **Description of the Work to be Performed:**

Deliverables

1.1. CCPM Support for RFB Office

The Contractor shall assist the RFB Office by performing the functions of the Branch-level CCPM Schedule Integrator who shall be responsible for the following duties:

1.1.1. **Creating Branch-level CCPM Schedules.** The CCPM Schedule Integrator shall assist the RFB Office to create a CCPM schedule for each Branch-level project managed by the RFB Office. The Government estimates that there will be a total of four such efforts during this period. Some example projects are:

- Wind Tunnel Enterprise (WTE) Global Cycle Time Reduction Project.
- WTE Statistical Quality Control Project.

1.1.1.1. The CCPM Schedule Integrator shall conduct a weekly CCPM status meeting for each of these Branch-level projects:

1.1.1.2. The CCPM Schedule Integrator shall print and distribute the associated CCPM reports to each of the Project Leads by COB each Wednesday.

1.1.1.3. The CCPM Schedule Integrator shall create the associated CCPM reports in the electronic file format specified by the Government that the CCPM Schedule Integrator shall post to the server or web site designated by the Government by COB each Wednesday.

1.1.2. **Branch-level CCPM Schedule Consolidation.** The CCPM Schedule Integrator shall be responsible for consolidating the Branch-level CCPM Schedules and establishing the Branch-level pipeline schedule.

1.1.2.1. The CCPM Schedule Integrator shall create a consolidated Branch-level CCPM schedule.

1.1.2.2. The CCPM Schedule Integrator shall post the consolidated Branch-level CCPM schedule to the official RFB Web site.

1.1.2.3. The CCPM Schedule Integrator shall conduct a weekly CCPM status meeting for the purpose of briefing the Branch Head on the RFB-level consolidated schedule.

1.1.3. **Branch-level Schedule-related What-if Analysis.** The CCPM Schedule Integrator shall assist the RFB Office with conducting Branch-level, schedule-related what-if analyses.

1.1.4. **Branch-wide Schedule-related Configuration Management.** The CCPM Schedule Integrator shall define the RFB configuration management standards needed to maintain accurate and dependable CCPM schedules throughout the Branch. The standards shall include, but shall not be limited to, file naming conventions, backup strategy, electronic file formats for posting, and backup

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strategy.

1.1.4.1. The CCPM Schedule Integrator shall conduct at least one configuration management audit every six months throughout the life of this Task Order.

1.1.4.2. The CCPM Schedule Integrator shall notify the Government within two working days of the configuration management audit of all findings and of all corrective actions initiated.

1.1.5. **Administer the WTE Integrated Wind Tunnel Planning System.** The CCPM Schedule Integrator shall serve as the Administrator of the WTE Integrated Wind Tunnel Planning System.

1.1.5.1. The CCPM Schedule Integrator shall be the WTE Integrated Wind Tunnel Planning System's representative on the AeroCOMPASS Project

1.1.5.2. The CCPM Schedule Integrator shall develop, administer, and monitor compliance with the WTE Integrated Wind Tunnel Planning System's data dictionary, database architecture, record-level coding schema, standard resource names, standard resource calendars, and a standard project calendar.

1.1.5.3. The CCPM Schedule Integrator shall administer and maintain the WTE Integrated Wind Tunnel Planning System's Help Request System.

Begin R1 block deletion

~~1.1.5.4. The CCPM Schedule Integrator shall serve as the RFB Point of Contact to ProChain Solutions, Inc., and shall coordinate all RFB-generated requests for technical support.~~

~~1.1.5.5. The CCPM Schedule Integrator shall maintain the RFB log of licensed *ProChain*® and *ProChain Plus*® users. RFB has 25 licenses for *ProChain*® and 12 licenses for *ProChain Plus*®. Users are licensed, not computers. The CCPM Schedule Integrator shall install all future upgrades to *ProChain*® and *ProChain Plus*®.~~

~~1.1.5.6. The CCPM Schedule Integrator shall act as point of contact for the ProChain Solutions, Inc. newsletters.~~

~~1.1.5.7. The CCPM Schedule Integrator shall coordinate and conduct all future CCPM-related training within RFB. The Government shall be responsible for reserving the classroom space, providing the necessary laptop computers, and notifying the attendees.~~

End R1 block deletion

1.1.6. R2 Special Project Support. The Contractor shall provide support for special non-recurring projects on an infrequent basis that is not anticipated to impact the completion of other subtasks or Contractor cost estimates for the overall task order. This support will be similar in nature to and at a lower level than the support already described above and may involve facilities not listed in Section 1.

1.2. **RFB Facilities – General Duties.** The Contractor shall provide CCPM support to each of the RFB Facilities listed in Section 1. The general duties shall include, but shall not be limited to, the following:

1.2.1. Develop a CCPM schedule for every significant project conducted by facility personnel with each Project Lead assigned to a given project. Projects that will take longer to plan than they will to execute shall be exempt from this requirement. The Government will determine which projects fit this definition.

1.2.2. Printing and distributing the associated CCPM reports, either as a hardcopy or in the electronic file format specified by the Government. Files shall be posted to the appropriate web site or server.

1.2.3. Maintaining compliance with the CCPM schedule-related configuration management standard.

1.2.4. Maintaining compliance with the WTE Integrated Wind Tunnel Planning System's data dictionary, database architecture, record-level coding schema, standard resource names, standard resource calendars, and a standard project calendar.

1.2.5. Posting the Facility's CCPM schedule files to the appropriate web site or server.

1.2.6. Assisting the RFB Facility Manager conduct schedule-related what-if analyses to assess the effect of Program-level changes on RFB.

1.2.7. Assisting the Facility Manager conduct the Facility's weekly CCPM status meeting.

1.2.8. Assisting the Facility Manager conduct the Facility's weekly Strategic Planning session.

1.2.9. Consolidating CCPM schedules and establishing the Facility's pipeline schedule.

1.2.10. The Contractor shall assist facility personnel to prepare the work package flow diagrams used to identify the hand-offs between tasks.

3. **Government Furnished Items:**

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The Government will provide the Contractor with:

- R2 Current software selected, or developed, by the Government as required for the implementation and maintenance of CCPM and other software products required to provide the deliverables identified in Section 2.
- Access to any of the Government's networked computer peripherals if the Government decides such access is needed to support this Task Order.
- Access to any of the Research Facilities Branch's network servers and Web servers as the Government decides are needed to support this Task Order.

4. 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.

5. Security clearance required for performance of work:

None required.

6. Period of Performance:

Planned start date: 2 January 2001

Completion date: R1 ~~31 December 2001~~

R3 ~~31 December 2002~~

R4 ~~31 December 2003~~

R5 ~~December 31, 2004~~

April 30, 2004

7. NASA Technical Monitor: R3 Tracey E. Redman

M/S: 267 Phone: 757-864-3015

NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth

M/S: 285 Phone: 757-864-8265

Task Order Number: 31RDA Revision: 3 Date of Revision: 11/19/04

Title: Facility Support For VDB

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

The Vehicle Dynamics Branch (VDB) conducts research to advance the state of the art in analytical and experimental characterization of vehicle stability, controllability, and control power requirements, spin characteristics, flying and handling qualities, agility, and maneuverability. Several wind tunnel test techniques are used as a part of this research. The current test techniques include: Static Force and Moment Test, Pressure Test, Power Effect Test, Tunnel Survey, Flow Visualization, and Dynamic Test including Forced Oscillation, Free-to-Roll, Dynamic Pitch, Free Spin, Rotary Balance, [R1]Free Fligh~~t~~. Additional information can be obtained on these test techniques on the VDB web page (URL http://asgsparc.larc.nasa.gov/docs/). The task pertains to developing and improving facility capabilities that are used in wind tunnel testing by Vehicle Dynamics Branch and was originally part of Task Order 20RDA.

Revision 1: Extends the completion date of the task 12 months. Adds requirements as new Subtasks 4 & 5. Subtask 2 deleted requirements for communication with data acquisition system and added a briefing when outside system modifications are complete. (see [R1] above and below).

Revision 2:Extends the completion date of the task 12 months, records completion of Subtask 5, adds Subtask 6, and puts subtask 1 on hold (see [R2] below).

Revision 3: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support with no changes in detailed requirements and documents a change in technical monitor for the new period of performance (see [R3] below).

2. Description of the Work to be Performed:

1. [R2]This task has been temporarily cancelled. It will be reactivated at a later data with a task modification. The Contractor shall provide oversight for the development of the forced oscillation rigs to be used in 12 Ft tunnel and 14x22 to assure that the rigs will have the functionality required by the branch. In addition the Contractor shall provide design and code for the user interface for the forced oscillation rig designed for 12 Ft. This will serve as the interface between the forced oscillation real time controller and the operator and/or the data acquisition system. This software will reside on the hardware computer system. The Contractor shall also provide an interim data acquisition system to acquire the balance data, rig position, and tunnel conditions in order to reduce the forced oscillation data for rig analysis and acceptance. Data shall include a time stamp and will be stored on a removable media. Position data and balance data must be synchronized.

Deliverables:

1) Design for the rig control user interface. Due three weeks after this task is issued.
2) Software for rig control user interface. Due 6 weeks after this task is issued
3) Interim data acquisition system. Due [R1]~~8~~ ***4*** weeks after this task is issued

Performance Standard: The rig meets the testing requirements of the branch and the rig will meet the safety requirements set by the NASA safety review process.

Performance Metrics: Exceeds: 'Meets' and software (deliverables 2 and 3) are delivered at lease two weeks ahead of required dates. Meets: Branch testing requirements have been met and the motion controller host computer software is functional as a stand alone system, moving the rig with direct user request, and when responding to the VDB data acquisition system

2. Air stations 4, 5, and 6 have been installed in 14x22 Tunnel to supply high-pressure air to support requirements of VDB test in the 14x22 Tunnel. The Contractor shall design, implement and provide coordination in the implementation of the system so that a desired air pressure and temperature can be requested through the data acquisition system. The software has been designed following the software acquisition plan: 'Remote Control of High Pressure Air and Temperature for VDB Testing in 14x22 Software Acquisition Plan'. Note: Work was conducted under previous Task Order DC26, Contract NAS1-96014, and Task Order 20RDA of this contract, however final acceptance will occur under current task order. The Contractor shall provide a branch system review at the milestones 1) R1 when current system modifications being done outside this task are complete and 2) when stand alone system acceptance R1 ~~and 2) completed data acquisition communication~~. All NASA safety requirements must be meet in the development of this system.

Performance Standard: The high pressure air system meets the testing requirements of the branch.

Performance Metrics: Exceeds: 'Meets' and the pressure system can be operated as quickly within the safety criteria as with a human operator. Meets: the system will control the pressure to the requested value

3. The Contractor shall coordinate the moving of the free flight testing technique to 30x60 Ft tunnel. This coordination shall include communication with Old Dominion University on building preparation and moving equipment and instrumentation needed for free flight testing.

Performance Standard: Free flight technique is operation in 30x60 Ft tunnel
Performance Metrics: Exceeds: 'Meets' and the move is accomplished without impact to the testing schedule. Meets: Free flight system maintains current functionality in 30x60 Ft Tunnel

Begin R1 block addition

4. The Contractor shall support VDB testing and facility modifications in preparation for

	testing. The Contractor shall provide test engineer support for approximately 3 wind tunnel tests per year to be conducted by VDB. This testing can be done on a two-shift operation. Request for services and tunnel schedule will be provided to the Contractor at least two weeks in advance using best information available. **Performance Standard:** Test engineers are available for tunnel preparation and testing when proper notification has been given and contribute to the progress of the test. **Performance Metrics:** Exceeds: 'Meets' and engineers take an active part in the test. Meets: Test engineers are provided according to the schedule established for specific test. 5. [R2]Completed **End [R1] block addition** **Begin [R2] block addition** 6. The Contractor shall support VDB test of Aries. The Contractor shall provide test engineer support for the model preparation and testing in 12 Ft Tunnel and TDT Tunnel. A test entry is tentatively scheduled for the first of November and is expected to be a two to three week entry. **Performance Standard:** Test engineers are available for test preparation and testing when proper notification has been given and contribute to the progress of the test. **Performance Metrics:** Exceeds: 'Meets' and engineering portions of the customer evaluation are high. Meets: Test engineers are provided according to the schedule established for the Aries test and engineers take an active part in the test. **End [R2] block addition**
3.	**<u>Government Furnished Items</u>:** Task may require integration or modification of hardware. In such cases the government may decide to purchase the required components. These will be provided to the Contractor for integration and modification and may be taken to Contractor site during integration or modifications and checkout. This will be determined on a case by case bases and will be decided by the technical monitor for the task
4.	**<u>Other information needed for performance of task</u>:** Software will be modified and developed in accordance to the LaRC LMS procedures. 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, <u>comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance.
5.	**<u>Security clearance required for performance of work</u>:**
6.	**<u>Period of Performance</u>:**

	Planned start date: 2/15/02	Completion date:	[R1] ~~1/1/03~~ [R2] ~~1/1/~~04 [R3] ~~*1/1/05*~~ ***12/31/05***
7.	**NASA Technical Monitor**: [R3] ***Susan Conry*** M/S: ***132*** Phone: 757-864-***2011*** NASA Competency/Other Technical Coordinator:		

Task Order Number: 31RFI Revision: 6 Date of Revision: 12/10/03

Title: Support for Combustion Water Vapor Sensor Development and Deployment

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

The NASA Hyper-X Project supports research into the phenomena of importance to hypersonic airbreathing propulsion, including effects of fuel injection strategies and geometries on the mixing and combustion of fuel with a supersonic airstream. In support of the Hyper-X project, studies are being conducted at the University of Virginia's Aerospace Research Laboratory (ARL) on generic supersonic combustors. The ability of the ARL facility to run continuously and without vitiation make it unique among supersonic combustion research facilities.

The Sensor Systems Branch of the Systems Engineering Competency has an important role to play in the Hyper-X supported research being conducted both at NASA Langley and at the University of Virginia. A first step in this process is the development of a water vapor mapping instrument to be demonstrated in the ARL's supersonic combustion facility. The instrument will be capable of providing a two dimensional map of water vapor concentration and temperature in a plane perpendicular to the predominant flow direction. This instrument will incorporate technology which has been developed for and used in the Diode Laser Hygrometer (DLH) which has been used extensively in support of atmospheric measurement campaigns. Support this new instrument is required in development, testing, demonstration at the ARL, and in data analysis.

Begin [R1] block addition
NASA's Office of Earth Science is sponsoring an airborne atmospheric science mission to the Arctic region during January to February 2003. This measurement campaign, named SOLVE-2, will involve the deployment of the NASA Dryden DC-8 aircraft that will be instrumented by principal investigator (PI) groups from several universities and government agencies. Primary objectives of SOLVE-2 are to validate measurements made by the SAGE-III satellite.

The Laser and Electro-Optics Branch of the Systems Engineering Competency has an important role in SOLVE-2 by providing measurements of key gas species on the DC-8 aircraft. High accuracy, fast response, *in situ* measurements of CO, CH_4 and N_2O will be provided by the Differential Absorption CO Measurement (DACOM) while high quality $H_2O(v)$ measurements will be provided by the Diode Laser Hygrometer (DLH). The DACOM and DLH instrument systems are scheduled to be in the field at either the DC-8 integration site (NASA Dryden) or based from the intensive operations site at Kiruna, Sweden. Personnel are required to support SOLVE-2 by shipping the instruments to the integration sites, aircraft integration, flight testing, in-flight operation and maintenance, shipping the instruments back to Langley, laboratory reorganization, and post mission instrument calibration and 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.

End R1 block addition

Revision 1: Adds new requirements as Subtasks 8 and 9 to prepare instrumentation for SOLVE-2 deployment and revises schedule metrics in Subtasks 1-4 (see R1 above and below).

Revision 2: Adjusts the schedule for the Hyper-X-supported water vapor mapping instrument development in Subtasks 1.0-4.0 and extends the period of performance six months (see R2 below).

Revision 3: (4/11/03) Extends the period of performance to September 30, 2003 (4/24/03) Adds new requirements as Subtask 10 to work on electronic, mechanical, and fluid subsystems relevant to combustion sensor, DLH, and DACOM instruments, also adds small purchase requirement to Section 4(see R3 below).

Revision 4: Extends the period of performance one month to October 31, 2003 (see R4below).

Revision 5: Extends the period of performance two months to December 31, 2003 (see R5below).

Revision 6: Extends the period of performance two months to February 29, 2004 (see R6 below).

2. **Description of the Work to be Performed**:

Subtask 1.0: Physical design and construction of instrument. The Contractor shall design and construct a physical housing for the instrument, including the laser and detector, and mount components in said housing. The Task monitor will review and provide approval of the designs prior to construction, and provide the laser and detector. The Contractor shall proceed if approval is not provided within 5 working days.

Deliverables

1. Drawing(s), complete housing with mounted components

Performance Standards and Evaluation Criteria

Meets:

1. Instrument design completed by R1~~March 22, 2002~~ R2~~December 31, 2002~~ March 21, 2003.
2. Housing complete by R1~~April 22, 2002~~R2~~December 31, 2002~~ April 21, 2003.

Exceeds:

1. Instrument design completed by R1~~March 8, 2002~~ R2~~November 30, 2002~~ March 7, 2003.
2. Housing complete by R1~~April 8, 2002~~ R2~~November 30, 2002~~ April 7, 2003.

Subtask 2.0: Integration of Laser/Detector with control and data acquisition systems. The Contractor shall design and implement hardware strategies for instrument control and data acquisition. The Task monitor will review and provide approval of these strategies prior to implementation. The Contractor shall proceed if approval is not provided within 5 working days.

Deliverables

1. Integrated measurement system

Performance Standards and Evaluation Criteria

Meets:

1. Acceptable strategies submitted for approval by [R1]~~May 6, 2002~~[R2]~~December 31, 2002~~ May 5, 2003.
2. Viable instrument available for testing by [R1]~~May 20, 2002~~[R2]~~December 31, 2002~~ May 19, 2003.

Exceeds:

1. Acceptable strategies submitted for approval by [R1]~~April 29, 2002~~[R2]~~November 30, 2002~~ April28, 2003.
2. Viable instrument available for testing by [R1]~~May 13, 2002~~[R2]~~November 30, 2002~~ May 12, 2003.

Subtask 3.0: Testing of the instrument at Langley Research Center in flat-flame burner. The Contractor shall test the operation of the instrument in a flat flame hydrogen-air burner, which will be provided by the Task monitor. The tests shall be performed to verify operational characteristics of the instrument, including knowledge of spectroscopic parameters used in interpreting data.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of the instrument, including anomalous behavior and/or failures.
2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on the instrument.

3. Test data files generated during check out tests.

Performance Standards and Evaluation Criteria

Meets:

1. Tests completed by [R1] ~~June 14, 2002~~[R2]~~December 31, 2002~~ June13, 2003, barring equipment failure.

Exceeds:

1. Tests completed by [R1]~~June 7, 2002~~[R2]~~November 30, 2002~~ June 6, 2003, barring equipment failure.

Subtask 4.0: Prepare instrument for transport to University of Virginia. The Contractor shall prepare the instrument and any necessary supporting equipment for shipment or hand-delivery to the University of Virginia's Aerospace Research Laboratory.

Deliverables

1. Instrument and supporting equipment ready for shipment.

Performance Standards and Evaluation Criteria

Meets:

1. Instrument ready to ship or hand-deliver by [R1]~~June 21, 2002~~[R2]~~December 31, 2002~~ June20, 2003.

Exceeds:

1. Instrument ready to ship or hand-deliver by [R1]~~June 14, 2002~~[R2]~~November 30, 2002~~ June 13, 2003.

Subtask 5.0: Operate and maintain the instrument while making measurements at ARL. The Contractor shall operate and maintain the instrument at the University of Virginia's Aerospace

Research Laboratory.

Deliverables

1. Log entries summarizing procedural verification of operation and performance of instrument for all measurements made at ARL.
2. Log entries of troubleshooting, repairs, modifications, adjustments and routine maintenance performed on instrument and supporting equipment.
3. Instrument test data files.

Performance Standards and Evaluation Criteria

Meets:

1. Data for each facility operating condition, barring laser, optics, or detector failures.
2. 24 hour turnaround for instrument operational changes, including selection of spectral absorption line, modulation depth, data acquisition rate.
3. 48 hour turnaround for instrument repairs, barring laser, optics, or detector failures.
4. Delivery of instrument data files to Task monitor within 24 hours of each test.

Exceeds:

1. Instrument operational changes implemented prior to next work day.
2. 24 hour turnaround for instrument repairs, barring laser, optics, or detector failures.

Subtask 6.0: Prepare instrument for return transport to NASA LaRC. The Contractor shall prepare the instrument and any necessary supporting equipment for shipment or hand-delivery to the Langley Research Center.

Deliverables

1. Prepare instrument and supporting equipment for shipping or hand-delivery to LaRC.

Performance Standards and Evaluation Criteria

Meets:

1. Instrument and supporting equipment ready for return to LaRC within 72 hours of final measurement at ARL.

Exceeds

1. Instrument and supporting equipment ready for return to LaRC within36 hours of final measurement at ARL.

Subtask 7.0: After return from deployment, unpack instrument and supporting equipment, reorganize laboratory, conduct equipment inventory, and calibrate instruments.

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 one month of receipt at LaRC.

Exceeds:

1. Equipment unpacked and laboratory reorganized within two weeks of receipt at LaRC.

Begin R1 block addition

Subtask 8.0: Prepare DLH and DACOM instruments for use in SOLVE-2 mission. The Contractor shall return DLH and DACOM instruments to condition for operation on the DC-8 aircraft during the SOLVE-2 deployment.

Deliverables

1. DLH in working order and ready to integrate on DC-8.
2. DACOM in working order and ready to integrate on DC-8.
3. Supporting equipment in working order and ready to integrate on DC-8.
4. DLH, DACOM, and supporting equipment packed for shipment to DFRC.

Performance Standards and Evaluation Criteria

Meets:

DLH, DACOM, and supporting equipment ready for shipment to DFRC by Nov. 14, 2002.

Exceeds:

DLH, DACOM, and supporting equipment ready to be packed (shipping notice complete) by Nov. 8, 2002.

Subtask 9.0: Integrate DLH and DACOM on DC-8. The Contractor shall install instruments on DC-8 aircraft (at DFRC) and demonstrate their operability once installed. The Contractor shall support government personnel by participating in all ground tests and test flights.

Deliverables

1. DLH integrated and working properly.
2. DACOM integrated and working properly.
3. Both instruments operating during test flights, including recording of data.

Performance Standards and Evaluation Criteria

Meets:
DLH and DACOM operating properly prior to final test flight before deployment, barring optics failure.

Exceeds:
DLH and DACOM operating properly prior to final test flight before winter holiday schedule break, barring optics failure.
End R1 block addition

Subtask 10.0: Integrate new subsystems into combustion water vapor sensor, DLH, and/or DACOM as necessary. The Contractor shall incorporate newly received electronics into instruments as they become available. The Contractor shall modify mechanical subsystems as new components become available. The Contractor shall modify fluid subsystems as new components or techniques become available.

Deliverables

1. New electronic components tested and made operational as required.
2. New mechanical components tested and made operational as required.
3. New fluid components and techniques tested and made operational as required.

Meets:
All components available by June 1, 2003 tested and operational by R6 ***February 29, 2004***.

Exceeds:
All components available by June 1, 2003 tested and operational by R6 ***January 15, 2004.***

3. **Government Furnished Items:**

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Title: Support for Combustion Water Vapor Sensor Development and Deployment

	1. The laser and detector, as well as supporting instrumentation, computer(s), 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.
4.	**Other information needed for performance of task:** Travel: Deployment schedule calendars for the measurements at U.Va. / ARL are very changeable due to student progress and class schedules. Approximately 3 trips will be required: one trip of a single day to view facility, associated equipment, and laser area; one trip of one week duration to perform preliminary assessment of instrument's capabilities; one trip of two weeks duration to perform measurements discussed in Section 2. There will be 2 operators with the instrument for at least 50% of the required measurements at U.Va. / ARL. (Note: The Task monitor or his designee will count as one operator of these instruments.) Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC [R3]Purchase: in order to perform subtasks in a timely manner, it may occasionally be necessary for Contractor to purchase small items. 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.
5.	**Security clearance required for performance of work:** None required.
6.	**Period of Performance:** Planned start date: February 11, 2002 Completion date: [R2]~~December 31, 2002~~ [R3]~~June 30, 2003~~ [R4]~~September 30, 2003~~ [R5]~~October 31, 2003~~ [R6]~~December 31, 2003~~ ***February 29, 2004***

	Task Order Number: 31RFI Revision: 6 Date of Revision: 12/10/03 Title: Support for Combustion Water Vapor Sensor Development and Deployment

7.	**NASA Technical Monitor:** Glenn S. Diskin M/S: 468 Phone: 757-864-6268 **NASA Competency/Other Technical Coordinator:** Systems Engineering Competency M/S: *nnn* Phone: 757-864-*nnnn*

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	
	Task Order Number: 32RAC Revision: ____ Date of Revision: Title: Advanced Concepts for the Aerial Exploration of Mars

1.	**Purpose, Objective or Background of Work to be Performed:** ***The purpose of this task order is to support the development of advanced concepts for the aerial exploration of Mars. Langley is in the proposal development phase and needs assistance with concept development.***
2.	**Description of the Work to be Performed:** Subtask 1: Perform aerodynamic analyses of Mars aircraft. It is expected that the one set of airplane aerodynamic performance results will be necessary per week until design freeze. Design freeze will occur when the Announcement of Opportunity is released. Metrics/Standards: Meets: Timely delivery of each set of performance results/2 working days. Exceeds: Next day delivery. Subtask 2: Perform sizing studies to develop concepts that meet the requirements of the Mars Airborne Regional Surveyor. Include geometry definition, aerodynamic prediction, mass prediction, propulsion modeling, performance estimation. Concept will be determined from the list of concepts that need to be analyzed. Contractor and requestor will match requirements and capabilities. Metrics/Standards: Meets: Innovation in creating robust and low-risk concepts is necessary. Exceeds: Validation with available data and other methods will provide exceptional products. Subtask 3: Generate stability and control aerodynamic derivatives for selected concepts that can be used to simulate the flight characteristics of the Mars airplane concepts. First delivery will be by Feb. 10. Then monthly updates to the model until design freeze. Final delivery will be of "frozen" design, 3 weeks after the design freeze. Metrics/Standards: Meets: Timely delivery and updates/ 5 days and 1 day. Exceeds: 2 days and same day
3.	**Government Furnished Items:** Aircraft concepts and software tools will be provided by the government. Some validation data may also available from NASA.
4.	**Other information needed for performance of task:** All NASA LaRC Safety practices will be followed. 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.

5.	**Security clearance required for performance of work:** *Security clearance is not required. Access to proprietary data may be required.*
6.	**Period of Performance:** Planned start date: Jan 1, 2002 Completion date: Sep 30, 2002
7.	**NASA Technical Monitor:** Paul A. Gelhausen M/S: *348* Phone: 757-864-*2290* **NASA Competency Coordinator:** ASCAC/M.F. Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 32RBJ Revision: 4 Date of Revision: 3/9/04

Title: 8-Ft. HTT Test Support:

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

The 8-Foot High Temperature Tunnel (8-Ft. HTT) is a large, hypersonic blowdown tunnel that provides true-temperature simulation of flight conditions for a range of free stream Mach numbers from 4 to 7 over an altitude range of 60,000 to 125,000 feet. The 8-Ft. HTT provides experimental data for several different types of hypersonic tests including air breathing propulsion, flight-weight structural verification, and aerothermal loads definition. These data support programs sponsored by NASA, DoD, and the aerospace industry. The 8-Ft. HTT is also supported by a small pilot facility, the 7-Inch High Temperature Tunnel (7-In. HTT), which runs infrequently to test new facility or model hardware prior to development for the 8-Ft. HTT.

Test programs in the 8-Ft. HTT generally involve large and/or complex models that require installation periods of several weeks duration. Also, each true-temperature tunnel run produces significant heat loads, which limit the run schedule to be no more than 2 full-duration runs per extended 8-hour day. Therefore, the number of different test programs in one year is 4 maximum, and the number of full-duration runs is approximately 20 runs maximum per month.

The 8-Ft. HTT requires extensive preparation for each run, which is about 3 minutes maximum duration. Generally, no more than 4 run attempts are made in an 8-hour plus day, but 1 or 2 run attempts per day is typical. Therefore, the data system must be highly reliable to meet NASA run schedules and flexible to recycle from an aborted tunnel run quickly.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements with Subtasks 2.3 and 2.4 deleted (see [R1] below).

Revision 2: Extends the period of performance one year in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R2] below).

Revision 3: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support with some updated/clarified requirements for the new period of performance (see [R3] below). Also it is anticipated that requirements will be migrated to ROME contract with an associated shortening in this task order period of performance.

Revision 4: For NASA's convenience the period of performance is moved up 8 months to April 30, 2004 with no other changes in detailed requirements (see [R4] below, Section 6).

2. Description of the Work to be Performed:

2.1. Data System Management and Operation:

The Contractor shall use the existing data system at the 8-Ft. HTT to provide, disseminate, archive, and retrieve data obtained from sensors installed in the tunnel systems or research models. This task includes customer consultation, setting up data system software and input files to customer specifications for a particular test program ([R3]***typically*** 4 times per year), modifying those input files for different model configurations or failed sensors ([R3]***up to once per day*** during actual runs), configuring the patch board, and end-to-end system checkout and/or calibration. During run preparations, the Contractor shall attend the Test Readiness Review, which is held approximately 30 to 60 minutes prior to the run, attend the Data Review, which is generally held within 24 hours after run completion, and provide timely status reports to the 8-Ft. HTT Test Director.

System modifications shall be accomplished only with the prior approval of NASA through the 8-Ft. HTT Task/Test Request (TTR) as described in 8-Ft. HTT Facility Management Plan (FMP).

System failures shall be formally reported on the 8-Ft. HTT Problem/Failure Report (PFR), as described in 8-Ft. HTT FMP.

Similar support shall be provided for the 7-In. HTT on a non-interference basis with 8-Ft. HTT activities.

Deliverables:
1) Electronic copies of data in NASA-specified engineering units (6-10 files).
2) Hard/electronic copies of plots in NASA-specified format (approximately 150 plots in different formats).
3) Log of archived data, maintained on hard copy in 8-Ft. HTT Data Room and electronically available to 8-Ft. HTT PCs and Macs.
4) Completed PFRs.

Metrics:
1) Data system supports tunnel run schedules without delay for 80% of scheduled runs.
2) Hard/electronic copies of plots and electronic data files distributed in NASA-specified formats 1 hour after run completion.
3) Completed PFRs within 48 hours.

Exceeds:
1) Data system-related run delays less than 20% of scheduled runs.
2) Data available in less than 1 hour.
3) PFRs available in less than 48 hours.

Schedule:
Meet NASA-specified schedule as defined by Master Schedule and run TTRs.
Note: Flexibility is required since schedule changes are frequent due to equipment failures, lack of consumables, etc.

	2.2. Data System Development: The Contractor shall implement and maintain a test bed data acquisition system consisting of a PC, AutoNet software, and a Neff 600 Analog Digital converter. This equipment is currently in the 8-Ft. HTT inventory. The test bed system will be used for troubleshooting and system development of the 8-Ft. HTT data system. Deliverables: Fully-operational data system as verified by demonstration. Metrics: Maintain Operational Systems 2.3 R1(Deleted) 2.4 R1(Deleted)
3.	**Government Furnished Items:** Data Acquisition Systems, Intel Pentium CPU-Based computers.
4.	**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.
5.	**Security clearance required for performance of work:** None required.
6.	**Period of Performance:** Planned start date: 2 January 2001 Completion date: R1 ~~31 December 2001~~ R2 ~~31 December 2002~~ R3 ~~31 December 2003~~ R4 ~~December 31, 2004~~ ***April 30, 2004***
7.	**NASA Technical Monitor:** Jeffrey S. Hodge M/S: 395 Phone: 757-864-5237 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

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

In-house programming support for the development of a customizable display prototype program for an airborne planning tool capable of displaying weather information and objects from a navigation database (e.g. Airports, navigation aids). The system shall interface with different real-time weather information servers and other Internet sources of weather information, in addition to a navigation database. The system must be portable to workstations running Linux, Windows, and other Unix variants. This effort is in support of the Advanced Weather Information Systems element of the Aviation Safety Program.

Revision 1: Extends the period of performance one year to 11/30/04 in continuation of NASA's support with no change in detailed requirements (see R1 below).
Revision 2: Extends the period of performance ten months to 9/30/05 in continuation of NASA's support with no change in detailed requirements (see R2 below).

2. Description of the Work to be Performed:

The task involves development of an easily customizable display program for an airborne route-planning tool that incorporates weather information in addition to navigation database objects. Implementation language is expected to be Java; the researcher(s) and the technical monitor make a final decision on the implementation language and code design. The display characteristics (i.e. icons, colors, size, etc.) of weather and navigation database features and objects shall be customizable through a resource file rather than by programming. Display objects' behavior shall be customizable by external code modules thus a clear/concise interface between the display program and the modules shall be developed. Researchers and the technical monitor will agree on all design choices before implementation starts. Three phases of development are anticipated:

Phase I: code interfaces to navigation database and display of navigation objects; resource file used to specify all display objects' attributes
Phase II: code interfaces to weather information servers and display of weather objects
Phase III: code interfaces for external modules.

The Contractor shall perform the following requirements:

Subtasks/Deliverables
Phase I
1. Develop and document code requirements by consensus with researcher(s) and technical monitor
2. Develop code architecture
3. Review code architecture with researcher(s) and technical monitor
4. Develop code detailed design and external module interfaces
5. Document detailed design and external module interfaces
6. Develop code interfaces to navigation database and displays basic objects; resource file used to specify all display objects' attributes.

	Deliverables: All Phase I, R1 ~~July 31, 2003~~ July 31, 2004 Phase II 7. Develop code interfaces to weather information servers and display of weather objects 8. Researcher(s) and technical monitor will test code after each phase of development. An informal report will be produced indicating all request for changes and problems encountered during testing. Before continuing to next phase of development all issues with current phase shall be resolved and documented. Deliverables: Code & documentation - 4 months after acceptance of Phase I Phase III 9. Develop code interfaces to external modules. 10. Develop user manual Deliverables: Code & documentation - 4 months after acceptance of Phase II Metrics 1. Reliability of delivered code (no. of known bugs not repaired) 2. On-time deliveries of documentation and code Standards Meets: All deliverables on time with no identified deficiencies. Exceeds: 80% deliverables provided two to four weeks ahead of schedule with no identified deficiencies.
3.	**Government Furnished Items:** *Navigation database*
4.	**Other information needed for performance of task:** Travel a) Possible Locations: NASA Ames, NCAR, National Weather Service sites b) Purpose of travel: To assess and obtain information/access to weather servers. c) Expected duration of travel: 1 day on site. 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.
5.	**Security clearance required for performance of work:** *None*
6.	**Period of Performance:** Planned start date: 11/30/2002 Completion date: R1 ~~11/30/2003~~ R2 ~~11/30/2004~~ ***9/30/05***

7.	**NASA Technical Monitor:** *Peter A. Padilla, Ph.D.* M/S: *152* Phone: 757-864-*6187* NASA Competency/Other Technical Coordinator (*above branch level*): *name (This is the management interface between COTR and TM for efficiency in PBC, technical focus, timely funding, modifications, scheduling, and award fee evaluations--selected by Competency/Office.)* M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 32RFF Revision: ____ Date of Revision:

Title: SAGE III/ISS Payload Contamination Control

1. **<u>Purpose, Objective or Background of Work to be Performed</u>:**

The purpose of this task order is to provide SAGE III/ISS Payload Contamination Control support based on 1) knowledge of the SAGE III and Hexapod designs and hardware, and International Space Station procedures, design, and hardware and 2) experience with space-flight designs and contamination analysis. Experience and knowledge of implementing cleanliness control programs at Kennedy Space Center (KSC) will be necessary with most of the work being performed off-site of Langley Research Center. For relative planning purposes only, it is anticipated that if the work were accomplished by a NASA senior engineer, it would require approximately 0.3 FTE (Full Time Equivalent) initially and ramp upward near the launch date, currently scheduled for April 2006.

Revision 1: Decreases the period of performance to 12/31/02 and deletes and/or revises the requirements to reflect changed NASA programmatic/funding priorities (see R1 below).

2. **<u>Description of the Work to be Performed</u>:**

The Contractor shall be responsible for the R1 ***development*** of the Cleanliness and Contamination Control Plan.R1 ~~and the plans for monitoring and cleaning of~~ for the SAGE III payload at LaRC and other NASA centers. R1~~The Contractor shall monitor and document Contamination Control activities. During SAGE III Integration and Test activities at KSC, the Contractor shall interface (in person, via phone or by e-mail) with the SAGE III Instrument Manager twice a week minimum on activities as related to Contamination Control. The Contractor shall also work closely with the LaRC, KSC, and MSFC Quality Specialists to assure procedures are being followed completely.~~

Specific requirements shall include, but not be limited to the following:

- Develop a Cleanliness and Contamination Control Plan for the SAGE III/ISS Payload, which addresses particulate contamination and nonvolatile residue, beginning with the integration of the SAGE III components and Hexapod components on the EXPRESS pallet adapter (ExPA) Mechanical Simulator, through launch and into the mission checkout phase. Where at all possible, cleaning procedures and contamination budgets shall be compatible with the Ball Aerospace DRL 33 and 73 and ESA/Alenia procedures. Cleanliness levels shall be equal or cleaner than the levels listed in DRL 33 and 73. The plan shall include steps for maintaining cleanliness and performing cleanliness measurements. A draft shall be submitted to the SAGE III Instrument Manager for his review R1***and incorporation of comments prior to final delivery of the plan***.~~by August 5, 2002. The plan shall be ready for implementation by September 3, 2002.~~

Standard: Delivery seven days or more before R1***funds are depleted*** = exceeds
Delivery date R1***1-6 days before funds are depleted*** = meets
After R1***funds depleted*** = fails

- Identify specific inspection and cleaning procedures needed to ensure meeting SAGE III/ISS mission level contamination requirements.

*****Begin R1 block deletion*****

- ~~Participate in planned technical discussions with ESA, Alenia Spazio, and NASA via phone or in person when contamination control issues need to be addressed. SAGE III Instrument Manager will notify the Contractor in advance of the discussions.~~

~~Standard: >90% attendance per year = exceeds~~
~~61-89% attendance per year = meets~~
~~<60% attendance per year = fails~~

- ~~Participate in SAGE III Payload activities at LaRC for inspection and cleaning during scheduled functional testing on an approximate quarterly basis, and review sampling and witness plate data to verify compliance with plans.~~

~~Standard: >90% attendance per year = exceeds~~
~~61-89% attendance per year = meets~~
~~<60% attendance per year = fails~~

- ~~Participate in Express Pallet level Integration and Test activities at KSC to support inspection and cleaning of the SAGE Payload systems during scheduled functional tests. Review Integration and Test contamination data with the SAGE III Instrument Manager. Data delivery dates to be established by SAGE III Instrument Manager and Contractor.~~

~~Standard: Delivery seven days or more before data delivery date = exceeds~~
~~Data delivery date to 6 days early = meets~~
~~After data delivery date = fails~~

- ~~Provide tests and analyses to assess the impact of contamination (molecular and particulate) on the Integration and Test phase and the Mission Operation phase. Tests and analyses include baseline tests of witness mirrors and post use testing of witness mirrors, tape lifts, and wipes. Delivery dates on tests and analyses to be established by SAGE III Instrument Manager and Contamination Control Engineer due to individual test complexity and need.~~

~~Standard: Delivery seven days early or sooner on delivery date = exceeds~~

Task Order Number: 32RFF Revision: ____ Date of Revision:

Title: SAGE III/ISS Payload Contamination Control

	~~Delivery date to 6 days early = meets~~ ~~After delivery date = fails~~ *****End R1 block deletion*****
3.	**<u>Government Furnished Items</u>:** R1~~LaRC will provide witness mirrors for contamination assessments for baseline testing and cleaning.~~
4.	**<u>Other information needed for performance of task</u>:** R1~~Travel to LaRC on a quarterly basis. Each trip estimated at 3 days.~~ 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<u>, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance.
5.	**<u>Security clearance required for performance of work</u>:**
6.	**<u>Period of Performance</u>:** Planned start date: June 1, 2002 Completion date: R1~~May 31, 2003~~ ***Dec 31,2002***
7.	**NASA Technical Monitor:** S. E. "Chip" Holloway M/S: 432 Phone: 757-864-7090 **NASA Competency/Other Technical Coordinator (*above branch level*):** M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 33RAC Revision: ____ Date of Revision:

Title: STOL Transport Design Study

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

With the increase in use of regional jets in place of turbo prop commuter aircraft, the capacity on longer runways has increased at many airports. The development of shorter takeoff regional jets which could use shorter runways would help reduce this capacity problem while at the same time, a new aircraft design specifically for these shorter range missions would result in increased performance and reduced emissions.

2. Description of the Work to be Performed:

This concept will be a "new" aircraft and not a derivative of an existing vehicle. We are looking for an innovative but reasonable advanced aircraft, for entry into service in the 2010 time frame. The concept will be used for benefits assessment of advanced technologies from the 21st Century Technology Program and other NASA initiatives. This years' task is for a preliminary concept definition with an anticipated follow on next year for a final concept definition.

The Contractor shall perform the following requirements:

1. Conduct a trade study to determine the best design range and payload.
2. Develop a Short-Takeoff and Landing transport design concept with sufficient geometry detail to enable higher-order, CFD analysis of the configuration. The concept shall be based on UEET engine technology and composite structures.

Reporting Requirements:

1. - Monthly progress report
2. - Biweekly status meeting conducted with the task monitor.

Deliverables:

1. Final report that documents the range/payload trade study and the finalized mission requirements.
2. Final report documenting the preliminary concept design geometry and aircraft performance.
3. Transfer of configuration Geometry and Performance deck files.

Standards:

Standards for all deliverables will be: does not meet, meets, or exceeds requirements

Meets:

1. Range/payload trade study that produces viable mission requirements and design.
2. Preliminary design that allows immediate CFD analysis without further geometric refinement other than standard meshing procedures.
3. Files readily usable for CFD analysis

Exceeds:

1. Supporting documentation for viability of results
2. Preliminary CFD results
3. Documentation of files for use in CFD analysis

3.	**Government Furnished Items**: Engine input file for FLOPS
4.	**Other information needed for performance of task**: No Required Travel. 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.
5.	Security clearance required for performance of work: None.
6.	**Period of Performance**: Planned start date:3-01-02 Completion date: 10-31-02
7.	**NASA Technical Monitor**: Robert McKinley M/S: 348 Phone: 757-864-7572 **NASA Competency/Other Technical Coordinator**: ASCAC/Rita Verlander M/S: 327 Phone: 757-864-1944

Task Order Number: 33RBI Revision: 8 Date of Revision: 3/17/05
Title: HYPERSONIC AIRBREATHING PROPULSION

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

The Hypersonic Airbreathing Propulsion Branch (HAPB) of the Aerodynamics, Aerothermodynamics, and Acoustics Competency (AAAC) at NASA Langley Research Center performs research on the design, testing, and engineering data analysis of airbreathing engine flow paths for propulsion of hypersonic cruise and trans-atmospheric vehicles. These propulsion systems are intended to operate in the supersonic/hypersonic flight regime with combustor flows transitioning from subsonic to supersonic; hence, they are referred to as dual-mode scramjets. Critically important elements of this research include the testing of scramjet engine configurations and components in HAPB scramjet test facilities, the collection of appropriate data, and the evaluation of scramjet performance through engineering and computational analysis of the data. In addition, the development of appropriate methods and processes to understand and interpret the experimental test data, to predict the ramjet/scramjet performance, and to extrapolate experimental data to flight performance is an important requirement.

The objectives of this Task are:

(1) The analysis and interpretation of HAPB experimental scramjet data to obtain performance assessments of various engine flow path configurations.
(2) The operation of HAPB fundamental studies laboratories, [R5]inclusive of diaphragm-rupture-dynamics studies [R6]and the operation of the Mach-4 Blow Down Facility (M4BDF), inclusive of model installation support
(3) The assessment and improvement of scramjet inlet, combustor, and nozzle concepts through experimental testing and computational fluid dynamics analysis
(4) [R5]The enhancements of the multi-block algorithm of the VULCAN CFD code to reduce the time required to perform an analysis of a scramjet combustor, and further modifications to improve the robustness and accuracy of the VULCAN patch-coefficient generation code

The successful performance of this Task requires knowledge and experience in a variety of disciplines, including supersonic fluid dynamics, thermodynamics and combustion chemistry of gases, experimental techniques and scramjet test facility operation, computational fluid dynamic codes and their implementation on computer systems, and technical and mechanical operation of experimental apparatus in fundamental studies laboratories.

The metrics for each sub-Task describe the minimal acceptable performance. Actions by the Contractor to exceed minimal performance are identified in the sub-Task descriptions.

[R1] **Note:** Some of the required support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Deletes Subtask 2.4 and adds PBC wording for hybrid R&T task (see [R1] above and below).
Revision 1, Change 1: Adds travel requirement (see [C1] below).
Revision 2: Extends the period of performance two months in continuation of NASA's support requirements and to allow planning for the next year's work (see [R2] below).
Revision 3: Extends the period of performance one year in continuation of NASA's support requirements, updates the requirements for the new period of performance (see [R3] below).
Revision 4: Extends the period of performance to December 31, 2003 in continuation of NASA's support with some requirements (Subtasks 2.1 and 2.3) suspended for the new period of performance (see [R4] below).
Revision 5: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support, clarifies Subtask 2.2 deliverable (3), adds new requirements as Subtask 2.5, and updates other info for the new period of performance (see [R5]above and below).
Revision 6: Modifies Subtask 2.2 to include the Mach-4 Blow Down Facility and descopes Subtask 2.5 (see [R6]above and below).
Change 1: Contractor-initiated change extends the period of performance 2 months to February 28, 2005 (see [R6.1] below, Section 6).
Revision 7: Extends the period of performance seven months to September 30, 2005 in continuation of NASA's support with no detailed changes in requirements (see [R7] below, Section 6).
Revision 8: Adds the anticipated requirement to disseminate information at foreign conferences (see [R8] Section 4 below).

2. **Description of the Work to be Performed:**

2.1.- Analysis and Interpretation of Experimental Scramjet Data: [R4](Suspended)

The Contractor shall perform work to provide data analysis, data plots, and written summaries from scramjet engine and component tests that have been and will continue to be acquired in LaRC ground test facilities.

In particular, the Contractor shall:
Provide data analysis support for HAPB tests of Hyper-X [R3]and/or AST-Program-derived engines. These tests will occur throughout the contract year. [R1] It is anticipated that [R3]~~80~~ 50 test analyses will be required. In the case of any schedule conflicts, priority will be determined by the Technical Monitor. Requirements for this task consist of two parts:
(1) graphical presentation of thrust stand measurements, selected pressure distributions–inclusive of comparison pressure distribution plots with previous corresponding tests, fueling sequences, and a minimum number of other parameters (as determined by a pre-test meeting) suitable for immediate post-test assessment for next test preparation and electronic cataloging of these data, and

(2) calculations of the appropriate engineering parameters to quantify the scramjet flow path performance to include inlet mass capture, net pressure force (derived from integration of surface pressure measurements and compared to thrust stand measurements), and test facility operating conditions in a format suitable for permanent cataloging of the engine operation and performance (this will be done only for some tests selected by the government).

Deliverables:

(1) Graphical results for immediate post-test performance assessment and electronically catalogued data files, and
(2) Electronic data files and a post-test written summary with graphics for the calculated engineering parameters, including methods used, key results, and important conclusions for each engine test series.

Metrics: (Describe minimal acceptable performance (MAP))
(1) Graphical results delivered immediately after each test in a test series to allow assessment prior to the next test and electronic cataloging of all acquired data at the end of the test day. Immediate is defined to mean delivery in time for next test preparation.
(2) The electronically cataloged files and the test summary for the inlet mass capture results are to be delivered within two weeks following completion of the selected tests. The electronically cataloged files and the test summary for the net pressure force results are to be delivered within 4 weeks of completion of the selected tests.

To exceed MAP, the Contractor can, for example: (1) develop and recommend engine test programs, including fuel injection, data sources, test sequences, and pre-test predictions for tests of scramjet engines in LaRC facilities; (2) suggest data analysis plans and additional measurements which enable a better assessment of engine performance; (3) create and implement improvements to the computer codes and data storage; and/or (4) write formal NASA Contractor Reports or conference (JANNAF) reports on analyses of engine test series.

2.2- Operation of Fundamental Studies Laboratories:
The Contractor shall provide the technical services and operational support for the operation of and data collection in the HAPB fundamental studies laboratories which includes the Basic Combustion Laboratory, the Nonintrusive Diagnostics Laboratory, the Propulsion Instrumentation Shock Tube Laboratory (PISTL), [R6]and the Mach-4 Blow Down Facility (M4BDF) in Building 1221C. The expected outcome of this Task is the orderly and safe operation of the apparatus to meet the research needs of basic combustion, measurement, and pulse facility studies in HAPB. [R1] It is anticipated that these facilities will be available for operation/testing throughout the entire period of performance. [R6]In the case of any schedule conflicts, priority will be determined by the Technical Monitor.

Deliverables:

(1) Configure and modify existing data acquisition systems to support laser-based diagnostic Development and testing in all laboratories.

(2) The fabrication or modification of small mechanical, electrical, or electronic components for use in all laboratories.

(3) Assembly, modification, and operation of gaseous flow apparatus for the Basic Combustion and Nonintrusive Diagnostics Laboratories, R6the operation of the M4BDF, and for the operation the PISTL facility, R5inclusive of conducting diaphragm-rupture-dynamics experiments (utilizing PISTL)

Metrics: (Describe minimal acceptable performance (MAP))

(1) Operation of the laboratories and fluid systems in a safe and efficient manner in compliance with NASA Safety Regulations, R6and LAPG 1740.7 (Process Systems Certification Program).

(2) Timely and efficient operation of the various laboratories to meet test schedules.

2.3- Experimental Testing, Computational Fluid Dynamics Analysis and R3Evaluation of Scramjet Flowpaths : (NOR) R4(Suspended)

The Contractor shall support the investigation of the baseline flowpath, or flowpaths, specific to the AST-Program elements, addressing inlet performance, and/or combustor performance, and/or nozzle performance; inclusive of integrated component R3and flowpath performance and operability limits.

Deliverables:

(1) The Contractor shall support the AST-Program elements addressing component, and integrated, performance of the ground-test hardware, associated flight hardware, and related flowpaths, to aid in the design and assessment of AST-Program propulsion systems. The scope of the analysis R3and experimental participation (to be specified in a NOR by the government prior to commencement) will include component, and integrated component, CFD, R3experimental testing and relevant theoretical analysis to assess the performance of the AST-Program's dual-mode scramjet engine; R3specifically, the AST-Program inward-turning concept, the ISTAR concept and the X-43C concept.

Metrics:

(1) Written archival summary report, inclusive of (but not limited to) significant conclusions and supporting technical notes, CFD related analysis, and theoretical work, due by December 31, 2002, constitutes minimally acceptable performance.

To exceed MAP, the Contractor can, for example: (1) perform further analysis of existing [R3]Mach 4, Mach 6, or Mach 7, data from a Rectangular-to-Elliptical Shape Transition (REST) inlet , (2) write a summary report on the data from these REST class inlets..

2.4 Analysis and Interpretation of ISTAR Engine Data: [R1] (Deleted)

Begin [R5]block addition

2.5 Improvements to the VULCAN CFD Code:

The Contractor shall perform work to the VULCAN CFD code to reduce the time required to perform an analysis of a scramjet combustor. These enhancements fall into two separate categories.

Software used to automatically decompose the user defined multi-block computational grid into the number of blocks required for efficient load balancing on a cluster computer and then, after the solution is obtained, merge the solution back into the original number of blocks created by the user for post-processing. [R6]~~This technology shall be brought to "production" code standards and extended to cover existing production VULCAN solver options~~. [R6]Subsequent, modifications to improve the robustness and accuracy of the patch-coefficient generation code [R6]maybe initiated [R6](subject to the completion of the multi-block splitter/merger algorithm and its associated documentation).

Deliverables:

Begin [R6] block deletion

~~(1) Written archival summary report, inclusive of (but not limited to) significant conclusions and supporting technical notes, for the VULCAN-CFD multi-block grid file and input file splitter/merger software (and the software itself).~~

~~(2) Written archival summary report for the technology relevant to the patch-coefficient generation code and the associated architecture/structure.~~

End [R6] block deletion

Metrics: (Describe minimal acceptable performance (MAP))

(1) The Contractor shall [R6]performthe technical work relevant to the VULCAN-CFD multi-block [R6]splitter/merger, inclusive of the testing and validation efforts. [R6]~~This technology shall be brought to production level standards by December/31/2004.~~

~~(2)~~ [R6]~~The Contractor shall initiate the technical work required to address the necessary modifications of the patch-coefficient code, in order that near-term efforts will be able to achieve production level standards.~~

To exceed the MAP, the contractor can complete the technical, and relevant documentation, for the patch-coefficient code, within the period-of-performance (terminating on [R6]~~December/31/2004~~ April 9, 2004).

End [R5] block addition

3. **Government Furnished Items:**

Task Order Number: 33RBI Revision: 8 Date of Revision: 3/17/05
Title: HYPERSONIC AIRBREATHING PROPULSION

	The Government shall make available to the Contractor the following equipment and items: 1.- Data acquired in scramjet engine and component tests and the operating conditions of NASA facilities. 2.- Access to the HAPB fundamental studies laboratories [R6]and the M4BDTF in Bldg. 1221C and to the scramjet test facilities in Bldg. 1221D, Bldg. 1247B, and Bldg. 1265. 3.- Access to specialized NASA and LaRC computer systems, including the HAPB distributed UNIX network (hyp00, hyp01), LaRC SNS system (Sabre, Borg, etc.), the NAS system at Ames RC (vonNeuman) and the NASA ACSF system at Ames RC (Eagle), secure computing environments at LaRC (Thunderbolt) and in HAPB (Secure1), [R5]and access to the VULCAN computer code and associated software elements. 4.- Design details and the propulsive flow path lines of the NASA Hyper-X and ARTT configurations as needed. 5.- Access to NASA pulse facilities and operational attributes.
4.	**<u>Other information needed for performance of task</u>:** [C1] ~~Travel to Boeing-Rocketdyne will be required to discuss results of inlet work under Subtask 2.3.~~ [R3]Travel to the AIAA Aerospace Conference in Reno, Nevada during January 2002, will be required to present results of work under Subtask 2.3. [R8]***Dissemination of information (subject to the NASA-LaRC release authorization procedures) at foreign conferences is an anticipated requirement.***
5.	**<u>Security clearance required for performance of work</u>:** Certain work done under this Task Order will expose the Contractor to classified or sensitive material. Contractors working classified projects shall be U. S. citizens and possess a security clearance level to SECRET, and [R3]Contractors working ITAR projects shall be U.S. citizens.
6.	**<u>Period of Performance</u>:** Planned start date: January 2, [R3]~~2001~~ 2002 Completion date: [R2] ~~October~~ [R6.1R3]~~December 31, 2004~~ [R7]~~February 28, 2005~~ September 30, 2005
7.	**NASA Technical Monitor:** Aaron H. Auslender M/S: 168 Phone: 757-864-6545 **NASA Competency Technical Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

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

This task is a continuation of the work started under sub-task 13 of task order 20RDA. The Guidance and Control Branch (GCB) is developing a radio-controlled [R1] 5.5% dynamically-scaled Generic Transport Model (GTM). The model will be used to conduct research on controls upset prevention and recovery. This task will cover installation of electrical instruments and testing of various model components such as actuator servos, receivers, transmitters, and turbine engines for [R1] ~~prototype~~ airplane models [R1] used in the GTM development and the final GTM.

Revision 1: Adds new requirements as Subtasks 2 and 3, extends the period of performance through April 1, 2003, and adds some clarification to section 1 (see [R1] above and below).
Revision 2: Adds new requirements as Subtask 4 and extends the period of performance through September 30, 2003 (see [R2] below).
Revision 3: Adds task-associated equipment requirement in Section 4 and modifies schedule in subtasks 2 and 3 (see [R3] below).
Revision 4: Updates the requirements for short and urgent additions to Subtasks 2 and 3 that are already completed to allow Contractor to re-plan task with new estimate of cost (see [R4] below).
Revision 5: Restarts work with additional requirements and period of performance ending 10/15/04 (see [R5] below).

2. **Description of the Work to be Performed:**

Subtask1: GTM-T1 Turbine Engine Tests This subtask involves the phase one model of the GTM development of a radio controlled version of the Generic Transport Model for training and initial instrumentation development and checkout (GTM-T1). The purpose of this subtask is to perform tests to document the characteristic of the [R5] ~~two~~ ***five*** turbine engines to be used for the GTM-T1 and subsequent models. The engine thrust and response times shall be measured as a function of both increasing and decreasing throttle input commands. A thrust versus throttle input curve shall be constructed from the test data for each engine. The method of testing shall be described and data collected shall be included in test reports for delivery to LaRC.

*****Begin [R5] block update*****

Part 1: Perform tests above for two AMT turbine engines (Completed)
Part 2: Perform tests above for three Jet Cat turbine engines (New)

Deliverables: (1) Report tests for two *AMT* turbine engines.
(2) Report tests for three *Jet Cat* turbine engines.

Performance Standard: Collection and documentation of sufficient data for modeling engine response and calibration of throttle input/thrust output relationship.

Performance Metrics:

Exceed: 'Meets' and test report is delivered ahead of schedule

Meets: (1) *AMT engine* test report is delivered by December 20, 2003.

(2) *Jet Cat engine* test report is delivered by October 1, 2004.

****End R5 block update*****

Begin R1 block addition

Subtask 2: Electrical Cable Design, Wiring, and Checkout of Airborne/Ground Telemetry System for FASER

This subtask involves an Ultra Stick model airplane (called FASER) that will be used for Parameter Identification (PID) research and for initial development and checkout of a telemetry architecture for the GTM. This task is concerned with wiring of the telemetry system components for FASER (Free-flying Aircraft for Subscale Experimental Research).

The Contractor shall design the wiring for the electrical cables to connect government-provided airborne and ground telemetry components for FASER and deliver a wiring diagram of this design to the government. The telemetry components to be wired are Microbotics components and are listed as follows with Microbotics part numbers:

L-band transmitter (TDL2A-422/LV)
L-band receiver (RDLA-422)
S-band video transmitter with subcarrier (TVS2A/422SC)
S-band video receiver with subcarrier (RVSA/422SC)
Inertial Navigation System (SIS90031)
Safety Board (GFA31016)
PCM-based Telemetry System with capacity for 48 channels of 0-5 volt analog data, 32 PWM servo drive channels, 8 digital output channels, and 8 digital input channels.
Ground Telemetry System with four high-speed full-duplex RS-422 ports and full-duplex IRIG PCM interface.

The Contractor shall construct the airborne and ground cables for the FASER telemetry system. The Contractor shall install the airborne cables in FASER and ground cables in the ground station for FASER.

After installation of the cables the Contractor shall provide consultation for checkout of the FASER telemetry system.

Deliverables: (1) FASER wiring diagram

(2) FASER ground and airborne cables installed on ground station and FASER

Performance Standard: Wiring cables completed and installed so that electrical checkout of

FASER systems can be initiated.

Performance Metrics:

Exceed: 'Meets' and wiring diagram and electrical cable installation is delivered ahead of schedule

Meets: FASER wiring diagram is delivered by February 17, 2003 and FASER electrical cable construction and installation is completed by R3~~February 10~~ R4~~June 9,~~ July 23, 2003.

Subtask 3: Electrical Cable Design, Wiring, and Checkout of Airborne/Ground Telemetry System for GTM-T1

This subtask involves the initial prototype of the GTM (GTM-T1 or GTM Trainer 1) that will be used to develop the electronics and train pilots for the final-design GTM. This task is concerned with wiring of the telemetry system components GTM-T1.

The Contractor shall design the wiring for the electrical cables to connect government-provided airborne and ground telemetry components for GTM-T1 and deliver a wiring diagram of this design to the government. The telemetry components to be connected by wiring cables are another set of those identified in task 2 above.

The Contractor shall construct the airborne and ground cables for the GTM-T1 telemetry system. The Contractor shall install the airborne cables in GTM-T1 and ground cables in the ground station for GTM-T1.

After installation of the cables the Contractor shall provide consultation for checkout of the GTM-T1 telemetry system.

R4The Contractor shall design, fabricate, and test an electronic device (Auto Deploy) for installation on the GTM-T1 that will detect electronic failures and low battery power conditions and subsequently deploys the landing gear automatically.

Deliverables: (1) GTM-T1 wiring diagram
(2) GTM-T1 ground and airborne cables installed on ground station and GTM-T1
R4(3) Auto Deploy electronic device

Performance Standard: Wiring cables completed and installed so that electrical checkout of GTM-T1 systems can be initiated.

Performance Metrics:

Exceed: 'Meets' and wiring diagram and electrical cable installation is delivered ahead of schedule

Meets: GTM-T1 wiring diagram is delivered by February 19, 2003; GTM-T1 electrical cable construction and installation is completed by R3 ~~April 1~~June 9, 2003; R4 and Auto Deploy electronic device by July 23, 2003.

End R1 block addition

Begin R2 block addition

Subtask 4: Intermittent Electrical Trouble-Shooting and Problem-Correction Support for FASER and GTM-T1 Flight Test Checkout

This task provides for electrical trouble-shooting and problem correction support for FASER and GTM-T1 model airplanes when electrical problems are encountered during checkout flights. Given that these problems are unpredictable, the support will occur on an intermittent basis. The support will be provided during the period April 1, 2003 to September 30, 2003. The estimated number of support hours for that period of time is 80 hours.

When a problem occurs, the Contractor will be notified of the problem encountered by email. Initiation of trouble-shooting support is expected to occur within 24 hours of notification. Initiation of support greater than 24 hours after notification can occur if acceptable to the government.

The Contractor will diagnosis the problem and provide a solution to correct the problem that is acceptable to government. Where deemed appropriate by the government, the Contractor shall assist in implementing the solution.

The Contractor shall document the problem, the details that caused the problem, and the solution used to correct the problem in an electronic text file. The Contractor shall deliver the electronic file to the government.

Deliverables: Electronic text report of the documented electrical problems supported containing information as described above and to be delivered by 9/30/03.

Performance Standard: Source of electrical problem is determined and correction is provided that is acceptable to the government.

Performance Metrics:

Exceed: 'Meets" and support is initiated less than 8 hours from notification of problem.

Meets: Performance Standard is satisfied and support is initiated less than 24 hours from notification of problem or the Performance Standard is satisfied and support is initiated 24 hours or more from notification of problem when acceptable to the government.

End R2 block addition

3. Government Furnished Items:

GTM-T1 turbine engines

4. 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. R3The Contractor shall provide electrical and electronic equipment not furnished by the Government that is needed to complete subtasks 2, 3 and 4. This equipment includes such things as batteries, antennas, and electronic components. This equipment will become government property upon receipt of the deliverables under task 2 and 3.
5.	**Security clearance required for performance of work**: None
6.	**Period of Performance:** Planned start date: R5~~12/2/02~~ ***8/15/04*** Completion date: R1~~12/31/02~~ R2~~4/1/03~~ R5 ~~9/30/03~~ ***10/15/04***
7.	**NASA Technical Monitor**: Richard Hueschen M/S: 161 Phone: 757-864-4036 NASA Competency/Other Technical Coordinator: M/S: Phone: 757-864-

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Statement of Work

Task Order Number: 33RFM Revision: 1 Date of Revision: 8/14/02

Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project.

1. **Purpose, Objective or Background of Work to be Performed**: NASA Langley Research Center is developing the Calipso (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) Mission in cooperation with the French Centre National d'Etudes Spatiales (CNES) for the purpose of studying aerosols and clouds in the Earth atmosphere. The primary instrument is a two-wavelength LIDAR (light detection and ranging) being developed by NASA-LaRC via contract to Ball Aerospace and Technologies Corporation (BATC). An Imaging Infrared Radiometer (IIR) is being provided by CNES via contract with Sodern in Paris, France. A Wide Field Camera is being provided by Ball Aerospace. Ball Aerospace is building, qualifying, and functionally testing the Payload. Payload assembly and testing is beginning in June '02, with delivery planned for June '03.

CNES is providing their standard Proteus Platform via contract with the Alcatel, Corp. in Cannes, France. The Payload will be shipped to France to begin Satellite level assembly and testing at the beginning of August '03. The Satellite will complete comprehensive testing in late March '04 and be delivered to Vandenberg Air Force Base (VAFB) in April '04. Launch date is planned August '04 aboard a Delta launch vehicle.

Some related CALIPSO mission milestones are as follows:

Schedule Item	Delivery Date
IIR Delivery	Jan '03
Payload Delivery	June '03
Platform Delivery	June '03
Begin Sat. AIT	Aug '03
Comp. Sat. AIT	April '04
Sat Deliv to VAFB	May '04
Launch Date	August '04

Revision 1: Adds new requirements as Subtask 3) (includes additional travel) and makes some minor clarifications (see [R1] below, including Appendix).

2. **Description of the Work to be Performed**:

In general, the Contractor will be responsible for:

1) All IIR instrument performance verifications, payload integration readiness testing, and performance and health checks during all phases of CALIPSO AIT. This is to be done by observing the IIR testing at the Sodern facility in France and working with IIR test engineers to develop test procedures for use in all phases of the AIT for the CALIPSO project.

2) Supporting CALIPSO Payload AIT activities at BATC in Boulder, Co, and Satellite AIT activities at Alcatel in Cannes, France and at VAFB in California. The specific Payload AIT activities include the operation of the Payload and GSE (ground support equipment) during OATS ([R1]***Optical and Aliveness Test System***) alignment testing, the generation and performance of a Payload interface electrical check procedure for pre and post-ship functional checkout of the CALIPSO Payload, and operational support during all powered laser activities of the CALIPSO Payload.

*****Begin R1 block addition*****

3). Supporting the Laser Electronics Unit board and box level assembly and test effort on-site at Fibertek, Inc. in Herndon, Virginia. All needed GSE, facilities, and design documentation will be provided to the Contractor.

*****End R1 block addition*****

In performing the requirements of this CALIPSO Activity, the Contractor will require access to LaRC facilities, Alcatel facilities in Cannes, France, BATC facilities, and (in the case of IIR testing) Sodern facilities, and CALIPSO instruments and ground support hardware, R1***and (in the case of LEU support) Fibertek, Inc in Herndon, Virginia***. The Contractor will have to interact and consult with CALIPSO personnel at LaRC, BATC, Alcatel, and (in the case of IIR testing), Sodern in the area of instrument, payload and satellite test operations.

Specifically, the Contractor shall be responsible for:

1) Modifying the existing IIR test procedures developed by Sodern for use at the Payload and Satellite levels of AIT. Additionally, the Contractor shall monitor all of the IIR instrument performance operations and assist in the development of test procedures to troubleshoot and resolve anomalous IIR instrument operations during Payload and Satellite environmental testing.
2) Supporting all aspects of Payload AIT in the area of OATS alignment operation, interface electrical checkout during pre and post-ship testing, and laser operation verification during atmospheric test activities. This support shall be in the form of procedure development, GSE definition, design, and operations, and laser operation verification and safety monitoring during all phases of Payload operation during AIT (Payload and Satellite) activities.

*****Begin R1 block addition*****

3) Planning and execution of the Laser Electronics Unit (LEU) board and box level testing to include inputs to and generation of procedures, definition of test scenarios, conducting tests, data analysis, and test report generation.

The Contractor shall perform LEU support activities in coordination with the CALIPSO Deputy Project Manager to include but not limited to the following support subtasks:

a) Support LEU test procedure generation and, as needed, generate test procedures to test the boards and integrated LEU box.
b) Help define the test setups and test sequence for the board and box level testing of the LEU.
c) Perform the tests necessary to verify the board and box level LEU requirements.
d) Perform data analysis on the test generated LEU board and box level data to validate LEU requirements.
e) Produce Test Reports detailing the test conducted, the hardware tested and the results of the data analysis within 7 days of the completion of the test.

Deliverables in support of the LEU I&T task:

1) Weekly oral reports to the CALIPSO Deputy Project Manager.
2) Test reports within 7 days of the completion of a test.

*****End R1 block addition*****

The Contractor shall perform CALIPSO AIT operations support activities in coordination with the CALIPSO Payload AIT Manager to include but not limited to the following Integration and Test operations support subtasks:

a) Verification of the CALIPSO payload functional status and readiness for I&T operations. This will be accomplished through the execution of the CALIPSO Performance Verification Test (PVT) Procedure at the Payload level of AIT.
b) Verification that the CALIPSO payload major instruments are operational within their designed specifications using the CALIPSO Health Check Procedure (HCT) and CALIPSO Aliveness Test Procedure (AT).
c) Verification that specific CALIPSO instruments and subsystems are operational within their designed specifications post any anomalous performance detected during I&T operations. This will be accomplished through the execution of approved special test procedures developed specifically to troubleshoot a performance problem revealed during normal I&T operations.
d) All specified instruments powered operations in support of Payload AIT.

NOTE: It is anticipated that the normal CALIPSO test operation procedures for the IIR, OATS alignment checks, Electrical Interface Check, and Laser operations during Atmospheric Tests will not change significantly from the Payload integration activities at BATC to the Satellite AIT activities at Alcatel and VAFB. As part of this task, the Contractor shall provide current information regarding execution of the above mentioned test procedures and instrument operations to the LaRC CALIPSO Payload AIT Manager for transfer to the procedures used at all levels of CALIPSO AIT activities.

e) The Contractor shall provide operations monitoring via respective GSE when the above mentioned test procedures are executed by Alcatel and Boeing during Satellite AIT.
f) The Contractor shall operate the respective GSE or computer with the CALIPSO Instrument Test Operation Console (ITOC) software and assist in the archival of the instruments performance data.
g) The Contractor shall maintain Log Records at LaRC or the operations sites tracking all the operation time of the instruments and GSE (OATS), executed test procedures, operations data files and operations anomalies.
h) The Contractor shall develop and maintain standard operations procedures required for GSE and instrument operation for both bench and payload testing.
i) The Contractor will participate in scheduled LaRC CALIPSO Project meetings dealing with Payload and AIT schedules and test operations.

j) The Contractor shall participate in Alcatel, Sodern, BATC, and VAFB meetings that pertain to CALIPSO Payload operations during instrument performance verification and Payload AIT.

k) The Contractor shall review Sodern (IIR), CNES (Alcatel), and BATC test procedures for performance specification, GSE configuration or design changes, data analysis, trending data and any other documents related to or effecting the operation and performance of the Payload instruments. The Contractor shall provide verbal and written assessments of these items to the CALIPSO Project. The assessment should include a discussion of the clarity, completeness, and applicability of the items to the CALIPSO Payload operations.

l) The Contractor shall setup the necessary GSE to support the I&T effort at BATC, Alcatel, and VAFB.

NOTE: The timetable is defined according to the attached schedule of the CALIPSO AIT events. The attached timetable is subject to change as 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 [R1]***for AIT tasks*****:**

a. Preliminary copy of the IIR functional performance test procedure, OATS alignment test procedure, and Electrical Interface test procedure four weeks (20 working days) prior to the scheduled tests. If the procedural changes are not identified in a timely manner to allow complete procedure modification four weeks prior to a scheduled test, then the complete modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test.

b. Final copy of the above mentioned CALIPSO procedures two weeks (10 working days) prior to the actual test. If the procedural changes are not identified in a timely manner to allow complete final procedure modification two weeks prior to a scheduled test, then the complete final modified procedure shall be delivered as soon as reasonably possible prior to the scheduled test. The final copy, once approved, will be the CALIPSO Test Procedure used to conduct the scheduled tests at Instrument level and will be incorporated in whole or in part into the larger Payload and Satellite level AIT procedures.

NOTE: Any changes to the test procedures after this review will be RED Lined into the procedure. If numerous procedural changes are required, the CALIPSO Project Staff will make a determination as to whether or not to have the procedure rewritten prior to proceeding with testing. 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.

c. Within 30 minutes following the formal completion of an operational test procedure or operational instrument task as described above, the Contractor shall provide a brief written summary reporting any anomalies that occurred during operation (s); and, the status of both the instruments and GSE.

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

e. Provide instruments history and operations plans, display history of instrument operations and near term forecast of instrument operations, and trending information on the instruments for Test Readiness Reviews and Pre-ship Readiness Reviews.

f. Monthly summary of task activities. The report shall include the instrument's history, operations plans, and a summary of the task activities including, if applicable, anomaly reports.

Metrics:

1. Satisfactory effort:

a) All of the CALIPSO instrument and GSE operations are executed in a manner such that the CALIPSO Payload operational readiness is maintained and the AIT and launch schedules are met.

NOTE: This is not to include any Platform, GSE, or CALIPSO instrument failures outside the CALIPSO Project or Contractor's control.

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

c) ALL of the above mentioned procedures will be a high quality in terms of organization, thoroughness, completeness, and readability as determined by CALIPSO Project reveiwers.

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

2. Exceeds effort:

a) All of the CALIPSO instrument and GSE operations are executed in an efficient manner such that the CALIPSO Payload operational readiness is maintained somewhat ahead of the AIT and launch schedule. Note that this is not to include any Platform, Launch vehicle, GSE, or CALIPSO instrument failures outside the CALIPSO Project or Contractor's control.

b) All of the above mentioned procedures and reports are delivered ahead of the required scheduled time and accepted with little or no changes post review by

	the CALIPSO Project reviewers. c) All of the above mentioned procedures and reports will be of exceptional quality in terms of organization, thoroughness, completeness and readability as determined by the CALIPSO Project reviewers. d) Contractor's response to anomaly events and schedules changes are timely and effective as determined by the CALIPSO Project Staff. e) All appropriate flight hardware product assurance and cleanroom policies and plans are followed.
3.	**Government Furnished Items**: a. Access to computers loaded with specialized software as required to support this task. b. Access to the CALIPSO GSE hardware, CALIPSO ICDs (interface control documents) and the BATC, CNES and CALIPSO Project documentation as required for record keeping and to monitoring the scheduled 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 CALIPSO GSE shall be scheduled and coordinated through the CALIPSO Project.
4.	**Other information needed for performance of task**: a. Electro-Static Discharge (ESD) certification is required to handle the instruments and instrument GSE . b. The GSE are flight critical hardware and subject to established NASA and CALIPSO Product Assurance Policies and Plans. c. Adherence to contamination control policy and procedures is required to support space flight cleanroom CALIPSO instrument operations. d. All instrument operations shall be scheduled with and coordinated through the CALIPSO Project. **Travel:** Periodic trips to Sodern (IIR task) in Paris, France; BATC in Boulder, Co; Alcatel in Cannes, France; and Vandenberg AFB in California are expected to conduct other Instrument and CALIPSO Payload AIT activities. The IIR task will require 2-3 weeks of travel to Sodern prior to IIR delivery to BATC. During Payload AIT, travel to Boulder, Co may be quite extensive. During Satellite AIT, travel to Cannes, France will be in three week shifts (three weeks at Alcatel, three weeks US, etc). VAFB travel will mirror Satellite AIT requirements. A detailed schedule of travel will be attached at a later date. Preliminary estimates are attached as Appendix. ***R1 For the LEU support task, travel will be to Herndon, Virginia for the period from Aug 19, 2002 to Nov 16, 2002.*** Note: When possible, these trips will be scheduled to coincide with other instrument I&T activities in order to control travel costs.

5.	**Security clearance required for performance of work**: None. International passport R1 ~~*and French work visa are*~~ required.
6.	**Period of Performance**: Planned start date: 7/15/02 Completion date: 9/30/04
7.	**NASA Technical Monitor**: Marilee M. Roell M/S: 435 Phone: 757-864-3741

Task Order Number: 33RFM Revision: Date of Revision:

Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project.

1) Travel estimates for IIR testing task: (working days – 5 days = week)

July ’02 5 days BATC, Boulder, Co IIR TIM
Sept ’02 2 days Sodern, Paris, France IIR TIM
Oct ’02 10 days Sodern, Paris, France IIR qualification
Nov ’02 20 days Sodern, Paris, France IIR qualification
Dec ’02 15 days Sodern, Paris, France IIR qualification
Jan ’03 10 days Sodern, Paris, France IIR calibration/delivery to BATC
Feb ’03 10 days BATC, Boulder, Co IIR post-ship Functional/ Payload integration
Mar ’03 20 days BATC, Boulder, Co Alignment activities and Payload functionals
April ’03 15 days BATC, Boulder, Co Payload Environmental testing (IIR operation)
May ’03 15 days BATC, Boulder, Co Payload Envir/Atmos testing (IIR operation)
June ’03 10 days BATC, Boulder, Co Pre-ship functional/packing operations

Aug ’03 10 days Alcatel,Cannes,France Payload delivery/unpacking/post-ship functionals
Sept ’03 15 days Alcatel,Cannes,France Satellite testing/IIR operation
Oct ’03 10 days Alcatel,Cannes,France Satellite testing/IIR operation
Nov ’03 15 days Alcatel,Cannes,France Satellite testing/IIR operation
Dec ’03 10 days Alcatel,Cannes,France Satellite testing/IIR operation
Jan ’04 10 days Alcatel,Cannes,France Satellite testing/IIR operation
Feb ’04 10 days Alcatel,Cannes,France Satellite testing/IIR operation
Mar ’04 10 days Alcatel,Cannes,France Satellite testing/IIR operation
Apr ’04 10 days Alcatel,Cannes,France Pre-ship functional/packing operations

May 04 10 days VAFB, Ca Post-ship functionals/unpacking operation
Jun ’04 10 days VAFB, Ca Satellite testing/IIR operation
Aug ’04 10 days VAFB, Ca Final Satellite testing/launch

Total 262 days (Note: subject to modification as Project schedules are adjusted)

2) Travel estimates for AIT support task: (working days – 5 days = week)

July '02	5 days BATC, Boulder, Co Atmos/AIT TIM
Oct '02	10 days BATC, Boulder, Co OATS testing/Elect interface testing
Nov '02	10 days BATC, Boulder, Co AIT support
Dec '02	10 days BATC, Boulder, Co AIT support
Jan '03	10 days BATC, Boulder, Co AIT support
Feb '03	10 days BATC, Boulder, Co AIT support
Mar '03	20 days BATC, Boulder, Co AIT support/Atmos testing
April '03	15 days BATC, Boulder, Co AIT support
May '03	15 days BATC, Boulder, Co AIT support/Atmos testing
June '03	10 days BATC, Boulder, Co Pre-ship functional/packing operations
Aug '03	10 days Alcatel,Cannes,France AIT support
Sept '03	15 days Alcatel,Cannes,France AIT support
Oct '03	10 days Alcatel,Cannes,France AIT support
Nov '03	15 days Alcatel,Cannes,France AIT support
Dec '03	10 days Alcatel,Cannes,France AIT support
Jan '04	10 days Alcatel,Cannes,France AIT support
Feb '04	10 days Alcatel,Cannes,France AIT support
Mar '04	10 days Alcatel,Cannes,France AIT support
Apr '04	10 days Alcatel,Cannes,France Pre-ship functional/packing operations
May 04	10 days VAFB, Ca Post-ship functionals/unpacking operation
Jun '04	10 days VAFB, Ca AIT support
Aug '04	10 days VAFB, Ca Final Satellite testing/launch
Total	245 days (Note: subject to modification as Project schedules are adjusted)

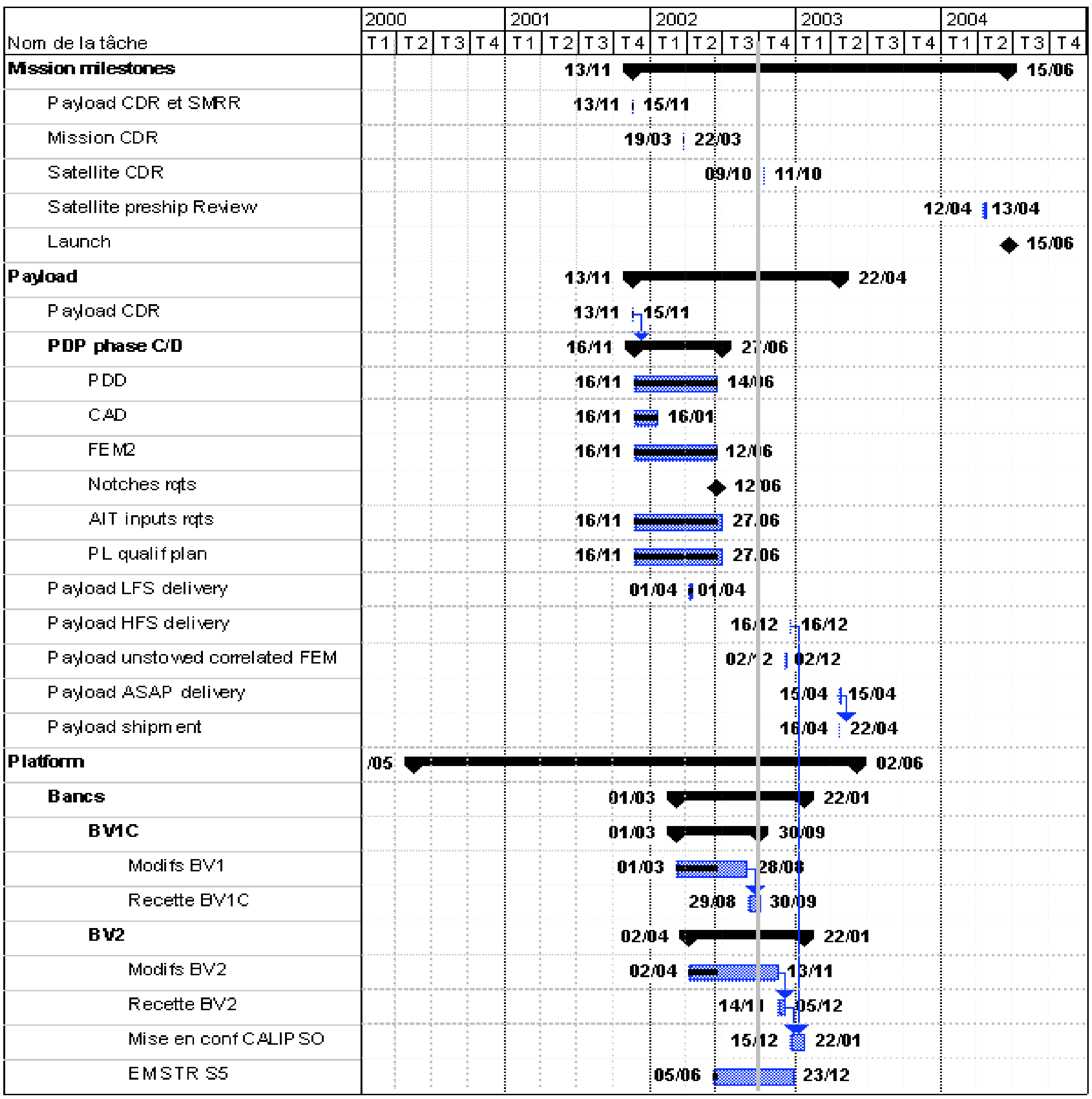
****Begin R1 block addition*****

3) Travel estimates for LEU support task: (on-site full-time support in Herndon, Virginia)

Aug 19 '02 through Nov 15 '02

Total 91 days (Note: subject to modification as Project schedules are adjusted)

****End R1 block addition*****



Nom de la tâche
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2001
2002
2003
2004
T1 T2 T3 T4
Mission milestones 13/11 15/06
Payload CDR et SMRR 13/11 15/11
Mission CDR 19/03 22/03
Satellite CDR 09/10 11/10
Satellite preship Review 12/04 13/04
Launch 15/06
Payload 13/11 22/04
Payload CDR 13/11 15/11
PDP phase C/D 16/11 27/06
PDD 16/11 14/06
CAD 16/11 16/01
FEM2 16/11 12/06
Notches rqts 12/06
AIT inputs rqts 16/11 27/06
PL qualif plan 16/11 27/06
Payload LFS delivery 01/04 01/04
Payload HFS delivery 16/12 16/12
Payload unstowed correlated FEM 02/12 02/12
Payload ASAP delivery 15/04 15/04
Payload shipment 16/04 22/04
Platform /05 02/06
Bancs 01/03 22/01
BV1C 01/03 30/09
Modifs BV1 01/03 28/08
Recette BV1C 29/08 30/09
BV2 02/04 22/01
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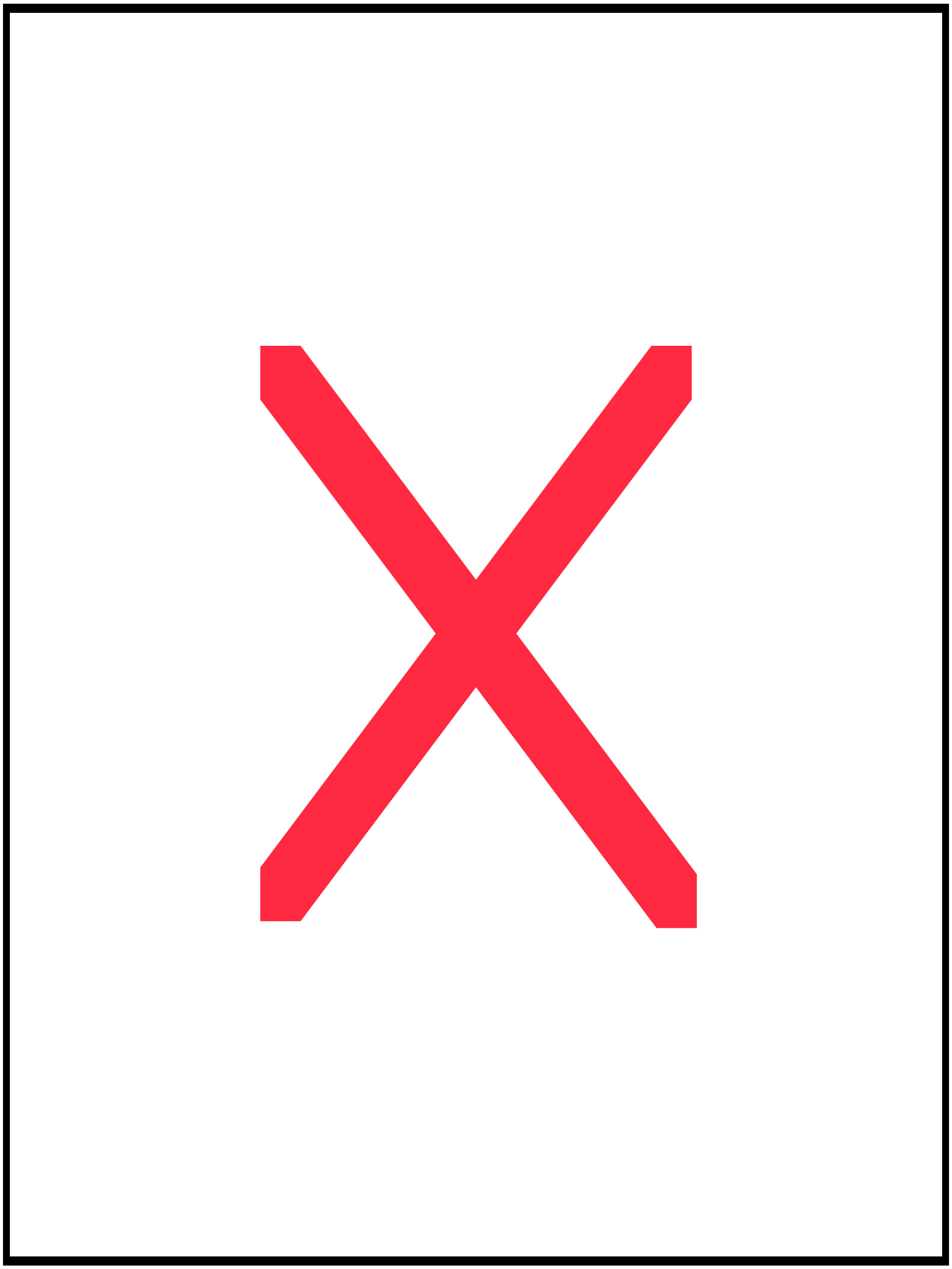
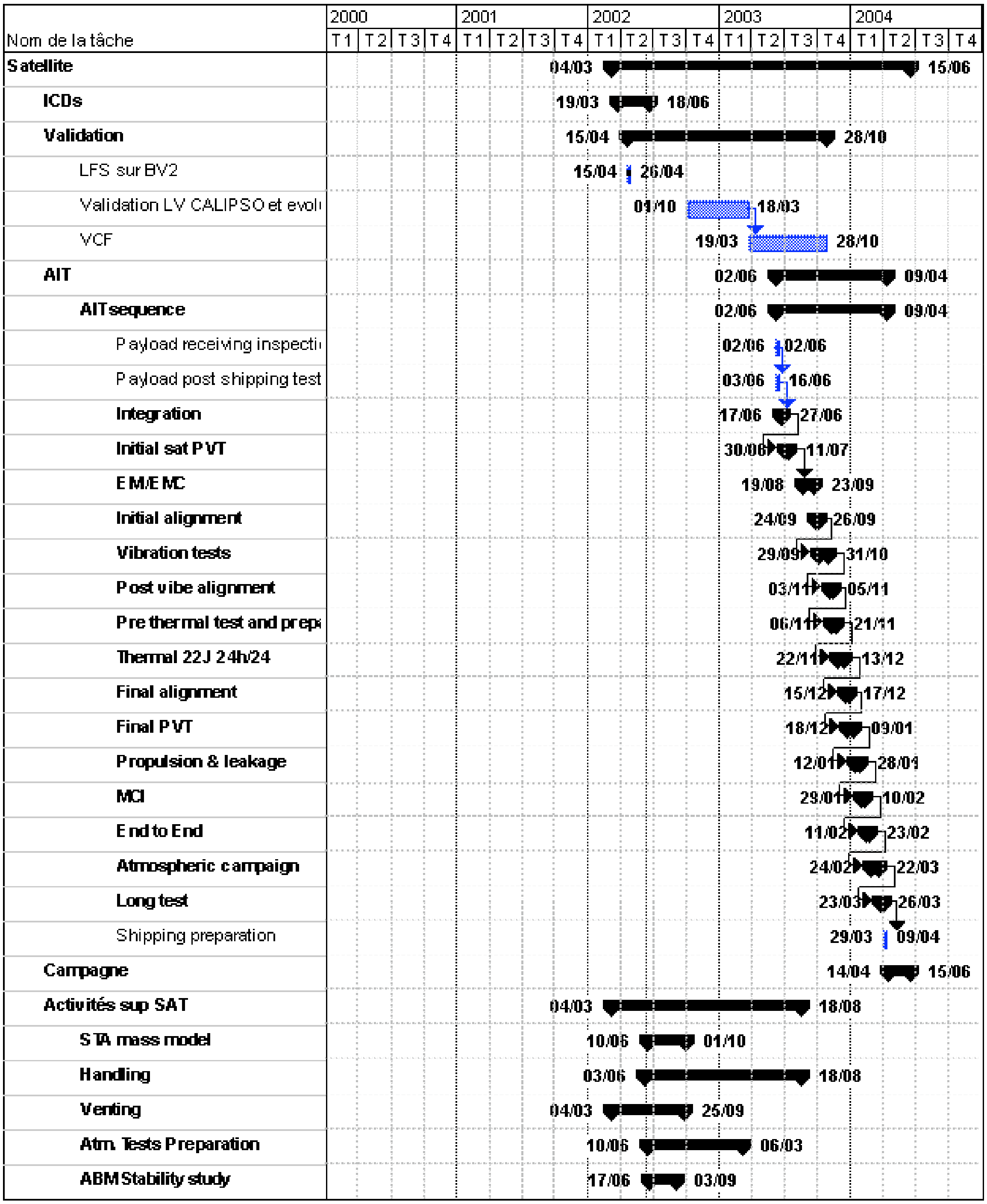


Task Order Number: 33RFM Revision: Date of Revision:

Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project.



SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 34RAE Revision: _ Date of Revision:

Title: Uncertainty Quantification and Propagation Analysis

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

This work consists of two subtasks - The Familiarization Task and The Applications Task. The total job duration is expected to be about six months from startup. Both subtasks involve the Contractor using a government-provided version of the UNIPASS uncertainty quantification and propagation software. In the first sub task (nominally, about one month from startup), the Contractor will become familiar with the numerous uncertainty quantification and propagation options available within UNIPASS and, in cooperation with Technical Monitor (Lawrence Green, 42228, l.l.green@larc.nasa.gov) of the task, establish a systemic and automated means for reporting the results of execution tests involving a very simple government-provided example code. In the second subtask (the remainder of the task duration), the Contractor will execute the UNIPASS software with one or more versions of government-provided application code(s) following a government-provided test schedule. UNIPASS executions will normally be expected to occur on a frequent, agreed upon basis (for example, one test per day, or ten tests per day), depending upon the expected required execution time of each UNIPASS test. The combined number of options available in UNIPASS software is such that a task duration greatly exceeding the proposed time frame of this study could be required to demonstrate all possible UNIPASS options for the selected application codes(s). Thus, it will be important for the Contractor to follow the supplied schedule of UNIPASS executions. The Contractor will document the results of executing the government-provided list of UNIPASS options involving the government-provided application code(s). Some documentation is expected to be completed with each execution of the UNIPASS software when used with the application code(s). The first phase of the work will define the content and automated reporting mechanisms of the documentation to be provided during the second phase of the work. Summary documentation will also be prepared at the end of the Applications Task.

2. Description of the Work to be Performed:

A. The Familiarization Task

1. The Contractor shall ensure that UNIPASS software has been installed correctly on machine(s) to be used during the demonstration and that the software functions as expected.
2. Using a government-provided example code, the Contractor shall test a wide variety of options in the UNIPASS software to become familiar with the software's general capabilities. The Contractor will provide the Technical Monitor timing estimates for various UNIPASS execution options with the example code to assist in defining the schedule of executions that will be required to be executed during the Applications Task. The Technical Monitor will provide a list of test cases to be executed and requirements

for what must be documented during subsequent executions of the software with the application code(s). Such documentation requirements may include:

a. the execution time required for a basic function evaluation
b. the execution time required for a specific UNIPASS option evaluation
c. a subjective measure of the ease of using specific UNIPASS options (using agreed upon criteria)
d. the accuracy of answers with respect to known, or accepted, benchmarks
e. the installed and execution disk space required
f. the installed and execution RAM required
g. the number of function evaluations required for a specific UNIPASS option
h. the number of gradient evaluations required for a specific UNIPASS option
i. the level of input uncertainty
j. the level of output uncertainty
k. the number of uncertain input variables
l. some measure of the frequency of a certain outcome occurring (using agreed upon criteria)
m. some measure of the consequence of a certain outcome occurring (using agreed upon criteria)
n. some measure of the risk (a combination of the frequency and consequence) of a certain outcome occurring (using agreed upon criteria)

3. The Contractor may offer suggestions about how and what to document during subsequent executions of the software with the application code(s).
4. The Contractor will document any options that do not appear to work correctly within the UNIPASS software.

A final list of the documentation requirements for the Application Task will be provided to the Contractor following the Familiarization Task.

Subtask Standard: The standard for meeting the subtask requirement is the development and demonstration of a mutually agreeable automated means to document subsequent UNIPASS executions with the application code(s). A provision is made for the standard to be exceeded in that the Contractor contributes to the requirement of what must be documented from UNIPASS executions with application code(s) beyond the above list, and to extent that the automated generation of execution documentation can be shown to be integrated within the UNIPASS tool execution, or a surrounding scripting language.

Familiarization Task Deliverables:

1. An agreed upon specification of what must be documented in subsequent UNIPASS executions with the application code(s)
2. A demonstration of an automated means to generate deliverable 1
3. Sufficient documentation of deliverables 1 and 2 such that a technical person, not familiar with specific example or application code(s), can make informed choices, for a given example, about what UNIPASS, or code input, options should be used
    a. to minimize the execution time and obtain some estimate of a given response
    b. to minimize the frequency, consequence, or risk associated with a specific occurrence
    c. to maximize the user's confidence that a given response is the best that can be obtained from the UNIPASS tool within a fixed amount of time

B. The Applications Task

1. Using the deliverables from the above task, and the government-provided execution schedule and documentation requirements, execute UNIPASS for the agreed upon sequence of application code(s) and UNIPASS options, while automatically generating the required execution documentation for each case.
2. The Contractor will prepare a document summarizing the executions that were performed and the general findings of the Task.
3. The Contractor shall also document any changes required to the government-provided code(s) for use within the UNIPASS software package.

Applications Task Deliverables

1. All NASA-delivered codes and sample input/output files
2. All required UNIPASS execution documentation (for individual tests and the Task summary)
3. The Contractor-developed automated documentation generation modules or scripts
4. If possible, the UNIPASS licensing files to allow transfer to a machine of NASA's choice

Subtask standard: The standards for meeting the subtask requirements are the required Task deliverables. A provision is made for the standard to be exceeded in that the Contractor will be provided a minimum list of application executions that must be completed. The standard can be exceeded to the extent that the Contractor exceeds the minimum execution schedule.

Task Schedule:

02/01/02 - NASA receives Authority To Proceed

Task Order Number: 34RAE   Revision: _   Date of Revision:

Title: Uncertainty Quantification and Propagation Analysis

03/01/02 - Contractor begins first phase of work- The Familiarization Task
03/31/02 - Contractor completes first phase of work; a list of applications tests to be executed is supplied to the Contractor along with a final list of documentation requirements
04/01/02 - Contractor begins second phase of work - The Applications Task
09/30/02 - Contractor completes second phase of work

Joint Task Performance Metrics:

1. Subtasks are completed within schedule and within the agreed upon cost
2. Subtasks fulfill the standards to meet or exceed the subtask requirements

3. **Government Furnished Items**:

Analysis codes and sample input/output files for the Familiarization and Applications Tasks. Some UNIPASS training is planned to be held at NASA LaRC. If such training is available at a time useful for Contractor in the completion of this task, the Contractor will be included in such training.

4. **Other information needed for performance of task**:

   1. The Contractor shall perform all computations on UNIX-based platforms, unless otherwise agreed upon in discussions with NASA (the unexpected exception may be due to the delivered UNIPASS software being designed explicitly for a different platform).
   2. The Contractor agrees that all deliverables will be owned by NASA and can be used and distributed by NASA with no restrictions imposed by the Contractor.

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.

5. **Security clearance required for performance of work**:

None applicable. Some issues with respect to code distribution to the Contractor may need to be addressed.

6. **Period of Performance**:

Planned start date: 03/01/02   Completion date: 09/30/02

7. **NASA Technical Monitor:** Lawrence Green
   M/S: 159   Phone: 757-864-2228

NASA Competency Coordinator: M.F. Verlander
   M/S: 327   Phone: 757-864-1944

Task Order Number: 34RBM Revision: 6 Date of Revision: 06/07/04
Title: Acquisition Software for an Intelligent Measurement System

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

This task order provides [R1]continued software updates for the acquisition software [R1]developed in 2001 for an Intelligent Measurement System at NASA LaRC Wind Tunnels. The proposed measurement system will be required to operate and support tunnel tests (which may begin anytime) up to 16 hours/day (two shifts) for approximately 5 days a week with an average of 3 on-off sequences per day. The life cycle of each Intelligent Measurement System is estimated to be 5 years.

[R1] The second objective of this task order is to develop software for a miniature Field Programmable Gate Array (FPGA)-based data acquisition circuit board that will be both useful and usable in flight as well as large production wind tunnels while providing accurate data in a robust and timely manner.

Revision 1: Extends the period of performance one year, updates Subtasks 1 and 2, and adds Subtask 3 in continuation of NASA's support requirements (see [R1] above and below).
Revision 2: Adds requirement to Subtask 3 in continuation of NASA's support requirements. (See [R2] below)
Revision 3: Extends the period of performance one year in continuation of NASA's support requirements and updates requirements for the new period of performance (see [R3] below).
Revision 4: Adds new requirements as Subtask 4 (see [R4] below).
Revision 5: Extends the period of performance one year to October 31, 2004, with some additional requirements and clarifications (see [R5] below).
Revision 6: Adds requirement to Subtask 1a in continuation of NASA's support requirements (see [R6] below).

2. **Description of the Work to be Performed :**

The Contractor shall perform the following subtasks:

1. Provide support for an Intelligent Measurement System for application in test sections at NTF and TDT. Provide [R1]updates to data acquisition software that utilizes a [R1]single or [R3]~~dual~~ multiple digital CCD or analog video [R1]cameras and image acquisition system for application to model deformation and other measurements. The Contractor shall modify and test new software in the required image acquisition system using government-supplied equipment. The Contractor shall develop any software required to control the operation of the government-supplied equipment for performing the investigations. The system shall meet the following specifications:

    a. Implement simplified system calibration and setup techniques to enable existing system operation by facility personnel. The system will provide improved diagnostic information regarding the state of the system. System will enable existing tunnel operations personnel to set-up, calibrate, and operate the existing systems at NTF and TDT. [R6]***Analyze and evaluate usage of Matlab's Genetic Algorithm toolbox for defining camera calibration parameters. If feasible, determine and implement new calibration procedure using Genetic Algorithms***. The existing system shall be enhanced to interface to [R3][~~R1~~]~~two~~ six digital or analog cameras.

b. For recording, the system shall be capable of acquiring, [R1]simultaneously from [R3]~~two~~ six cameras, snapshots or sequences of images from frame grabber cards and saving them as files. Images shall be grabbed individually or in sequences. The number of images in each sequence shall be selectable. When applicable exposure times for images shall be selectable ranging from the shortest to the longest times featured on the camera. Sequences shall be subject to the frame grab rate and spatial resolution pre-selected by the operator.

c. These files are to be distributed to customers via diskettes, CD, local network, internet, etc. Image files are to be saved in a compressed format such as tiff. File names shall contain the test number, point number, and any other alphanumeric identification used by the wind tunnel data acquisition system that distinguishes one image from another during acquisition.

d. The system shall be enhanced to read a sequence of image files [R1](from [R3]~~both~~ all cameras simultaneously) into frame buffers for further processing. The user shall be able to sequence through and view individual images or display many images at a reduced resolution on the screen.

e. The system's current target recognition and processing shall be enhanced to search for and process [R3]a minimum or 100 targets on a sequence of [R3]images ~~files~~. Three-dimensional spatial models will be used to visually aid target and pattern recognition techniques.

f. Recording of model deformation parameters shall be performed in near real-time at predefined field and frame rates.

g. Maximum spatial resolution on snapshots and sequences shall vary by field or frames.

h. Implement new techniques for improved target pattern recognition.

2. [R3]Discontinued (web page support) **Begin [R1] block**

3. The Contractor shall develop software for a laboratory demonstration model of an FPGA-based acquisition board accommodating several different types of sensors (i.e. accelerometer, strain gage, thermistor, [R5]array of acoustic sensors) providing inputs. Auto gain setting, auto spectrum analysis (for pre-sample filter selection), and self-healing shall be demonstrated. The data acquisition software for the small evolvable instrumentation system shall have the ability to reconfigure its own hardware structure dynamically and autonomously in response to

changes in task requirements or changes in the environment. This instrumentation shall be capable of measuring pressure, transition, model attitude and deformation, temperature, shear stress [R5]and noise measurements from landing gear model. The on-board system of instrumentation is made in a small form factor and has an electronic data handling capability accommodating a number of MEMS type sensors. The software for the evolved system shall be capable of performing complex signal processing functions, such as adaptive filtering, randomization, [R3]and spectral analyses. [R5]The system shall accommodate a variety of serial protocols such as RS-422 and LVDS as required by the project. Data transmitted in blocks shall be stored in FIFOs with simultaneous sampling occurring between channels. Interfaces between the FPGA and Digital Signal Processing (DSP) shall be developed.**End [R1] block**
Begin [R3] block addition

a. Implement simplified system calibration and setup techniques to enable personnel to configure, modify, download and run the software in a Field Programmable Gate Array as part of a laboratory test model. The system shall provide improved diagnostic information regarding the state of the system.
b. The existing acquisition system shall be enhanced to interface to a variety of sensors.
c. Implement and demonstrate evolutionary algorithms and neural networks that evolve solutions enabling adaptation to occur. The system shall be capable of automatically reconfiguring itself using a combination of neural networks and evolutionary computations to perceive sensor failures.
d. Implement a variety of operational artificial neural networks both on an FPGA as well as on a PC (such as multi-layer perceptron, radial basis functions, Hopfield, SOM) for use in pattern matching and adaptation.
e. Implement a variety of Digital Signal Processing functions (FFTs) for sensor arrays.
f. Maintain a laboratory record book with available source code (printout and on CD) as well as records of studies indicating results of testing for each technique developed.
g. These files are to be distributed to customers via diskettes, CD, local network, internet, etc. The system's current target recognition and processing shall be enhanced to search for and process targets on a sequence of images. Three-dimensional spatial models will be used to visually aid target and pattern recognition techniques.
h. Maximum spatial resolution on snapshots and sequences shall vary by field or frames.
i. Implement new techniques for improved target pattern recognition.
j. Technical Support for a period of 30 days after completion to resolve any technical problems that may arise.
k. Documentation describing a test validation procedure along with the results obtained from the units constructed; all documentation shall be provided both on paper and electronically as an MS-Word file.

End [R3] block addition
Begin [R4] block addition

4. The Contractor shall develop and test FPGA system for a star tracker. Work entails utilizing off the shelf FPGA board to drive and control a star tracker. The star tracker utilizes novel active pixels arrays which require custom timing signals and to control the focal plane array. The FPGA will interface with the satellite using standard RS-422 interface. RS-232 is also desirable for older system compatibility. In addition, labview and/or lab windows CVI will be utilized for A/D (analog/digital) and to facilitate system development. FPGA implementation of signal processing for low level calibration and compensation of fixed patter noise and temporal noise is required.

End R4 block addition

Deliverables:

The Contractor shall provide to the customer:

For Subtask 1:

1. An operational software program known as the "Intelligent Measurement Data Acquisition Program" that meets all the requirements under Subtask 1.a through 1.i. This program shall be delivered to the customer in its entirety as an executable file and as source code on CD-ROM with compilation instructions and full documentation both on paper and electronically as an MS-Word file.
2. R1 A users manual for distribution to wind tunnel facility personnel that describes R3 additional operational functions and features of the program.
3. SPMP requirement: The Contractor shall comply with the contractor responsibilities for a low control project as described by LMS-CP-5528, LMS-CP-5529 and LMS-CP-5532. Documentation detailing all software developed in accordance with Software Engineering Processing Group (SEPG) procedures outlined in the Langley Management System; all documentation shall be provided both on paper and electronically as an MS-Word file.
4. Any software upgrades required to operate the upgraded system as well as any documentation updates required describing proper operation of the code, and data format.
5. Documentation describing a test calibration procedure along with the results obtained from the software units constructed; all documentation shall be provided both on paper and electronically as an MS-Word file.
6. R6 ***Evaluation and implementation of Genetic Algorithms for determining the camera calibration parameters for the "Intelligent Measurement Data Acquisition Program". Determine pros and cons of the GA system versus the current calibration technique being used.***

Begin R1 block

For Subtask 3:

R5 Host software for interfacing DSP/FPGA acquisition boards in a laboratory demonstration model of an acoustics test.

Begin R4 block
For Subtask 4:

1. An operational software program that meets all the requirements under Subtask 4. This program shall be delivered to the customer in its entirety as an executable file and as source code on CD-ROM with compilation instructions and full documentation both on paper and electronically as an MS-Word file.
2. An operational laboratory demonstration model with off the shelf FPGA board to drive and control a star tracker. The star tracker utilizes novel active pixels arrays which require custom timing signals and to control the focal plane array. The FPGA will interface with the satellite using standard RS-422 interface. RS-232 is also desirable for older system compatibility. In addition, labview and/or lab windows CVI will be utilized for A/D and to facilitate system development. FPGA implementation of signal processing for low level calibration and compensation of fixed patter noise and temporal noise is required.

End R4 block

Schedule of Deliverables:

Metrics for Performance:

Minimum Acceptable Performance Standards: Evaluation of Contractor performance on Subtasks 1 and R3 3 will be based on the following:

- Delivery of fully operational and tested Intelligent Measurement System upgrade in support of wind tunnel tests along with diagrams, software, and documentation.
- R1 Delivery of a R3 revised User's Manual for the Intelligent Measurement System by January R3 ~~'02~~ '03.
- R1 Delivery of a fully operational acquisition FPGA board.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 1.

- Deliverables all received meeting specifications, at the contracted cost and with an earlier delivery time by 10% of the total working days in the performance period.

3. **Government Furnished Items:** Access to tunnel and/or data acquisition facilities as required to perform the task order requirements.

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

5. **Security clearance required for performance of work:** None.

6. **Period of Performance:**

Planned start date: January 1, 2001 Completion date: R1 ~~October 31, 2001~~
R3 ~~October 31, 2002~~

	R5 ~~October 31, 2003~~ October 31, 2004
7.	**NASA Technical Monitor:** Sharon Graves M/S: 236 Phone: 757-864-5018 **NASA Competency/Other Technical Coordinator** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8002

Task Order Number: 34RDM Revision: 2 Date of Revision: 10/19/04

Title: **ATC/NAS Operations Research Support for OELO**

1.	**Purpose, Objective or Background of Work to be Performed:** Operations Engineering and Logistics Office (OELO) of the Langley Research Center (LaRC) is engaged in research activities that involve aircraft operations in the National Airspace System (NAS) as well as flight deck and flight display design. These activities require expert air traffic control (ATC) operations input into research flight test and simulation development as well as day-to-day flight planning and coordination with air traffic control personnel. This research requires the support of personnel who have extensive experience in aircraft operations from an ATC perspective combined with an understanding of air traffic flow management. The research requirement also involves providing expert advice in the design of experimental facilities and procedures, as well as assistance in planning and coordinating flight experiments and deployments. Note: This new task order is a roll-out continuation of work previously included in task order 07RDE. Revision 1: Extends the period of performance and schedule one year to December 31, 2004, in continuation of NASA's support with no other change in detailed requirements for the new period of performance (see [R1] below). Revision 2: Extends the period of performance 12 months to December 31, 2005, in continuation of NASA's support with no changes in detailed requirements for the new period of performance (see [R2] below, Sections 6).
2.	**Description of the Work to be Performed:** The Contractor shall provide support for these areas: simulation, research flight test operations, ATC scenario development, flight deployment planning and coordination, current and future ATC/NAS operations. The Contractor shall perform the following subtasks: **Subtask 1: Flight Operations and Simulation ATC Support** – Provide planning and coordination for research flights from an air traffic controller perspective to include all research programs using LaRC's research aircraft and other aircraft to support LaRC research activities. Provide training, operational, and technical support to programs and to OELO to facilitate integration of projects with Federal Regulations procedures, National Airspace System (NAS), ATC and pilot/cockpit crew procedures, other R&D projects, and technologies/systems as required. Current research programs include the Small Aircraft Transportation System (SATS) and the Aviation Safety Program. Ensure that all coordination with the appropriate ATC facilities and military facilities that control the airspace of the research flight is complete. **Subtask 2: Flight Operations Review Support -** Review of specific research simulation and flight test projects shall be provided to ensure ATC considerations are adequately reflected in the plan of test. The overall goal of this task is to ensure that research conducted is appropriately designed and executed to ensure that the value of the resulting data is maximized with respect to realistic current and foreseeable future ATC operations. ATC

operations review reports shall include appropriate scenarios. Scenarios shall either be modified from existing scenarios provided by the researchers or be completely new scenarios based on research requirements.

Completion date: December 31, R1 ~~2003~~ ***2004***.

Metrics: Minimum acceptable performance shall be based on documentation which indicates that the necessary planning and coordination has been affected to facilitate research flight activities.

Meets Standards: No delays or cancellations of research flights are attributable to inadequate planning or coordination on the part of individuals providing those services under this task.

Exceeds Standards: Value added to the research flights through the negotiation of maximum latitude for flight activities in operational airspace. Evaluation from technical monitor for applicable research project results in an "exceeds requirements" that is accompanied by adequate justification based on exceptional contributions to planning and flight coordination.

Deliverables: Formal and/or informal documents and/or briefings providing ATC operations information to optimize anticipated research results. ATC operations deliverables shall include proposed maneuvers and scenarios to optimize the relevance of research results to current aircraft operations and conceptualized future aircraft operations.

3. **Government Furnished Items**:

Access to computers loaded with specialized software, and lab or office space required to complete the tasks.

4. **Other information needed for performance of task**:

Personnel will, on occasion, be required to work other than a normal duty schedule although the expected hours will be between 0800 to1630.

Travel:

The Contractor will be required to perform tasks while on offsite deployment during the period of performance as listed below. Locations may include, but are not limited to, Reno, Nevada, Wallops Island, Virginia, Oshkosh, Wisconsin, and Southern California TRACON.

Training:

The Contractor will be required to obtain any training necessary for adequate completion of the task deliverables.

	Task Order Number: 34RDM Revision: 2 Date of Revision: 10/19/04 Title: **ATC/NAS Operations Research Support for OELO**

	Work described in Subtask 1 above is ongoing, essential to LaRC mission, and integral to programmatic milestones. Expeditious start of added work requires special consideration and may include immediate short-term implementation with transition to a long term scenario to avoid further delays in the affected LaRC programs.
5.	**Security clearance required for performance of work:** All work will be unclassified.
6.	**Period of Performance:** Planned start date: January 1, 2003 Completion date: R1 ~~December 31, 2003~~ R2 ~~December 31, 2004~~ ***December 31, 2005***
7.	**NASA Technical Monitor:** OELO/Luci Crittenden M.S. 255A Phone: 757-864-1776

Task Order Number: 34RFG Revision: 1.1 Date of Revision: 10/20/03
Title: Cockpit Motion Facility (CMF) Component Stress Analysis

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

The purpose of this work is to analyze and document structures that have been installed in the three flight decks (RFD, IFD, and GFD) of the Cockpit Motion Facility (CMF) facility. The documentation of these analyses will be used by a review board to evaluate the safety of the facility during operation and will serve as part of the archival documentation for the facility.

Revision 1: Extends the period of performance to September 30, 2003 and adds requirement clarifications and refinements (see R1 below)

Change 1: Extends the period of performance to October 31, 2003 and updates schedule (see R1.1 and below)

2. Description of the Work to be Performed:

The Contractor shall perform structural analyses, prepare a structural analysis report, and present the analysis and results as described below.

Structural Analyses

Stress and fatigue analyses shall be conducted for the items listed and described below. The government will provide the methodology for evaluating fasteners. Stresses and margins of safety shall be determined for each part using the provided first-order failure loads. The fatigue life of each structure in cycles shall be determined using the provided operational loads.

1. Main Instrument Panel, Glare Shield, Mode Control Panel, and Fasteners.

   A finite-element analysis of the structural assembly consisting of the Main Instrument Panel (MIP), Glare Shield, and Mode Control Panel shall be performed for two flight decks (i.e., the RFD and the IFD). The Main Instrument Panel is attached to the cockpit floor and supports the Glare Shield. The Mode Control Panel is attached to the Glare Shield. The Glare Shield and Mode Control panel may be treated as a single lumped mass in the finite-element model of the Main Instrument Panel. The instruments supported by the Main Instrument Panel shall be modeled as lumped masses using appropriate connections. The fasteners attaching the Main Instrument Panel to the floor, the Glare Shield to the Main Instrument Panel, the Mode Control Panel to the Glare Shield, and the instruments to the Instrument Panel shall be evaluated. The fastener calculations shall be presented in an EXCEL spreadsheet. A fatigue analysis shall be preformed for the structural components, but is not required for the fasteners. R1The Contractor shall provide design services to eliminate negative margins from the IFD MIP.

2. Aft Enclosure Floor, Seat Tracks, and Fasteners.

A finite-element analysis of the Aft Enclosure Floor shall be performed. The three observer seats are installed on seat tracks, which are fastened to the Aft Enclosure Floor. The Aft Enclosure Floor consists of three separate floor panel sections, with one seat installed on each panel section. Since two of the three panels are symmetric, an analysis of only two of the three panels is required. The analysis shall assume a 200 lb. person in each seat, the weight of the seat, and shall consider three configurations of the seat position on the track (i.e. the most forward, the most aft, and a center position). The fasteners attaching the Seat Tracks to the Aft Enclosure Floor, the fasteners between the Aft Enclosure Floor and mating base, and stresses in the panels and floor beams of the Aft Enclosure Floor shall be evaluated for each of these configurations under the first order failure loads. The fastener calculations shall be presented in an EXCEL spreadsheet. A fatigue analysis shall be performed on the floor beams and panels, but is not required for the fasteners.

3. Center Display Unit.

A stress analysis of the Center Display Unit shall be performed. The Center Display Unit is installed in the RFD cockpit and is attached to the cockpit floor. The analysis shall evaluate the fasteners attaching this unit to the floor. The fastener calculations shall be presented in an EXCEL spreadsheet. A fatigue analysis of this component is not required.

Deliverables and Schedule:

1. Structural Analysis Report – Due February 14, 2003 [R1](Initial completed) Final structural analysis report due [R1.1]~~September 16, 2003~~ ***October 15, 2003***

A structural analysis report shall be prepared and shall present all hand, spreadsheet, and finite-element analyses for the items identified above. The report shall be suitable for serving as an archive for future reference. The analysis and results for each structural system and component shall be presented in sufficient detail to enable readers to understand and follow the analysis without other references and without consultation with the report's author(s). The report shall include table of contents, list of figures, list of tables, summaries of the significant results and findings, descriptions of the structural systems and components, material properties, loadings, calculations, results, margins of safety based on the provided safety factors, and list of references used in the analysis including computer codes and drawing numbers.

For each part or member analyzed, the structural description shall provide enough detail to familiarize the reader with the structural geometry. This includes location of the part in the structural system, sketches, and reduced drawings as needed or referenced drawings. The manner in which the provided inertial loadings are applied shall be explained and fully justified. The analysis of each part shall contain sketches showing forces and moments acting on the part when appropriate, a statement of the assumptions, approximations, section properties, calculations of mass and stiffness properties, and material properties. For hand analyses and spreadsheet calculations, references shall be given for formulas and equations utilized, each term in the formula or equation shall be defined unless obvious, and the value of each term shall be stated unless its value is shown substituted into the formula. All derivations shall include sufficient steps to allow the reader to easily follow. For spreadsheet calculations, all equations, terms, and inputs shall be clearly presented and explained such that later modifications may be easily made if needed. For finite-element models, the following shall be included: 3-D plots of models showing key element numbers, grid numbers, and element types; explanation of offsets; definition of coordinate systems used; boundary conditions and constraints; plots of results such as stresses; print-out of results when warranted; and reference to the code and solution used.

All finite-element models and spreadsheets utilized in performing the structural analyses shall be submitted on PC-compatible disks, along with the structural analysis report.

2. Weekly Progress Meetings

The Contractor shall participate in weekly progress meetings. The purpose of the meetings is to minimize the occurrence of any misunderstandings relative to the structures, drawings, materials, loadings, analytical methods, and deliverables. The Contractor shall brief project personnel on planned approaches for analyzing the structures including analytical methodology and assumptions, and report current status of the task order. The Contractor will have the opportunity to ask for clarification on issues that may have arisen.

3. Presentation of Results – [C2]~~Due February 28, 2003~~ [R1]July 11, 2003

Oral [R1]presentations of the analyses and results shall be given at the NASA Langley Research Center to project personnel with opportunity for questioning.

Begin [R1] block addition
Concept Review – July11, 2003

The Contractor shall present the design concepts and supporting preliminary analysis to project personnel prior to the start of final design. The presentation shall be given at the NASA Langley Research Center.

Final Design Review – R1.1 ~~August 31, 2003~~ ***October 31,2003***

The final design and analysis shall be presented to project personnel. **End R1block addition** Two weeks prior to presentation, R1the drawings, the structural analysis report, R1fabrication cost and schedule estimates shall be submitted to the Technical Monitor for technical review by project personnel.

Acceptance

The criterion for acceptance of the structural analyses and structural analysis report is that they meet the above requirements.

Exceeds Standard

Requirements will be considered exceeded if the contractor verifies the analysis results using an alternate approach within the original cost and schedule.

3. Government Furnished Items:

The government will provide the following items with the statement of work:

- Drawings for all structures to be analyzed
- Methodology for analyzing and assessing fasteners
- Loadings (first-order failure and operational) for each required analysis
- Safety factors and the margin of safety definition to be used in the analyses

The government will provide the following item at the award of the task order:

- Component weights and cg's

Field Verification

The Contractor shall field verify the component boundary conditions.

4. Other information needed for performance of task:

Work may be performed off-site to accommodate required period of performance. (Paragraph F.3, NAS1-00135)

The installed hardware that is to be analyzed will be available for inspection and field verification by contacting Alton Hall at 757-864-6456 to make arrangements.

Task Order Number: 34RFG Revision: 1.1 Date of Revision: 10/20/03
Title: Cockpit Motion Facility (CMF) Component Stress Analysis

5.	**Security clearance required for performance of work:** A security clearance is not needed for the performance of the work. The government furnished items as described above are not classified. The results of this work will not be classified.
6.	**Period of Performance:** Planned start date: August 15, 2002 Completion date: C2 ~~February 28, 2003~~ C3 ~~March 31, 2003~~ R1 ~~April 21, 2003~~ R1.1 ~~September 30, 2003~~ ***October 31, 2003***
7.	**NASA Technical Monitor:** Winifred S. Feldhaus M/S: 431 Phone: 757-864-7039 **NASA Competency/Other Technical Coordinator**: Roslyn L. McCreery M/S: 441 Phone: 757-864-6940

Appendix, Task Order 34RFG, Statement of Work

Loads and Safety Factors to be used for stress analysis:

First Order Failure Loads:

Load Magnitude	Load Direction	Load Type
3.75 G	X, Y, or Z Independently	Inertial

Factors of Safety for First Order Failure Loads:

Yield	**Ultimate**
2.0	2.5

Loads and Evaluation Criteria to be used for fatigue analysis:

Operational Loads:

D.O.F	Max. Accel.
Vertical	± 1 g
Lateral	± 0.7 g
Longitudinal	± 0.7 g

Metallic components shall be assessed for fatigue life in accordance with the procedure in the American Aluminum Association "*Aluminum Design Manual*", Part 1A - Allowable Stress Design".

Task Order Number: 35RAB Revision: ____ Date of Revision:

Title: GPS Dual RF Receiver Board Build and Test

1.	**Purpose, Objective or Background of Work to be Performed:** Dual RF GPS boards have in the past been purchased from GEC Plessey, but are no longer being made. Because those boards are presently being needed for various GPS applications, Langley has obtained the Gerber files and approval to build from Plessey. Four dual rf boards have been built to date as per the Plessey Gerber files, populated by the electronics fab shop, and operationally tested. The long-term goal is to preserve the capability to build these boards in-house and advance toward modifications that will allow reaping the benefits of parallel correlation processing seen as a necessary advance in GPS Surface Reflection Measurements.
2.	**Description of the Work to be Performed:** ***The Contractor shall perform the following requirements/subtasks:*** 1. The work to be performed consists of coordinating the purchase of unpopulated dual RF GPS receiver boards, verifying the boards adherence to the guidelines in Mitel Application Note AN4855, specifying and purchasing any electronic components to populate the boards that are not in the current inventory, performing component testing, coordinating the population of the boards with the electronics fab shop, and testing the boards per a previously developed test plan. Finally, a test report is required to document the results. Deliverables: 1. Parts list with vendors, costs, delivery information 2. Test Report 3. Four (4) populated and tested dual RF GPS boards Schedule: 1.May 24, 2002 or 15 working days ATP (Authorization To Proceed) + 3 weeks - Completion of parts list, and ordering. 2.October 31, 2002 or ATP + 25 weeks - GPS Board population complete. 3.November 15, 2002 ATP + 27 weeks - GPS Board testing complete. 4.November 29, 2002 ATP + 29 weeks - Task complete.with test report Metrics: Standards (meets, exceeds): Meets: 1.Monthly report 2.Parts list with vendor, cost, and delivery information 3.Clearly written test report Delivery of Four (4) populated and tested dual RF GPS boards by scheduled delivery date.

	Exceeds: Delivery of Four (4) populated and tested dual RF GPS boards before at least 2 weeks ahead of the scheduled delivery date.
3.	**<u>Government Furnished Items</u>:** 1.Gerber file including parts listing 2.Test Plan 3.Electronic fabrication (through separate contract) 4.Access to specialized lab equipment 5.Access to direct and reflected GPS signals (Bldg. 1202 rooftop antennas/amplifiers) 6.Consultation for troubleshooting 7.Mitel Application Note AN4855
4.	**<u>Other information needed for performance of task</u>:** 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<u>, comprised of the "Contractor Y2K Compliance Verification Form" and its supporting documentation,</u> describing how the IT items demonstrate Year 2000 compliance.
5.	**<u>Security clearance required for performance of work</u>:** None
6.	**<u>Period of Performance</u>:** **Planned start date:** May 6, 2002 **Completion date:** November 29, 2002
7.	**NASA Technical Monitor:** George Ganoe M/S: 328 Phone: 757-864-1940 **NASA Competency/Other Technical Coordinator:** ASCAC/Marguerite F. Verlander M/S: 327 Phone: 757-864-1944

1. **<u>Purpose, Objective or Background of Work to be Performed</u>:**

This effort is primarily a continuation of existing work with only minor modifications and the completion date defined as [R1R3R5R6]12/31/~~020304~~***05***Note: Subtasks that do not require additional work are marked as complete.

This task order supports the development and application of state-of-the-art instrumentation technologies. The purpose of this task is to provide custom [R5]design, fabrication, assembly, [R2]integration, and documentation support for [R1R5]Micro/Nano sensing techniques, Doppler Global Velocimetry, [R1]Point Doppler Velocimetry, Pressure Sensitive Paint [R1]development, Particle Image Velocimetry, Molecular Diagnostics, Projection Moiré Interferometry, [R6]***Video Model Deformation and other Videogrammetric Measurements*** , Multi-point Laser Vibrometry, and Unified testing in the laboratory and in NASA facilities.

Revision 1: Extends the period of performance one year in continuation of NASA's support requirements and redefines/updates the requirements for the new period of performance (see [R1] above and below).

Revision 2: Adds integration and documentation requirements as new subtasks 6 and 7 (see [R2] above and below).

Revision 3: Extends the period of performance one year in continuation of NASA's support with schedule dates increased accordingly and no changes in other requirements (see [R3] above and below).

Revision 4: Adds special purchase requirement in Section 4 (see [R4] below).

Revision 5: Adds design requirement to work description and extends the period of performance one year to December 31, 2004, in continuation of NASA's support with schedule dates increased to indicate continued work required in the designated areas (see [R5]above and below).

Revision 6: Extends the period of performance one year to December 31, 2005, in continuation of NASA's support requirements with schedule dates increased accordingly. Video Model Deformation and other videogrammetric measurements were added to the general description of the task but no other detailed changes to the requirements are necessary. In addition, the Branch name was modified where referenced to reflect the current name, Advanced Sensing and Optical Measurement Branch (ASOMB) (see [R6] above and below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following subtasks:

Begin [R1]block requirements redefinition

1. [R5]Assist researchers in developing optimal design and then fabricate components required for the development of Molecular Optical Measurement techniques, to include:
   - (a) [R5]Components for molecular optical measurement lab and other Langley facilities;
   - (b) [R5]Components required to modify generic hypersonic model to test "Molecular Tufts" technique in the 15 inch Mach 6 High Temperature Tunnel (contingent on C of F completion and tunnel availability);

Deliverables: The Contractor shall provide:

1. Custom optical mounts required for tunnel test;
2. Miscellaneous hardware In support of Laser Induced Thermal Acoustic(LITA) R6***and other molecular diagnostic*** development;
3. Metal inserts to install seeding system in hypersonic model;

End R1 block requirements redefinition

4. Mechanical drawings of all constructed components in DXF format;
5. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Subtask 1 shall be completed by R1R3R5R6 December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005.***

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

- R1Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.

- Deliverables shall all be received by the subtask 1 completion date of R1R3R5R6 December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005*** and meet all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 1.

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than the R1R3R5R6December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005***date by 10% or more of the total working days in the performance period.

2. R5Design and fabricate components for R1advanced optical diagnostics and advanced chemistry research and development, to include:
   (a) Design and fabricate various hardware components in support of the R1advanced optical diagnostics.
   (b) Design and fabrication of R1advanced sensor systems that are under investigation by the advanced R5chemistry group.

Deliverables: The Contractor shall provide:

1. Miscellaneous hardware components for R1 Point Doppler Velocimetry, Multi-point laser vibrometry, Projection Moire Interferometry, R6 ***Video Model Deformation, General Videogrammetry, IR diagnostics*** , Doppler Global Velocimetry, Particle Image Velocimetry, and other advanced sensing techniques.
2. Mechanical drawings of all constructed components in DXF format;
3. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Subtask 2 shall be completed by R1R5R6 September 30, ~~2003~~ ~~2004~~ ***2005.***

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

- Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.

- Deliverables shall all be received by the subtask 2 completion date of R1R3R5R6 September 30, ~~2002 2003 2004~~ ***2005*** and meet all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 2.

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than the R1R3R5R6 September 30, ~~2002 2003 2004~~ ***2005*** date by 10% or more of the total working days in the performance period.

Begin R1 block requirements redefinition

3. Design and fabricate components for shear stress sensor research and testing system, to include:

(a) Design and fabricate fixtures for test and evaluation of direct shear stress measurement techniques.
(b) Integrate MEMS indirect shear sensors into test articles for ASOMB labs and FPCB flow facilities.

Deliverables: The Contractor shall provide:
1. Various hardware components associated with the testing of direct and indirect shear stress sensors.

End R1 block requirements redefinition

2. Mechanical drawings of all constructed components in DXF format;
3. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Subtask 3 shall be completed by R1R3R5R6December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005.***

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

- R1Fabricated components shall meet all specifications provided by R1drawings supplied by NASA within the contracted cost.

- Deliverables shall all be received by the subtask 3 completion date of R1R3R5R6December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005*** while meeting all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 3.

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than the R1R3R5R6December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005*** date by 10% or more of the total working days in the performance period.

Begin R1 block requirements redefinition

4. Evaluate condition of, fabricate components for, and maintain High-Speed Flow Generator(HFG) and assist with modifications/maintenance of R5ASOMB low speed flow diagnostics facility(LSFDF).

Deliverables: The Contractor shall provide:

1. Report on the current condition of the HFG and what is needed to make operational;
2. Miscellaneous hardware needed to support testing in HFG and LSFDF;
3. Maintenance schedule for the HFG;

End R1 block requirements redefinition

4. Mechanical drawings of all constructed components in DXF format;
5. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables: Subtask 4 shall be completed by R1R3R5R6December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005***.

Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 4 will be based on the following:

- [R1]Fabricated components shall meet all specifications provided by drawings supplied by NASA within the contracted cost.

- Deliverables shall all be received by the subtask 4 completion date of [R1R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005*** and meet all specifications.

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

- Deliverables all received meeting specifications, at the contracted cost and with a delivery time earlier than the [R1R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005*** date by 10% or more of the total working days in the performance period.

[R1]5. (formerly numbered as 8) Maintain the machine shop so that all equipment is safely operational and that a stock of cutting blades, bits and tools are available for the band saw, milling machine and lathe respectively. Maintain the milling machine within calibration as specified by LMS-TD-0529. Maintain a stock of standard nuts bolts screws (cap, flat head, round head) and washers (flat and lock) organized according to size in the shop cabinets. The Contractor shall provide:

(a) Inventories of cutting blades, bits and tools;
(b) Inventories of screw and washer stock.

Deliverables: The Contractor shall provide:
1. Inventory list of cutting blades, bits and tools on a quarterly basis;
2. Inventory list of screw and washer stock on a quarterly basis;
3. Requests for purchase of cutting blades, bits, tools, screws, and washers as needed to maintain the needed stock
4. Documentation describing the calibration of the milling machine as directed by LMS-TD-0529.

Schedule of Deliverables: Subtask 5 shall be completed by [R1R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005***.

Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 5 will be based on the following:

- Maintenance of shop inventory at acceptable levels.

- Maintenance of the milling machine calibration.

- Deliverables all received by the subtask 5 completion date of [R1 R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005***.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 5.

- Maintaining the shop inventory in a neat and organized manner with a complete stock sufficient to satisfy normal usage within the budgeted time and dollars.

Begin [R2] block addition
6. Document advances in measurement science by updating Advanced [R6]***Sensing and Optical Measurement*** Web sites to reflect latest accomplishments in this field.

The Contractor shall create a data base for various tools that are used in measurement science including sensors, actuators, and general measurement systems.
The Contractor develop website to document data gathered.

Deliverables: The Contractor shall provide: database and website changes

Schedule of Deliverables: Subtask 6 shall be completed by [R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005***.

Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 6 will be based on the following: Deliverables received by Subtask 6 completion date of [R3R5R6]December 31,~~2002 2003~~ ~~2004~~ ***2005***

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 6. Deliverables received at contracted cost, and delivery time earlier than the [R3R5R6]December 31, ~~2002 2003~~ ~~2004~~ ***2005*** date by 10 percent or more of the total working days in the performance period.
7. Investigate methods for making techniques more compatible for use in unified testing.

The Contractor shall determine methods for improving compatibility of various measurement techniques.
The Contractor shall develop an implementation plan for suggested improvements.

	Deliverables: The Contractor shall provide: report of methods and implementation plan. Schedule of Deliverables: Subtask 7 shall be completed by [R3R5R6]December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005***. Minimum Acceptable Performance Standards: Evaluation of Contractor performance on subtask 7 will be based on the following: Deliverables received by Subtask 7 completion date of [R5R6]December 31,~~2003~~ ~~2004~~ ***2005***. Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for subtask 7. Deliverables received at contracted cost, and delivery time earlier than the [R3R5R6]December 31, ~~2002~~ ~~2003~~ ~~2004~~ ***2005*** date by 10 percent or more of the total working days in the performance period. **End [R2] block addition**
3.	**<u>Government Furnished Items</u>:** Building 1200, Rooms 103 and 115. Specialized Shop Equipment Milling machine, drill press, lathe, grinder, band saw Computer Printers Color laser jet, E-size ink jet printer
4.	**<u>Other information needed for performance of task</u>:** Contractor shall have access to Government facilities and equipment required to support this task [R4]and in order to perform subtasks in a timely manner, material purchase may be required.
5.	**<u>Security clearance required for performance of work</u>:** All work will be unclassified
6.	**<u>Period of Performance</u>:** **Planned start date:** ~~January 1, 2001~~ **Completion date:** ~~December 31, 2001~~ [R1]~~January 1, 2002~~ [R1]~~December 31, 2002~~ [R3]~~January 1, 2003~~ [R3]~~December 31, 2003~~ [R5]~~January 1, 2004~~ [R5]~~December 31, 2004~~ [R6]***January 1, 2005*** [R6]***December 31, 2005***

7.	**NASA Technical Monitor:** Kenneth Wright M/S: 493 Phone: 757-864-4665 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 35RDA Revision: 2 Date of Revision: 10/23/03

Title: Technical Support Services for Computational Methods for Stability and Control (COMSAC)

1.	**Purpose, Objective or Background of Work to be Performed:** This Statement of Work describes the requirement to provide technical and programmatic support for the NASA Computational Methods for Stability and Control (COMSAC) project. Consultation in the technical planning and assessments of progress and directions of the program activities is required. Aircraft stability and control technology, computational fluid dynamics, and technical program planning are critical in the requirements for this task. Revision 1: Adds a deliverable, updates schedule, and extends the period of performance one month to October 31, 2003 (see R1 below). Revision 2: Extends the period of performance one month to November 30, 2003, and adds requirements (see R2 below).
2.	**Description of the Work to be Performed:** The Contractor shall accomplish the following tasks: • Identify and collate detailed technical information on critical areas of stability and control technology that would benefit from the application of CFD for military and civil aircraft. • Participate in planning meetings with NASA personnel to identify appropriate strategies, key external contacts, and technical briefing information to acquire advocacy and partners for expansion of COMSAC activities. • Prepare briefing materials and participate with NASA personnel during briefings on COMSAC opportunities at off-site facilities of industry, DOD, and academia. • Assess the status of program progress and advise COMSAC project management of recommended modifications to plans and procedures. • Provide technical briefings to the NASA COMSAC staff on specific technical issues to provide background and documentation for assistance in technical studies. • Prepare and present an exit briefing on the accomplishments of the COMSAC project and recommendations for follow-on work at the conclusion of the contracted period. • R1 Prepare final Abrupt Wing Stall (AWS) report, including links to COMSAC project. • R2 ***Analyze existing BWB and 757 stability data and make recommendations relative to optimum methodology for pending free-to-roll (FTR) tests of same.*** • R2 ***Advise and assist COMSAC team in preparation of strategic plan and provide support to team in area of building industry advocacy, including attendance in on-site and off-site meetings as necessary.*** Deliverables: Progress report on COMSAC advocacy/technical interchanges with prospective partners/customers prior to a planned COMSAC workshop now scheduled for May, 2003. Deliverable to be Microsoft PowerPoint document and briefing to Langley COMSAC staff. Due: April 11, 2003.

Task Order Number: 35RDA Revision: 2 Date of Revision: 10/23/03

Title: Technical Support Services for Computational Methods for Stability and Control (COMSAC)

Progress report on potential strategies and recommendations following the NASA COMSAC workshop. Deliverable to be Microsoft PowerPoint document and briefing to Langley COMSAC staff. Due: June 27, 2003.

Technical assessment of COMSAC progress. Deliverable to be Microsoft PowerPoint document and briefing to Langley COMSAC staff. Due: August 22, 2003.

Final briefing and recommendations for COMSAC project. Deliverable to be Microsoft PowerPoint document and briefing to Langley COMSAC staff. Due: September [R1]~~19~~30, 2003

[R1] Final AWS report. Deliverable to be Microsoft Word document. Due: October 31, 2003.
[R2]***Final briefing and recommendations for free-to-roll test planning. Deliverable to be Microsoft PowerPoint document and briefing to Langley COMSAC team. Due: October 31, 2003.***

Performance Standard: Provides detailed technical information on critical areas of stability and control technology that would benefit from the application of CFD for military and civil aircraft. **Performance Metrics**: Exceeds: 'Meets" and reports provide thorough coverage of subject. Meets: Reports are delivered on time

3. **<u>Government Furnished Items</u>:**

Work shall be performed at Langley and the Contractor's site.

4. **<u>Other information needed for performance of task</u>:**

The Contractor will expected to participate during visits by NASA personnel to industry and DOD organizations.

5. **<u>Security clearance required for performance of work</u>**:

Unclassified

6. **<u>Period of Performance</u>:**

Planned start date: 1/03/03 Completion date: [R1]~~9/30/03~~ ~~10/31/03~~ ***11/30/03***

7. **NASA Technical Monitor**: Charles M. Fremaux

M/S: 153 Phone: 757-864-1193

Task Order Number: 35RFM Revision: 1 Date of Revision: 2/9/05

Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project–Logistics

1.	**Purpose, Objective or Background of Work to be Performed**: Provide logistics support on site at LaRC, Ball Aerospace, Alcatel, and VAFB for the CALIPSO Project. This task encompasses the storage, handling, shipment and set-up of specialized GSE related to the support of AIT activities associated with the Payload and integrated spacecraft at the aforementioned sites. In addition to the these duties, the Contractor will assist Ball Aerospace personnel in the packing and shipping of the Payload from the Ball facility to Alcatel in France, and will, assist CNES and Alcatel personnel in the packing and shipment of the integrated spacecraft from Alcatel to the launch site at VAFB. The Contractor will provide support to the CALIPSO Project in the acquisition of specialized GSE, hardware, and materials necessary to support AIT activities at LaRC, Ball Aerospace, Alcatel, and VAFB. This task includes the acquisition, shipment and set-up of those items necessary to support AIT activities at the above sites. Change 7: Contractor-initiated change extends the period of performance 2 months to February 28, 2005 (see [R0.7] below, Section 6). Note: For previous Contractor-initiated Changes 1-6, no changes in SOW were necessary. Revision 1: Extends the period of performance 6 months to 8/31/05 in continuation of NASA's support with some requirements deleted, updates some info, and notes the change in technical monitor effective in February 2004 (see [R1] below).
2.	**Description of the Work to be Performed**: 1.0 The Contractor shall provide logistics support in coordination with the CALIPSO Logistics Coordinator as outlined in the following elements: 1. Formulation of schedules necessary to facilitate the timely preparation, shipment, and set-up of GSE, hardware, and supplies required to support AIT activities at the various integration, test and launch sites. 2. Identification and acquisition of general and specialized GSE, hardware, and supplies necessary to support all AIT activities. 3. Planning for required facility support at the various test locations to ensure that there are adequate utilities available to support tests such as the Atmospheric Tests. This facility support will include utilities (electrical power, water, etc.), and equipment movement capabilities (cranes, forklifts, etc.). 4. Packing, shipment, and set-up of GSE, Payload, and Spacecraft to and from the various AIT locations. This task shall include assisting in the formulation of procedures ensuring adherence to contamination control and ESD established guidelines necessary to ensure the integrity of the equipment and hardware as well as that of the Payload and

Spacecraft. This task shall include the logistics required for the set-up and implementation of GSE, Payload, and Satellite to accomplish environmental and atmospheric tests at the prescribed AIT locations.

5. Ensure that proper export control procedures are followed to support the shipment of GSE, hardware, and materials, as outlined in the NASA Export Control Program, to R1 ***and from*** France. The Contractor shall adhere to ITAR and EAR regulations in support of NASA's shipment of these articles.

6. Review, and provide inputs, as needed, for Ball Aerospace and CNES generated procedures applicable to the handling and set-up of flight hardware and GSE.

*****Begin R1 block deletion*****

7. ~~Provide mechanical support and perform closeout tasks as required for such items as thermal blankets (including repair if required), contamination covers, purge lines, and any other items procedurally specified.~~

8. ~~Serve as Contamination Control Coordinator, working closely with the Contamination Control Engineer, at the various AIT sites. These duties will include, but will not be limited to, setting up and ensuring the proper operation of particle counters and other monitoring equipment, implementing the use of tape lifts and witness plates, and ensuring that proper bagging and covers are applied as required in the Contamination Control Plan. The Contractor will also be responsible for the proper handling of contamination samples to be sent for analysis.~~

*****End R1 block deletion*****

Deliverables *for AIT tasks*:

a. The Contractor shall maintain an inventory record of GSE, hardware, and supplies, and provide a monthly status report.

b. The Contractor shall maintain records of documentation related to the shipment of hardware, GSE, and supplies to the various AIT locations.

c. The Contractor shall generate and document procedures necessary to maintain compliance with the Contamination Control Plan.

d. The Contractor shall maintain records of contamination control activities, and provide a monthly report of those activities.

e. The Contractor shall provide informal reports of anomalies, work arounds, and concerns in regard to the task items listed above.

f. ***R1 The Contractor shall develop a report of lessons learned for international and domestic logistics associated with the CALIPSO Project. This report shall be***

completed before the end of this contract currently dated August 31, 2005.

Metrics:

1. Satisfactory effort:

a) All of the CALIPSO instrument and GSE are executed in a manner such that the CALIPSO Payload operational readiness is maintained and the AIT and launch schedules are met.

NOTE: This is not to include any Platform, GSE, or CALIPSO instrument failures outside the CALIPSO Project or Contractor's control (including facility site scheduling delays).

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

c) ALL of the above mentioned procedures shall be a high quality in terms of organization, thoroughness, completeness, and readability as determined by CALIPSO Project reviewers.

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

2. Exceeds effort:

a) All of the CALIPSO instrument and GSE setups and checkout operations are executed in an efficient manner such that the CALIPSO Payload operational readiness is maintained somewhat ahead of the AIT and launch schedule. Note that this is not to include any Platform, Launch vehicle, GSE, or CALIPSO instrument failures outside the CALIPSO Project or Contractor's control (including facility site scheduling delays).

b) All of the above mentioned procedures and reports are delivered ahead of the required scheduled time and accepted with little or no changes post review by the CALIPSO Project reviewers.

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

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

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

3. Government Furnished Items:

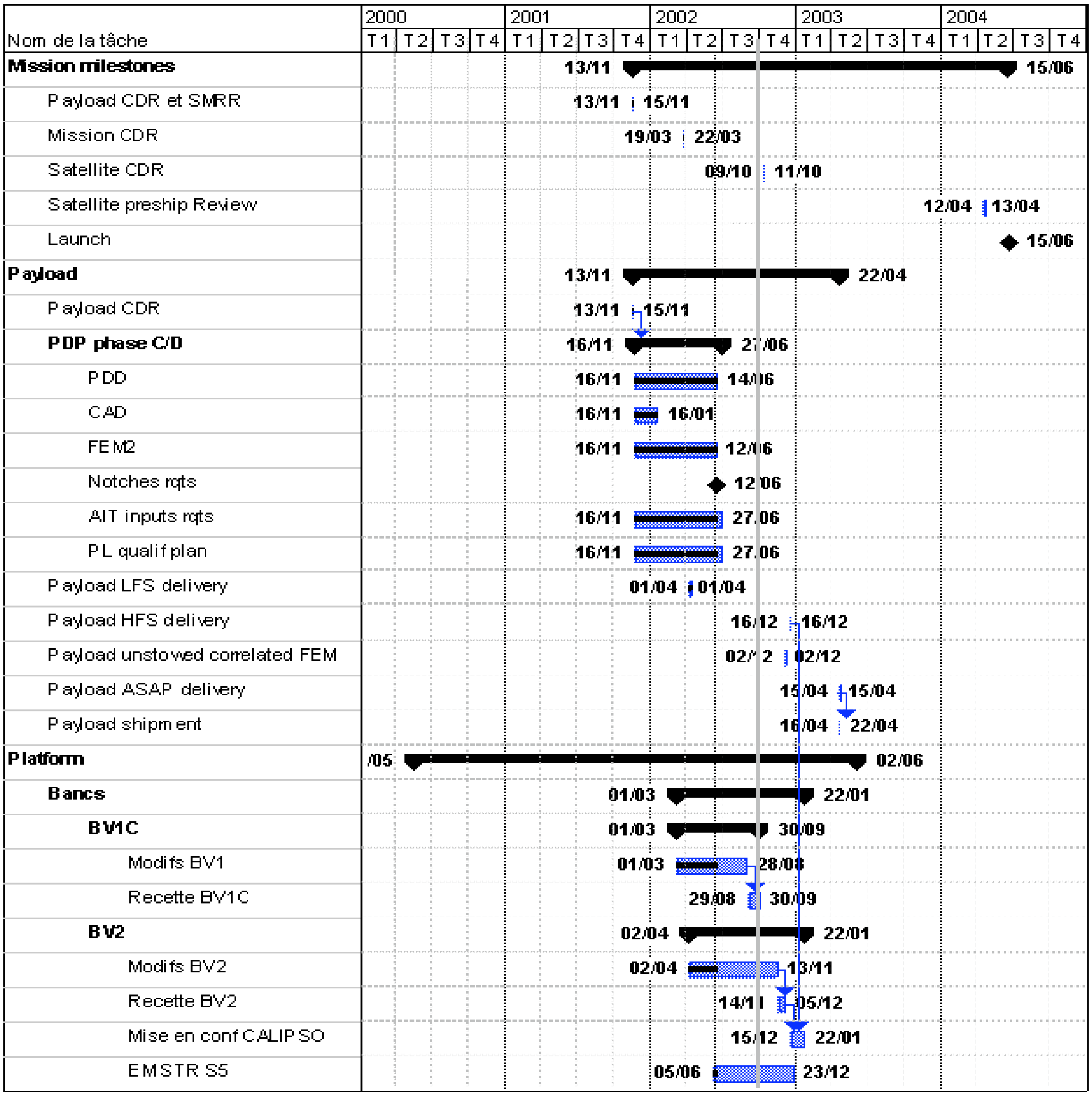
	a. Access to computers loaded with specialized software as required to support this task. b. Access to the CALIPSO GSE hardware, CALIPSO ICDs (interface control documents) and the BATC, CNES and CALIPSO Project documentation as required for record keeping and to monitoring the scheduled certification 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 CALIPSO GSE shall be scheduled and coordinated through the CALIPSO Project.
4.	**<u>Other information needed for performance of task</u>**: a. Electro-Static Discharge (ESD) certification is required to handle the instruments and instrument GSE . b. The GSE are flight critical hardware and subject to established NASA and CALIPSO Product Assurance Policies and Plans. c. Laser safety certification is required where personnel proximity to electrically active Payload is necessary for performance of duties. d. Adherence to contamination control policy and procedures is required to support space flight cleanroom CALIPSO instrument operations. e. All instrument operations shall be scheduled with and coordinated through the CALIPSO Project. **<u>Travel:</u>** Periodic trips to BATC in Boulder, Co; Alcatel in Cannes, France; and Vandenberg AFB in California are expected to conduct other Instrument and CALIPSO Payload AIT activities. During Payload AIT, travel to Boulder, Co may be quite extensive. During Satellite AIT, travel to Cannes, France will be in three week shifts (three weeks at Alcatel, three weeks US, etc). VAFB travel will mirror Satellite AIT requirements. A detailed schedule of travel will be attached at a later date. Preliminary estimates are attached as Appendix. Note: When possible, these trips will be scheduled to coincide with other instrument I&T activities in order to control travel costs.
5.	**<u>Security clearance required for performance of work</u>**: None. International passport required.
6.	**<u>Period of Performance</u>**: Planned start date: 10/1/02 Completion date: R0.7 ~~12/24/04~~ R1 ~~2/28/05~~ ***8/31/05***
7.	**NASA Technical Monitor**: R1 ***J. Richard Rawls*** M/S: ***424*** Phone: 757-864-***4093***

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 3 Appendix to Statement of Work
Task Order Number: ??RFM Revision: Date of Revision: Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project.	

1) Travel estimates for AIT Logistic task: (working days – 5 days = week)

Oct '02	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
Nov '02	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
Dec '02	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
Jan '03	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
Feb '03	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
Mar '03	5 days BATC, Boulder, Co Atmospheric Test/Contamination control
April '03	10 days BATC, Boulder, Co Atmospheric Test/Contamination control
May '03	15 days BATC, Boulder, Co Atmospheric Test/Contamination control
June '03	10 days BATC, Boulder, Co Pre-ship functional activities/packing operations
July '03	10 days Alcatel,Cannes,France Logistics for receipt of Payload
Aug '03	15 days Alcatel,Cannes,France Payload delivery/unpacking/post-ship activities
Sept '03	15 days Alcatel,Cannes,France Satellite AIT operation
Oct '03	10 days Alcatel,Cannes,France Satellite AIT operation
Nov '03	15 days Alcatel,Cannes,France Satellite AIT operation
Dec '03	10 days Alcatel,Cannes,France Satellite AIT operation
Jan '04	15 days Alcatel,Cannes,France Satellite AIT operation
Feb '04	10 days Alcatel,Cannes,France Satellite AIT operation
Mar '04	10 days Alcatel,Cannes,France Satellite AIT operation
Apr '04	15 days Alcatel,Cannes,France Pre-ship functional activities/packing operations
May 04	10 days VAFB, Ca Post-ship functional activities/unpacking operation
Jun '04	15 days VAFB, Ca Atmospheric Test/Contamination control
Jul '04	10 days VAFB, Ca Atmospheric Test/Contamination control
Aug '04	10 days VAFB, Ca AIT support/Contamination control
Sept '03	10 days VAFB, Ca AIT support/Contamination control
Oct '03	10 days VAFB, Ca AIT support/Contamination control (launch operations)
Nov '03	10 days VAFB, Ca Packing and shipping of equipment back to LaRC/BATC
Dec '03	10 days VAFB, Ca/BATC,Boulder Packing and shipping of equipment back to LaRC/BATC
Total	275 days (Note: subject to modification as Project schedules are adjusted)

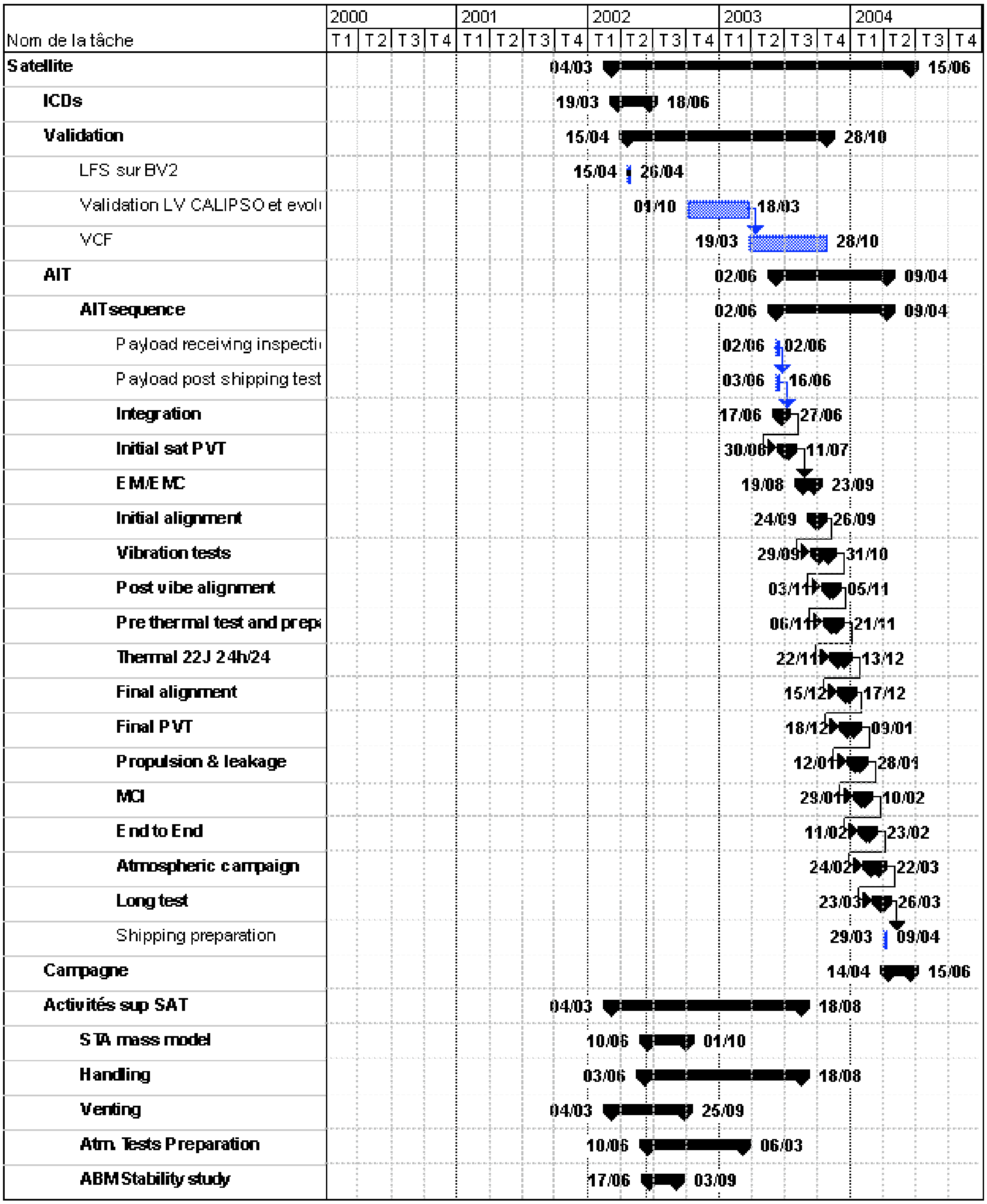
Preliminary CNES schedule is attached. Update expected October 1, 2002.



Nom de la tâche
2000
2001
2002
2003
2004
T1 T2 T3 T4
Mission milestones 13/11 15/06
Payload CDR et SMRR 13/11 15/11
Mission CDR 19/03 22/03
Satellite CDR 09/10 11/10
Satellite preship Review 12/04 13/04
Launch 15/06
Payload 13/11 22/04
Payload CDR 13/11 15/11
PDP phase C/D 16/11 27/06
PDD 16/11 14/06
CAD 16/11 16/01
FEM2 16/11 12/06
Notches rqts 12/06
AIT inputs rqts 16/11 27/06
PL qualif plan 16/11 27/06
Payload LFS delivery 01/04 01/04
Payload HFS delivery 16/12 16/12
Payload unstowed correlated FEM 02/12 02/12
Payload ASAP delivery 15/04 15/04
Payload shipment 16/04 22/04
Platform /05 02/06
Bancs 01/03 22/01
BV1C 01/03 30/09
Modifs BV1 01/03 28/08
Recette BV1C 29/08 30/09
BV2 02/04 22/01
Modifs BV2 02/04 13/11
Recette BV2 14/11 05/12
Mise en conf CALIPSO 15/12 22/01
EMSTR S5 05/06 23/12

Task Order Number: ??RFM Revision: Date of Revision:

Title: Assembly, Integration, and Test (AIT) Support for the CALIPSO Project.



Task Order Number: 36RAC Revision: 6 Date of Revision: 2/9/05

Title: Aircraft Design and Technology Studies and Methods Development

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

The objective of this task is to provide vehicle design and aircraft technology studies and methods development support for the Aeronautics Systems Analysis Branch (ASAB) at the NASA-Langley Research Center. ASAB conducts a wide range of systems analysis efforts in support of the NASA Aeronautics Enterprise. This Enterprise is developing technology that will overcome the barriers to more efficient subsonic and supersonic flight. Proper investment of technology development funding requires that systems level trade studies be conducted to determine the best suite of technologies to overcome these barriers. To perform these studies, NASA requires baseline vehicles with sufficient definition to be developed. Under this task, a series of aircraft concepts will be developed and technology trade studies will be conducted. Also, critical design and analysis tools will be developed under this task to support the system analysis efforts. This task consists of four subtasks that define the work to be conducted in CY/FY [R2] ~~03~~ [R5]~~04~~ 05.

Begin [R2] Block addition This effort is to support both the [R5]Aeronautics Systems Analysis Branch and the Conceptual Design [R5]Shop (CDS) tool development effort under the Efficient Aerodynamic Shapes & Integration (EASI) project of the Vehicle Systems Program. The objective of the [R5]CDS sub-project is to establish a rapid variable fidelity numerical capability for developing and evaluating novel aircraft concepts and component vehicle technologies in a conceptual design environment. In addition continued support for the existing conceptual design codes is required. **End [R2] block addition**

Revision 1: Extends the period of performance ten months in continuation of NASA's support with RASC requirements added as Subtask 5 for the new period of performance.

[R2]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 36RAC, 36RAC01, [R5]36RAC02, 36RAC03, and 36RAC04.

Revision 2: Extends the period of performance 12 months to December 31, 2004, in continuation of NASA's support with new requirements (Subtasks 6-11) for the new period of performance and documents the Technical Monitor change.

Revision 3: Redefines/updates requirements of Subtasks 7-9. Adds requirements as new Subtasks 9.5 and 12.0.

Revision 4: Extends the period of performance 3 months to March 31, 2005, in continuation of NASA's support with new requirements (Subtasks 6-11) for the new period of performance.

Revision 5: Extends the period of performance 9 months to December 31, 2005, in continuation of NASA's support with redefined requirements (Subtasks 6-12) for the new period of performance (see [R5] above and below).

Task Order Number: 36RAC Revision: 6 Date of Revision: 2/9/05

Title: Aircraft Design and Technology Studies and Methods Development

Revision 6: Reduces requirements due to budgetary constraints by deleting Subtasks 2, 7, and 9 (see R6 below).

2. Description of the Work to be Performed:

Major Subtasks

Begin R2 block requirements addition

6.0 Core Sizing and Synthesis Tools

Tasks to be performed fall into two main areas; continued support of the current Flight Optimization System (FLOPS) code and related software and support for the R5CDS sub-project WBS 2.2.3.1 (Variable Fidelity Framework).

1. Maintaining and improving the Flight Optimization System (FLOPS) and related codes for the Systems Analysis Branch:

a) The Contractor shall provide maintenance for the Flight Optimization System (FLOPS) and related codes such as the XFLOPS Graphical User Interface, the updated Harris Wave Drag code (Awave), and the Harry Carlson codes Aero2s, Wing design, Cdmin, and LtStar. Maintenance will include tracking down and fixing all reported errors, and ensuring that the codes operate properly on both UNIX and PC platforms.
b) The Contractor shall prepare and maintain user's manuals and methodology documentation on all supported codes. All documentation will be accessible on-line.
c) The Contractor shall prepare and maintain distribution packages for all supported codes for both UNIX and PC platforms. Packages will contain all methodology documentation and user's guides, input and output files for example problems, any auxiliary data files required for proper operation, installation instructions, source files, and executables when appropriate.
d) The Contractor shall, in response to valid requests, distribute codes in accordance with NASA regulations.
e) The Contractor shall provide technical assistance to customers both within NASA and in the U.S. aerospace community in the proper installation and use of these codes.
f) The Contractor shall provide technical assistance to NASA personnel in the integration of additional capabilities into FLOPS for research purposes.

g) The Contractor shall implement improvements in methodology in the production codes when they become available.
h) R5 The Contractor shall insure that all updates/changes to codes listed in item (a) above are compatible with and deployed to the conceptual design system (currently built around the ModelCenter framework integration software).

Begin R5 block update

2. R6 ***Deleted*** CDS Support:

7.0 R6 ***Deleted*** Integration framework implementation with SAB legacy codes.

8.0 Variable Fidelity Structural Analysis Tools

This subtask supports CDS WBS 2.2.3.1 (Variable Fidelity Framework). The objective of this work is to integrate variable fidelity structural analysis tools into the CDS system.

a) The Contractor shall develop a strategy and process for interfacing between geometry, aerodynamics and structural analysis tools. This will require interfacing with the GSLP team, and the Framework sub-team.
b) The Contractor shall then develop a proof-of-concept demonstration that supports the implementation of the interfacing strategy.
c) The Contractor shall then build off of the proof-of-concept to produce a prototype method and process for integrating structural analysis capability into CDS.

Deliverables:

a) The Contractor shall produce a "Structural Analysis Tool Integration Strategy" report, due by 3/31/2005. This short report will contain a detailed description of the implementation strategy and process for integrating structural analysis tools into CDS, including the required interfaces.
b) The Contractor shall deliver a proof-of-concept demonstration that utilizes an internal structural layout model from the GSLP team (i.e. 777-200 baseline vehicle wing structure) and interfaces with structural anlaysis tools within CDS. Due by 7/29/05.
c) The Contractor shall deliver prototype capability and documentation for

integrated structural analysis capability in CDS. Due by 11/30/2005.

9.0 [R6]***Deleted*** Geometry Tool Development for CDS

10.0 Technology Evaluation Support for the Aviation Safety Program Assessment Team

a) Product Dictionary – Complete a Project Dictionary, listing the name and description of all technical products completed as part of any Aviation Safety Program projects.

Deliverables:

a) Intermediate Program Product Dictionary – In electronic form (MS Word, Excel and or PowerPoint as appropriate). Report shall contain a list, with descriptions, of all technical products completed by the SAAP and SVS projects as of December 1, 2004. Due Date: February 28, 2004.

b) Final Program Product Dictionary – In electronic form (MS Word, Excel and or PowerPoint as appropriate). Report shall contain a list, with descriptions, of all technical products completed by the SAAP and SVS projects. Due Date: June 25, 2005

11.0 Supersonic Aircraft (SSA) Sector for Vehicle Integration, Strategy, and Technology Assessment (VISTA) Support.

1) The Contractor shall support the VISTA SSA Team by providing conceptual design and analysis as well as impact assessments of Vehicle Systems' technology portfolio applicable to the SSA Sector.

2) The Contractor shall participate and support the EASI CCCT subproject Low Boom/Low Drag WBS 2.2.2.3.2. The Contractor shall modify an existing NASA Baseline configuration to the current supersonic mission and contribute to the design and analysis of a new low boom/low drag reference configuration.

Deliverables:

1a) Report detailing the results of the "Bottoms Up Analysis" for the Vehicle Systems technology solicitation in parallel with the SSA Vehicle Sector Analyst. Due date: February 27, 2005.

1b) Report detailing the results of the "Scenario II" analysis in parallel with the SSA Vehicle Sector Analyst. Due date: December 31, 2005

2a) Report detailing the configuration study of a modified existing NASA Baseline configuration that meets the current mission for a Small Supersonic Transport. Provide final OML to the SSA Vehicle Sector Analyst. Due date: April 31, 2005

2b) Document results of Contractor's participation in design team to provide a new reference vehicle for a low boom low drag configuration. Report must include final performance results of the team's reference configuration. Due date: November 31, 2005.

12.0 R6 ***Deleted*** Variable Fidelity Low Speed Aerodynamic Analysis Tools

End R5 block update

Standards for All Subtasks:

Meets Minimum Performance: Deliverables as described and on time.

Exceeding Minimum Performance: Deliverables on time, plus added value in terms of report quality, drawings or data provided, or initiative shown in identifying high-payoff areas for future research. For software, the Contractor would exceed the minimum performance with: suggestions of improvements to models, modeling techniques or analyses; identification of code deficiencies with suggestions for improvements; development of improved models or analysis techniques using existing tools, or developing new tools that allow for faster turn-around, or better integration of analysis methods; or perform studies in a more rapid manner than original time estimates (at least one week prior to specified date of delivery).

3. Government Furnished Items:

NASA shall furnish the necessary design and mission specifications for subtasks 1 & 4.

NASA shall furnish Visual Studio and Visual Fortran for Subtask 3.

NASA shall furnish the required engine-cycle data for all Subtasks.

NASA shall obtain and install the solar electric fuel cell report and software for subtask 4. NASA shall also provide training in the code if required.

NASA shall furnish access to computer workstations, CPU time, FORTRAN compiler, word-processing software, ACAD software, Pro/Engineer software, FLOPS software, ELAPS software, and linear theory computer programs as required.

	Task Order Number: 36RAC Revision: 6 Date of Revision: 2/9/05 Title: Aircraft Design and Technology Studies and Methods Development

	NASA shall furnish geometry and data descriptions for NASA owned configuration models when required for validation. NASA will furnish required source code for subtasks 3d) and 3e). NASA will furnish network access, telephones, and office space for the personnel required to perform these subtasks.
4.	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.
5.	Security clearance required for performance of work: Unclassified. Proprietary Data.
6.	Period of Performance: Planned start date: November 1, 2002 Completion date: R2~~December 31, 2003~~ R4~~December 31, 2004~~ R5~~March 31, 2005~~ December 31, 2005
7.	NASA Technical Monitor: .R2William M. Kimmel M/S: 348 Phone: 757-864-7136 NASA Directorate/Other Technical Coordinator (*above branch level*): R5Dr. Ajay Kumar M/S: 327 Phone: 757-864-2283

1. Task Order Number and Title Number: 36RBG Revision:

Title: **MEASUREMENT TECHNOLOGY SUPPORT**

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

This task order supports the development and application of state-of-the-art measurement technologies. The purpose of this task is to provide technical support for the set up of an optics laboratory and subsequently assist in the development of advanced measurement techniques.

3. Description of the Work to be Performed:

The Contractor shall perform the following Subtasks:

1. Set up optics laboratory in support of the development of mechanical deformation measurement including the following:
   - (a) Research, prepare specifications, recommend sources, and provide cost estimates for the procurement of optics laboratory hardware;
   - (b) Assemble all components and check out for proper operation, perform necessary design and fabrication of electronic circuits and simple mechanical parts;

Deliverables:

The Contractor shall provide:

1. Completed mounting of optical system;
2. Drawings of all constructed electronic, mechanical, and optical components;
4. Documentation describing the characteristics of the constructed components in accordance with the ISO-9001 procedures outlined in the LMS.

Schedule of Deliverables:

Subtask 1 shall be completed by June 30, 2001

Minimum Acceptable Performance Standards:

Evaluation of Contractor performance on Subtask 1 will be based on the following:

- Optical laboratory shall be completed as designated in the specifications provided by NASA.

- All deliverables shall be delivered by the Subtask 1 completion date of June 30, 2001 while meeting all specifications.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for Subtask 1.

- Providing input to the tasks that significantly improves the functionality of the completed laboratory.

2. Support the development of advanced measurement techniques.

The Contractor shall provide:
(a) Mechanical assembly;
(b) PC-based data acquisition and analysis including appropriate Windows-based software with acquisition hardware and other commercial software;
(c) Analog and digital circuit design, fabrication, and checkout.

Deliverables: The Contractor shall provide:
1. Fully documented reports from data acquired during tests.
2. Fully documented software listings used in various tests.
3. Fully documented reports on all setups.

Schedule of Deliverables:

Subtask 2 shall be completed by December 31, 2001.

Minimum Acceptable Performance Standards:

Evaluation of Contractor performance on Subtask 2 will be based on the following:

- Completion of data acquisition and documentation to levels as specified in LMS procedures.

Significantly Exceeds Minimum Performance Standards: Meeting the standard listed below will constitute exceeding the minimum acceptable performance for Subtask 2.

- Providing input to the tasks that increase the overall effectiveness of a technique or procedure over what was originally expected.

4. Government Furnished Items: Building 1200, Room 124B

Shop Equipment	Milling machine, drill press, lathe, grinder, bandsaw
Computer	Pentium class PC

Printers	Color laser jet, E-size ink jet printer

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: January 1, 2001	Expected completion date: December 31, 2001

8. NASA Technical Monitor: Ping Tcheng
   M/S: 493 Phone: 757-864-4717

Task Order Number: 36RDA Revision: 3 Date of Revision: 02/04/05

Title: [R2]*Dynamic-Stability and High-Lift Studies for the Computational Methods for Stability and Control (COMSAC) and Ground to Flight Scaling-High-Lift Projects*

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

This Statement of Work describes the requirement to provide technical support for the NASA Computational Methods for Stability and Control (COMSAC) project [R2]and the NASA Ground to Flight Scaling-High-Lift Project. The projects require assessment [R2]and development of computational fluid dynamics (CFD) capability to predict [R2]stability and control (S&C) and high-lift characteristics of aircraft. It is anticipated that considerable experience with steady and unsteady Reynolds Averaged Navier Stokes (RANS) as well as Detached Eddy Simulation (DES) CFD with static and moving grids will be required to perform the work described below. [R2]Experience with advanced turbulence models (e.g., Mentor's SST) is also required.

Revision 1: Extends the period of performance one month to November 30, 2003, and adds requirements.

[R2]Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 36RDA and 36RDA01.

Revision 2: Resets the period of performance in continuation of NASA's support with redefined requirements, new title and other updated info (see [R2] above and below).

Revision 3: Extends the period of performance 6 weeks to account for unavoidable delays in delivery of GFI (see [R3] below, Section 6).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following requirements:

Begin [R2] block redefinition

- Assess the ability of CFD to predict the dynamic stability characteristics measured in wind tunnel tests of a blended wing body (BWB) configuration in the subsonic speed range. Within the limits of available computer resources, run up to 31 cases using RANS/URANS and DES with appropriate turbulence models to assess the effect of angle of attack, slat deflection, oscillation frequency, and oscillation amplitude (see Attachment 1 for specific run plan). Provide results to NASA for comparison with NASA-provided wind tunnel data
- Assess the ability of CFD to predict aerodynamics of transport aircraft in high-lift configurations. Within the limits of available computer resources, run up to 22 cases on the Boeing 777 geometry in the landing configuration using RANS/URANS and DES with appropriate turbulence models to predict high-lift performance, in particular, C_{Lmax}. Determine the effect of Reynolds number on C_{Lmax} for the Boeing 777 by performing the calculations at flight Reynolds number and wind tunnel Reynolds number. Run up to 11 cases on the Trap Wing geometry in a high-lift configuration using RANS/URANS and DES with appropriate turbulence models to predict high-lift performance. See Attachment 2 for specific run plans for both 777 and Trap Wing. Compare results with NASA-provided wind tunnel data.

	• Prepare and present an exit briefing and final report on the accomplishments and recommendations of the work at the conclusion of the contracted period. **Deliverables:** Final report, briefing, recommendations, and summary of results. Deliverables to be: Final report in a standard word processing format readable by Microsoft Word Microsoft PowerPoint document and briefing to Langley staff Excel spreadsheet summarizing final calculated forces, moments, and damping derivatives (as applicable) Archived solution files Due: March 31, 2005. **Performance Standard**: Completeness of investigation to assess the ability of chosen CFD algorithms to predict the dynamic stability derivatives of the BWB in the linear and non-linear angle of attack range, and high-lift aerodynamics of a transport configuration. **Performance Metrics**: Meets: All cases are run (within the limits of available computer resources) and adequately summarized Exceeds: 'Meets" and reports provide thorough coverage of subject, including identification of potential shortcomings in CFD prediction capability and recommendations for improvement **End R2 block redefinition**
3.	**Government Furnished Items:** **Begin R2 block addition** Wind tunnel data for comparison as-applicable Baseline CFD grids. In the case of the 777 and Trap Wing high-lift configuration s, the government may provide "wall function" grids instead of "fully viscous" grids. **End R2 block addition** Work shall be performed at Langley and the Contractor's site
4.	**Other information needed for performance of task:** Travel to NASA Langley once for a planning session and once for a final out-brief
5.	**Security clearance required for performance of work**:

Task Order Number: 36RDA Revision: 3 Date of Revision: 02/04/05

Title: [R2]*Dynamic-Stability and High-Lift Studies for the Computational Methods for Stability and Control (COMSAC) and Ground to Flight Scaling-High-Lift Projects*

	Unclassified
6.	**Period of Performance:** Planned start date: [R2]~~04/28/03~~ 04/01/04 Completion date: [R1]~~09/30/03~~ [R2]~~11/30/03~~ [R3]~~03/31/05~~ ***05/12/05***
7.	**NASA Technical Monitor**: Charles M. Fremaux M/S: 153 Phone: 757-864-1193 Email: charles.m.fremaux@nasa.gov

Attachment 1

BWB-450 CFD runs in support of COMSAC (in order of priority)

1. a sweep at b=0 (baseline pitch damping)
   - a_{nom} = 0, 8, 16, 20, 22, 24, 26, 28, 30, 32 (10 points)
   - free air (qbar=2 psf, M=0.2 as appropriate)
   - slats = 0^o
   - k=0.07 + A= ±5^o

2. a sweep at b=0 (slat effects)
   - a = 20, 22, 24, 26, 28, 30, 32 (7 points)
   - free air (qbar=2 psf, M=0.2 as appropriate)
   - slats = 30^o
   - k=0.07 + A= ±5^o

3. a sweep at b=0 (frequency effects)
   - a = 20, 22, 24, 26, 28, 30, 32 (7 points)
   - free air (qbar=2 psf, M=0.2 as appropriate)
   - slats = 0^o & 30^o
   - k=0.211, A= ±5^o

4. a sweep at b=0 (amplitude effects)
   - a = 20, 22, 24, 26, 28, 30, 32 (7 points)
   - free air (qbar=2 psf, M=0.2 as appropriate)
   - slats = 30^o
   - k=0.07, A= ±15^o (if practicable), otherwise A= ±10^o

Attachment 2

Boeing 777 and Trap Wing CFD runs in support of Ground to Flight Scaling-High Lift (in order of priority)

Appendix, page 2 of 2

Note: Results on the Boeing 777 are of a higher priority, although it is expected that the contractor will begin the task with the Trap Wing.

1. 777 a-sweep at b=0 (determination of C_{Lmax} and Re-effects on C_{Lmax})
   - a = 4, 6, 8, 10, 12, 14, 16, 18, 20 PLUS up to two additional runs to determine C_{Lmax}
   - M = 0.21
   - Re = 23.74×10^6 and Re = 5.8×10^6 (22 runs)
   - Note 1: flight C_{Lmax} occurs at 18.5^o
   - Note 2: additional areas of interest (if time permits) include
     1. runs at an intermediate Re
     2. viscous sidewalls effects at all Re
     3. flaps = 20^o run
     4. Decision on which additional runs to make will be made in cooperation with the government.
   - Note 3: If time/resources become an issue, runs in the linear region of the lift curve may be omitted with the concurrence of NASA

2. Trap Wing a-sweep at b=0 (determination of C_{Lmax} and Re-effects on C_{Lmax})
   - a = 4, 12, 16, 20, 24, 28, 30, 31, 32, 34, 36
   - M = 0.20
   - Re = 4.3×10^6 based on m.a.c. of 39.6 inches (11 runs)
   - Note 1: C_{Lmax} occurs at ~32^o
   - Note 2: wind tunnel data range is from a = -4^o to a = $+36^o$
   - Note 3: hysteresis is present in the wind tunnel data from a = -4^o to a = $+4^o$ and from a = $+33^o$ to a = $+36^o$
   - Note 4: in additional to balance forces and moments, surface pressures, PIV, and hot film data are available for a = 4^o, 12^o, 16^o, and 24^o

Task Order Number: 36RFJ Revision: 2 Date of Revision: 11/18/04
Title: High Power Laser Diode Technology

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

Solid state laser diode arrays operating at 792nm are of particular importance in that they serve as the optical pump source for solid state laser materials such as HoTm:YLF, which in turn lases in the 2 micron region. Such laser output is valuable in that it would enable space based lidar systems that would measure winds, as well as other atmospheric phenomena and constituents. However, current technology and understanding of the long-term operation of these diodes is quite limited. It is the goal of this project to purchase/obtain high power laser diodes at 792nm (or 808 nm for validation) from a number of vendors and test them for long-term reliability. In addition, the objective of this work is to advance the technology, reliability, and understanding of risk reduction for these high power laser diode arrays. This work includes development, documentation, and functional testing of diodes and related components using state of the art testing methods.

Revision 1: Extends the period of performance one year to 12/31/04 and updates the schedule accordingly in continuation of NASA's support requirements with no other changes to the detailed description (see R1 below).
Revision 2: Extends the period of performance one year to 12/31/05 and updates the schedule accordingly in continuation of NASA's support requirements with no other changes to the detailed description (see R2 below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following tasks and subtasks:

Task 1: General daily laboratory operation
The Contractor shall be responsible for selection of thermal testing methods and protocols, development and fabrication of test fixtures, evaluation-use of methods and protocols, and selection of test equipment. The Contractor shall participate in test evaluation and data interpretation. The Contractor shall keep laboratory records in a way that documents protocols and formulations and any data developed along the way. The Contractor may be required to contribute to publishing the results of this research effort. Modifications to control programming (Labview) shall be documented. The Contractor shall investigate improved methods for acquiring test data.

Task 2: Specific testing and evaluation
Laser diodes will be evaluated upon arrival by the Contractor and prepared for extended lifetime testing. At regular intervals, the Contractor shall remove the diodes from life testing and perform detailed characterization. Initial testing shall include PIV/LIV (power, current, voltage/ life, current voltage) characteristic curves, temperature versus wavelength/efficiency curves and photo documentation of physical characteristics. Characterization may include thermal analysis

and heat transfer efficiency that will allow for development of improved design, construction and/or cooling methods.

Deliverables:

Quarterly reports R1 ~~2/30/03, 5/30/03, 8/30/03, 11/30/03~~
R2 ~~3/30/04, 6/30/04, 9/30/04, 12/30/04~~
3/30/05, 6/30/05, 9/30/05, 12/30/05

Initial operating data on all laser diodes delivered.
A design for a dual point of contact cooling system for A-package laser diodes.

Schedule: Work is to be carried out in a fashion that conforms to the overall project schedule.

Performance Standards (meets, exceeds):

Meets:
a. Adheres to schedule.
b. Written reports are provided according to schedule above.
c. Overall assigned tasks are completed within budget allowed.
d. Specified testing is completed.

Exceeds:
a. Testing completed ahead of schedule.
b. Written reports are provided according to schedule above.
c. All assigned tasks are completed under budget.
d. Specified testing is completed and additional contributions are made to furtherance of scientific goals and objectives.

3. Government Furnished Items:

The Government will provide all specialized material and equipment to conduct the work.

4. Other information needed for performance of task:

The Contractor may be required to participate in travel in support of this project. Need for travel will be evaluated as required and budget augmentations provided to cover cost as needed. Tentatively, for planning purposes, it is anticipated that the Contractor may need to make as many as two trips to GSFC for a period of 4 days each.
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.

	Task Order Number: 36RFJ Revision: 2 Date of Revision: 11/18/04 Title: High Power Laser Diode Technology

5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: R1 ~~12/02/02~~ Completion date: R1 ~~12/31/03~~ R2 ~~1/01/04~~ ~~12/31/04~~ ***1/01/05*** ***12/31/05***
7.	NASA Technical Monitor: Byron L. Meadows M/S: 468 Phone: 757-864-5168 NASA Competency/Other Technical Coordinator (*above branch level)* M/S: Phone: 757-864-

Task Order Number: 37RAB Revision: Close Date of Revision: 8/1/03

Title: Spacecraft Systems Analysis for RASC (Revolutionary Aerospace Systems Concepts)

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

The LaRC Aerospace Systems, Concepts, and Analysis Competency (ASCAC) Spacecraft and Sensors Branch (SSB) is often required to produce independent trade studies and systems analyses for Revolutionary Aerospace Systems Concepts. The Contractor will be required to provide analysis and consultation for, and enhancement of analysis software and methods used in, spacecraft systems studies.

The work described below was performed formerly as elements 3.0 and 6.0 under task order 13RAB and has been broken out for continuation in this separate task order. (For previous details see original, Revision 1, and Revision 2 SOWs in ETOS *doc* files *13RAB, 13RAB01.doc, and 13RAB02.doc*, respectively.)

Close: Effective July 31, 2003 with deletion of a deliverable (see [C] below)

2. **Description of the Work to be Performed:**

General Requirements Summary

The Contractor shall conduct analyses for spacecraft systems and perform tool development to support work ongoing in the SSB for the work described below:

RASC (Revolutionary Aerospace Systems Concepts) studies

The Contractor shall develop detailed plans to perform the work, including schedules of the deliverable products. The primary products shall be modifications to the existing SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) software tool, and a final set of documentation for a SPASIM Users Manual.

The Contractor, in cooperation with SSB shall develop schedules for the final documents and/or the tools.

The Contractor shall implement the work plans to perform tool development and analyses/modification studies which encompass the following technical areas.

(a) Guidance, Navigation, and Control– Waypoint tracking angles and slant ranges, realtime tracking of multiple waypoints
(b) Communications and data transfer Operations– Waypoint Tracking RF Link analyses
(c) Microsoft Office Programming
(d) Matlab/Simulink Programming
(e) Other associated areas

During the tasks the Contractor shall provide in-depth software development and documentation upgrades.

Deliverables:

(1) The plan, cost, and schedule for each task 1-week after the start of each task. A final report summarizing the technical effort at the completion of each task.

Metrics:

Minimum acceptable performance:
(1) The final report on modifications and documentation shall be evaluated for the following.
(a) technical accuracy of the software additions/modifications
(b) A Users Guide featuring all the screen menus and options
(c) Clearly outline/demonstrate the ability to Setup and run SPASIM analysis
(d) Operator selections and options must be fully discussed for each subsystem and their Matlab menus
(e) Discussion of the usage of Test Cases from the on-screen menu selections
(2) Software products shall be evaluated for completeness and supporting documentation.

Exceeds minimum performance:
(1) The final technical report shall be evaluated for the following.
(a) Summary of changes made to the software tool and associated equations for waypoint tracking (b) Recommendations for improving efficiency, capability, cost, and quality
(c) Executive summary identifying risks

(2) The documentation shall be evaluated for the following:

(a) Provide instruction and description of ALL menus, screens, and default selections
(b) Discussion of the usage and benefit of Test cases from the on screen menu selections

Requirements by Element/Subtask

1.0 SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) support for RASC (Revolutionary Aerospace Systems Concepts)

The Contractor shall provide support to enhance and utilize SPASIM in conducting analyses for RASC, to include dynamic simulations and report generation. These enhancements and analyses shall provide the following:

(a) Multiple waypoint tracking from a single spacecraft to multiple points that are varying their position with respect to the spacecraft:

- Provide outputs that indicate distance from spacecraft to each waypoint over the course of a defined simulation.
- Provide outputs that indicate RF Link margins from spacecraft to each waypoint over the course of a defined simulation
- Provide blockage flags that indicate line-of-sight coverage from spacecraft to each waypoint, including blockage from planets, moons, and antenna vector misalignment; include main spacecraft comms antenna(s) pointing vector to waypoint angles (command and telemetry).

(b) Generate output report modifications and files (readable in Excel) that list spacecraft to waypoint distances and blockage as a function of SPASIM simulation time steps.

Deliverables:

(1) Generate analysis cases for supporting communications and navigation satellites for the Callisto mission – Due December 17,2002.

(2) Modification to SPASIM version 1_06dev to provide multiple waypoint tracking from a single spacecraft to multiple points that are varying their position with respect to the spacecraft, to include**:**
- Provide SPASIM outputs that indicate distance from spacecraft to each waypoint over the course of a defined simulation.
- Provide SPASIM outputs that indicate RF Link margins from spacecraft to each waypoint over the course of a defined simulation
- Blockage flags that indicate line-of-sight coverage from spacecraft to each waypoint, including blockage from planets, moons, and antenna vector misalignment; include main spacecraft communication antenna(s) pointing vector to waypoint angles (command and telemetry).

(3) Generate output report modifications and files (readable in Excel) that list spacecraft to waypoint distances and blockage as a function of SPASIM simulation time steps.

Metrics:

Minimum acceptable performance:

(1) Delivery of a new version of SPASIM that incorporates the capability to perform waypoint tracking and communications analysis for the defined set of satellites used for supporting a mission to Callisto.

(2) Defined set of analysis examples to show capabilities of Way-point tracking.

Exceeds minimum performance:

(1) Capability to model TDRSS satellites as waypoints and show the ability to assess coverage and communications by LEO satellites with TDRSS.

2.0 Updates of SmallSat and SPASIM (Spacecraft Performance Analysis and Simulation of Integrated Missions) User's Guides

The Contractor shall update the SmallSat and SPASIM online User's Guides to reflect the latest versions to the tools (currently SmallSat version 008 and SPASIM version 1_06dev).

Note: FY03 schedule and organization constraints for the work will not afford time for training new Contractor personnel who do not already have proficiency in the operation and underlying logic of both SmallSat and SPASIM.

The specific tasks associated with this element follow.

(a) Obtain the online versions of the SmallSat and SPASIM User's Guides.
(b) Provide a step-by-step explanation of the inputs required to perform both SmallSat design and SPASIM simulations, highlighting new capabilities such as waypoint tracking and analyses.
(c) Provide an overview of the subsystem level logic and algorithms used in each tool, including test cases used for verification.
(d) Update screen captures of overview, model, database, input, and output pages

Deliverables:

(1) The plan, cost, and schedule for the task 1-week after the initiation of the task. [C]~~Completion by November 28, 2003~~.
(2) Electronic versions of the SmallSat and SPASIM User's Guides at the end of each quarter of the task.

Metrics:

Minimum acceptable performance:
(1) User's Guides shall be evaluated for completeness and clarity.
(2) Demonstrate, through a presentation, the ability to model and analyze a mission simulation using the documentation and the software.

Exceeds minimum performance:
(1) Enhancements to the User's Guides that improve the ability to implement future updates.

3.	**Government Furnished Items**: Access to special software analysis tools and environments.
4.	**Other information needed for performance of task**:
5.	**Security clearance required for performance of work**: None. However, non-disclosure agreements must be signed by all Contractors required to handle RASC proposals and concepts.
6.	**Period of Performance**: Planned start date: 12/2/2002 Completion date: C~~11/28/2003~~ ***7/31/03***
7.	**NASA Technical Monitor:** Frederic H. Stillwagen M/S: 328 Phone: 757-864-9061 **NASA Competency/Other Technical Coordinator:** ASCAC/ Michael P. Fitzgerald M/S: 327 Phone: 757-864-3681

Task Order Number: 37RBE Revision: 4 Date of Revision: 12/10/04
Title: Wake Flowfield Analysis and Prediction

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

The Aeroacoustics Branch has a continuing responsibility to develop and use computer codes that predict nearfield and farfield noise from all classes of aircraft and their components. Much of this work is driven by requirements of the [R4]***NASA Vehicle Systems Program***, ***Rotorcraft Sector as well as the Quiet Aircraft Technology Project that focuses on*** research in airframe noise, jet noise, and rotorcraft noise.

Note: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Extends the period of performance through September 30, 2003, in continuation of NASA's support requirements and redefines and/or updates the requirements for the new period of performance (see [R1] below).
Revision 2: Extends the period of performance one year to September 30, 2004, in continuation of NASA's support requirements with no changes to the detailed requirements (see [R2] below).
Revision 3: Extends the period of performance and schedule three months to December 30, 2004 with requirements added as Subtask 4 (see [R3] below).
Change 1: Contractor-initiated change extends the period of performance 2 months to February 28, 2005, and adjusts for more accurate accounting and spending profiles (see [R3.1] below, Section 6).
Revision 4: Extends the period of performance ten months through December 30, 2005 with updates in task requirements and info (see [R4] above and below).

2. **Description of the Work to be Performed:** The Contractor shall provide support for data analysis and prediction support for the HART (Higher Harmonic Control Aeroacoustic Rotor Test) program, [R1]EDAS (Electronic Data Access System), and [R4]***CARMA (Comprehensive Analysis of Rotorcraft Modeling for Acoustics)***

1. (NOR) Implement methods specified by NASA to analyze [R1]PIV (Particle Image Velocimetry) vector maps of the wake flow field.

    1. Write analysis codes to determine characteristics of the vortex wake (such as

vortex center, vortex core size, vortex strength, [R1]and turbulent characteristics) by different methods in either Fortran or C to run on a unix workstation.

2. Process HART 2 PIV vector maps [R1]and QFF grid turbulence PIV vector maps for selected conditions (by NASA) using the analysis codes developed.

Begin [R1] block deletion

~~2. Predict the wake using NASA comprehensive rotorcraft code CAMRAD.Mod1 for selected HART 2 rotor conditions. The input decks and scripts for running the CAMRAD.Mod1 code will be provided by NASA.~~

~~1. The predicted wake results shall be analyzed and compared with the measured data by the contractor. The analysis codes used to determine the vortex characteristics of the measured data will be applied to the predictions.~~

~~2. New wake model modifications developed by NASA shall be implemented in the CAMRAD.Mod1 and verified by comparison with measured results.~~

End [R1] block deletion

3. [R1]Provide support in developing and maintaining EDAS capabilities. Continue to populate the EDAS with existing databases such as HART 2 and flight acoustic databases as provided by NASA.

Begin [R4] block deletion

Begin [R3] block addition

4. Prov~~ide support in developing and maintaining the HART database for both the HART I and HART II tests. Computer codes and scripts shall be written to read and process the data as well as provide TECPLOT compatible output files. The processing shall include capability to compute spectra from acoustic time histories.~~

End [R3] block addition

End [R4]block deletion

Begin [R4] block addition

5. Analysis codes are to be developed using signal processing methods and theory which will be used to support investigation of the rotorcraft source noise generation from measured data and be used to develop and advance the prediction capabilities for rotorcraft source and system noise. Codes shall be written to run on a UNIX workstation in FORTRAN, C and/or other appropriate languages.

End [R4] block addition

Schedule of Deliverables: Complete tasks by [R3]~~September 30~~ [R4]***December 30***, [R1]~~2002~~ [R2]~~2003~~ ~~2004~~ ***2005***

.

Metrics for Deliverables: Minimum acceptable performance would be to demonstrate [R1]EDAS

	capabilities to store and archive model and flight data R4***and demonstration of capabilities to extract vortex properties (core size and strength) from PIV vector maps*** A level of performance exceeding the minimum acceptable performance would be demonstrated by the "user-friendliness" R4 ***and documentation*** of EDAS and R1of the codes developed (under this task).
3.	Government Furnished Items: (see above) Access to the R4***CARMA*** system will be provided by NASA.
4.	Other information needed for performance of task: All software and codes developed will be property of NASA to use and distribute R4***without limitations*** 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.
5.	Security clearance required for performance of work: none.
6.	Period of Performance: Planned start date: R1~~May 1, 2002~~ November 15, 2002 Completion date: R1~~Sept. 30, 2002~~ R2~~Sept. 30, 2003~~ R3~~Sept. 30, 2004~~ R3.1~~December 30, 2004~~ R4~~February 28, 2005~~ ***December 30, 2005***
7.	**NASA Technical Monitor:** Casey L. Burley M/S: 461 Phone: 757-864-3659 **NASA Competency/Other Technical Coordinator:** Lorenzo R. Clark M/S: 461 Phone: 757-864-3637

Task Order Number: 37RDH Revision: Close Date of Revision: 7/31/03
Title: MATLAB® Analysis of Tropospheric Airborne Meteorological Data Reporting Sensor

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

NASA is working with Georgia Technology Research Institute and Optical Detection Systems (ODS), of Rapid City, SD, for the development of the Tropospheric Airborne Meteorological Data Reporting (TAMDAR) sensor. The sensor will measure temperature, pressure, wind speed and direction, relative humidity, airspeed, icing, and turbulence. The sensor is designed for use on aircraft flying below 25,000 feet and will output additional state parameter data from the aircraft including time, position information, indicated and true airspeed, and indicated and true altitude. Meteorologically instrumented aircraft will be utilized to conduct flight tests with the TAMDAR sensor. These aircraft include the Naval Postgraduate School (NPS) Twin Otter and the National Oceanic and Atmospheric Administration (NOAA) WP-3D "Hurricane Hunter." Comparison data for each of the parameters will be recorded and will require post-mission processing and analysis. To date, only initial tests flights have been performed with the NPS Twin Otter. Additional flights are schedule for both aircraft to be completed by August 2003.

Closing: Closes out activity to date due to programmatic revision, deletes deliverables from Subtasks B and C, accepts results to date for Subtask A (see [C] below).

2. **Description of the Work to be Performed**:

A. Develop MATLAB® tools [C] ***Cease activity as of 7/31/03.***

The Contractor shall develop MATLAB® scripts from standard meteorological and air-data algorithms, and from NASA-provided algorithms for quality checking and analyzing sensor performance. The Contractor shall develop additional MATLAB® scripts to further process the various data sets, such as filtering, decimation, spectral estimation, and for time and frequency domain analysis. Algorithms to be implemented in MATLAB® will be provided and/or developed by various sources including the Contractor, NASA, the TAMDAR manufacturer, and the research aircraft provider/operator. All MATLAB® scripts shall be delivered in electronic format. Sufficient technical literature and flight test data exists to perform this subtask.

Metrics: Developed scripts shall produce accurate, error-free results with NASA acceptance by documentation and demonstration to the technical monitor.

Meets: Joint development of initial analysis algorithms, and Contractor delivery of scripts within five weeks of flight test task initiation. Scripts and/or data formats may have to be modified slightly when importing data from each of the separate platforms.

Exceeds: Predominately independent and novel and/or creative development of analysis algorithms with Contractor delivery of the scripts within three weeks of flight test task initiation. The scripts will automatically accept and/or reconfigure for the different data formats and data sets.

*****Begin* ^{C}*block deletion*****

B. Quality check of sensor and aircraft data using MATLAB® tools
The Contractor shall use the MATLAB® scripts developed in subtask (A) to perform quality checking and summary analysis of meteorological sensor data from the TAMDAR sensor suite, from the NPS Twin Otter, and from the NOAA WP-3D. The Contractor shall analyze and depict the results of these quality checks using MATLAB®. The Contractor shall modify, as specified by the technical monitor, the MATLAB® scripts from subtask (A) to provide desired plot format or style. All plots shall be delivered in color hardcopy and electronic form suitable for presentation and publication.

Metrics: Analyses and plots are delivered free of error to technical monitor in a timely period.

Meets: Quality performance checks and summary analyses are completed and accepted within 5 weeks of the start of each flight test subtask (B) using standard tools and formats. New data sets can be ported into the tools and analyses packages with some data format or scripts manipulation.

Exceeds: Quality performance checks and summary analyses completed and accepted within 3 weeks of the start of each flight test subtask (B) using new and novel tools and formats. New data sets can be easily ported into the tools and analyses packages with minimal data format and scripts manipulation.

C. Analyze and compare results with MATLAB® tools
The Contractor shall use the MATLAB® scripts and data from subtasks (A) and (B), and modify them as needed, to analyze the accuracy, limitations and potential problem areas of TAMDAR data, the NPS Twin Otter data, and the NOAA WP-3D data. The Contractor shall depict and plot the results of these analyses using MATLAB®. The Contractor shall develop additional MATLAB® scripts to analyze and compare data and plots with the reference aircraft meteorological sensor data. The Contractor shall use MATLAB® to produce separate plots and graphs that depict interrelation and trend of the TAMDAR and each of the different aircraft recorded flight test data. The Contractor shall use MATLAB® to produce plots and graphics that depict the TAMDAR performance results including margins of error from the aircraft data and magnitude of errors from the acceptable tolerance limits. All plots shall be delivered in color hardcopy and electronic form suitable for future publication.

Metrics: Analyses, plots and graphics are delivered free of error to technical monitor in a timely period.

Meets: Performance analysis, plots and graphical summaries are completed and accepted within 5 weeks of the start of each flight test subtask (C) using standard tools and formats. New data sets can be ported into the tools and analyses packages with some data format or scripts manipulation.

Exceeds: Performance analysis, plots and graphical summaries are completed and accepted within 3 weeks of the start of each flight test subtask (C) using new and novel tools, formats and comparative techniques. New data sets can be easily ported into the tools and analyses packages with minimal data format and scripts manipulation.

*****End [C]block deletion*****

D. Reporting and Final Delivery

The Contractor shall deliver oral or written weekly technical reports to the technical monitor. The Contractor shall deliver all MATLAB® script files, comparison plots, and informal reports developed in performance of this task in electronic format.

Metrics: The quality and timeliness of the product outputs.

Meets: A final report summarizing the task including a data analyses summary plus the products generated and delivered within 5 weeks of final task completion.

Exceeds: A final report detailing the breadth and depth of the effort, data analysis summaries, description of all products generated and delivered, problems notes within 3 weeks of final task completion.

3. Government Furnished Items:

NASA will provide office space, a PC computer, one color printer, one MATLAB® user license, access to TAMDAR data, access to aircraft data, partial set of meteorological algorithms, partial set of data analysis algorithms, and plotting formats.

4. Other information needed for performance of task:

No travel is required. NASA shall retain all data rights to MATLAB® scripts. TAMDAR data is considered company proprietary to Optical Detections Systems, Rapid City, SD.
No safety issues exist.

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.

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date: May 1, 2003 Completion date: [C]~~December 31, 2003~~*

July 31, 2003

	*Completion date dependent on flight schedule, with anticipated 15 weeks total effort.
7.	**NASA Technical Monitor**: Taumi Daniels M/S: 473 Phone: 757-864-4659

	Task Order Number: 37RFJ Revision: 7 Date of Revision: 3/23/2005 Title: DLH and DACOM Support for R5 In-flight Test and Science Missions

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

Support is for in-flight missions described below:

Begin R6 background addition

PAVE

NASA Headquarters is sponsoring the Polar Aura Validation Experiment (PAVE) atmospheric science mission that is scheduled for December, 2004 through February, 2005. PAVE is the first of several Aura validation field campaigns. The Diode Laser Hygrometer (DLH) and Differential Absorption CO Measurement (DACOM) instruments have been selected to participate in PAVE. PAVE mission objectives include validation of instruments aboard the Aura satellite, and both DLH and DACOM are being utilized to provide Priority 1 measurements ($H_2O(v)$ by DLH, CO by DACOM) aboard NASA's DC-8 aircraft. In addition, DACOM will also provide Priority 2 measurements of CH_4 and N_2O.

The Chemistry and Dynamics Branch of Langley's Science Directorate has an important role in PAVE by supporting DACOM and DLH on the DC-8. The DACOM and DLH instrument systems are scheduled to be integrated on the DC-8 during late December and early January 2005 at NASA Dryden. The field mission will be based from Pease AFB, New Hampshire. Contractor personnel will support PAVE by coordinating the shipment of the instruments to the integration site; aircraft integration; flight testing; in-flight operation and maintenance; coordinating the return shipment to Langley; laboratory reorganization; and post mission instrument calibration and data handling.

End R6 background addition

SOLVE-2 R5 Completed

Begin R5 background addition

INTEX-NA

NASA Headquarters is sponsoring the Intercontinental Chemical Transport Experiment - North America (INTEX-NA) atmospheric science mission that is scheduled for late June to mid August 2004. INTEX-NA will be one component of a larger internationally-coordinated program called International Consortium for Atmospheric Research on Transport and Transformation (INCART2). The DACOM (Differential Absorption CO Measurement) and Diode Laser Hygrometer (DLH) instruments have been selected to participate in INTEX-NA. INTEX-NA mission objectives include characterization of the intercontinental (Asia, North America and Europe) transport of pollutants, characterization of North American gas emissions, and validation of Terra and Aqua satellite sensors and global transport computer models. Two U.S Government agencies (NOAA and NASA) and research institutions from the United Kingdom, Germany, Canada, and France will coordinate flights of their research aircraft to enhance the science output of this major field mission. DACOM will provide measurements of carbon monoxide (a Priority 1 or "mission critical" measurement) as well as methane and nitrous oxide (Priority 2 or "very important" measurements) on the NASA DC-8 aircraft. DLH will provide high accuracy water vapor (a Priority 1 measurement). DACOM's carbon monoxide measurements will (a) validate carbon monoxide sensors on the Terra and Aqua satellites, (b) validate several global pollution transport computer models and (b) factor into nearly every scientific analysis of mission data. DACOM's methane and nitrous oxide measurements will help characterize and quantify the North American inventories of these important greenhouse gases. DLH's water vapor measurements will (a) validate water vapor measurements from the Terra and Aqua satellites and (b) will factor into nearly every scientific analysis of mission data.

The Laser and Electro-Optics Branch of the Systems Engineering Competency has an important role in INTEX-NA by supporting DACOM and DLH on the DC-8. The DACOM and DLH instrument systems are scheduled to be integrated on the DC-8 during late May and June 2004 at NASA Dryden. The field mission will be based from intensive sites at Pease AFB, New Hampshire and Mid America Airport located near St. Louis, MO. Contractor personnel will support INTEX-NA by coordinating the shipment of the instruments to the integration sites; aircraft integration; flight testing; in-flight operation and maintenance; coordinating the return shipment to Langley; laboratory reorganization; and post mission instrument calibration and data handling.

End R5 background addition

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.

R5Contractor subtasks in support of DACOM and DLH activities during INTEX-NA are combined into this single task order. The DACOM PI is Glen Sachse and the DLH PI is Glenn Diskin (Technical Monitors)

Revision 1: Extends the period of performance to September 30, 2003.Revision 2: Extends the period of performance one month to October 31, 2003.

Revision 3: Extends the period of performance two months to December 31, 2003.

Revision 4: Extends the period of performance two months to February 29, 2004.

R5Note: For historical details deleted for clarity and/or convenience see previous versions of this Statement of Work located on the electronic task order system (ETOS) as "doc" files 37RFJ, 37RFJ01, 37RFJ02, 37RFJ03, and 37RFJ04, corresponding respectively to original issuance and subsequent Revisions 1 through 4.

Revision 5: Extends the period of performance one year in continuation of NASA's support, redefines the requirements for the new period of performance, updates title and other info, and adds a second Technical Monitor (see R5 above and below).

Revision 6. Extends period of performance 5.5 months to Aug. 15, 2005 and adds PAVE mission subtasks (see R6 above and below).

Revision 7: Extends period of performance 3.5 months to Dec. 31, 2005, adds new requirements as Subtasks 15.0 through 18.0; and adds a statement regarding procurements to Section 4 (see R7 below).

2. **Description of the Work to be Performed**:

The Contractor shall perform the following subtasks and requirements:

Begin R5 block redefinition

Subtask 1.0: Prepare and characterize DACOM and DLH performance prior to shipment. Contractor shall verify the DACOM and DLH 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 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 Government-approved procedures, prior to shipment barring any optics failures.
2. Delivery of DACOM and DLH data files to respective PIs within 5 days of each test.

Exceeds:

3. Delivery of DACOM and DLH data files to respective PIs within 1 day of each test.

Subtask 2.0: Coordination of shipment of DLH and DACOM to the DC-8 integration site. The contractor shall develop procedures to ship these instruments 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 coordinate pick-up and loading of DLH and DACOM with NASA personnel. The government will cover shipping costs.

Deliverables

1. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DLH and DACOM packed to meet scheduled ship date of May 20th, 2004.
2. Shipping list complete and up-to-date on day of shipment.

Exceeds:

1. Shipping list complete and up-to-date at least two days prior to shipment.

Subtask 3.0: Integrate and preflight test DACOM and DLH on DC-8. This requires the contractor to unpack, assemble and install DACOM and DLH on the DC-8. The contractor shall verify the DACOM and DLH 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 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 Government-approved procedures to meet scheduled science flights (R6details to be provided) barring optics failure.
2. Delivery of DACOM and DLH data files to respective PIs within 24 hours of each test.

Exceeds:

1. DACOM and DLH 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 and DLH subsystems during the INTEX-NA 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 each flight barring laser, optics, or detector failures.
5. Delivery of DACOM and DLH data files to respective PIs 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.

Subtask 5.0: Coordinate off-loading of DACOM and DLH with DC-8 support personnel and shipment of equipment to Langley with INTEX-NA project personnel.

Deliverables

1. Provide PIs 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:

1. Equipment packed and shipping list complete and up-to-date one day prior to shipment.

Subtask 6.0: After return from deployment, unpack DACOM and DLH and supporting equipment, reorganize laboratory, conduct equipment inventory, and calibrate instruments.

Deliverables

1. Results of equipment inventory.
2. 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.

Subtask 7.0: INTEX-NA data reduction and archival

Deliverables

1. INTEX-NA DACOM and DLH data reduced.
2. DACOM and DLH data submitted to INTEX-NA archive.

Performance Standards and Evaluation Criteria

Meets:

DACOM and DLH data archived prior to Feb. 15, 2005.

Exceeds:

DACOM and DLH data archived prior to Jan. 15, 2005.

End R5 block redefinition
Begin R6 block addition

Subtask 8.0: Prepare and characterize DACOM and DLH performance prior to shipment. Contractor shall verify the DACOM and DLH 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 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 Government-approved procedures, prior to shipment barring any optics failures.
2. Delivery of DACOM and DLH data files to respective PIs within 5 days of each test.

Exceeds:

1. Delivery of DACOM and DLH data files to respective PIs within 1 day of each test.

Subtask 9.0: Coordination of shipment of DLH and DACOM to the DC-8 integration site. The Contractor shall develop procedures to ship these instruments 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 coordinate pick-up and loading of DLH and DACOM with NASA personnel. The government will cover shipping costs.

Deliverables

1. Shipping List

Performance Standards and Evaluation Criteria

Meets:

1. DLH and DACOM packed to meet scheduled ship date of Dec. 9, 2004.
2. Shipping list complete and up-to-date on day of shipment.

Exceeds:

1. Shipping list complete and up-to-date at least two days prior to shipment.

Subtask 10.0: Integrate and preflight test DACOM and DLH on DC-8. This requires the Contractor to unpack, assemble and install DACOM and DLH on the DC-8. The Contractor shall verify the DACOM and DLH 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 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 Government-approved procedures to meet scheduled science flights (detailed in Attachment A) barring optics failure.
2. Delivery of DACOM and DLH data files to respective PIs within 24 hours of each test.

Exceeds:

1. DACOM and DLH are ready one week prior to first scheduled science flight barring optics failure.

Subtask 11.0: Operate, according to previously developed procedures, and maintain DACOM and DLH subsystems during the PAVE 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 each flight barring laser, optics, or detector failures.
5. Delivery of DACOM and DLH data files to respective PIs 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.

Subtask 12.0: Coordinate off-loading of DACOM and DLH with DC-8 support personnel and shipment of equipment to Langley with PAVE project personnel.

Deliverables

1. Provide PIs 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:

1. Equipment packed and shipping list complete and up-to-date one day prior to shipment.

Subtask 13.0: After return from deployment, unpack DACOM and DLH and supporting equipment, reorganize laboratory, conduct equipment inventory, and calibrate instruments.

Deliverables

1. Results of equipment inventory.
2. 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.

Subtask 14.0: PAVE data reduction and archival

Deliverables

1. PAVE DACOM and DLH data reduced.
2. DACOM and DLH data submitted to PAVE archive.

Performance Standards and Evaluation Criteria

Meets:

1. DACOM and DLH data archived prior to Aug. 15, 2005.

Exceeds:

1. DACOM and DLH data archived prior to Aug. 1, 2005.

End [R6] block addition

*****Begin [R7] block addition*****

Subtask 15.0: Investigate feasibility of carbon monoxide (CO) remote sensor.

Deliverables

1. Calculations of total atmosphere CO spectra.
2. Calculations of optimum correlation cell parameters.
3. Calculations of differential absorption sensitivity.

Performance Standards and Evaluation Criteria

Meets:

Calculations completed by Aug 1, 2005.

Exceeds:

Calculations completed by July 1, 2005.

Subtask 16.0: Install and characterize quantum cascade laser (QCL).

Deliverables

1. Laser dewar modified for QCL.
2. Laser power supply adapted for QCL.
3. Laser characterization data.

Performance Standards and Evaluation Criteria

Meets:

Delivery by Dec. 1, 2005.

Exceeds:

Delivery by Nov. 1, 2005.

Subtask 17.0: Move DACOM/DLH/GFCR laboratories and offices from B1202 to B1250

Deliverables

1. Organization of current labs and disposition of unneeded equipment and supplies.
2. Excess identified equipment.
3. Coordinate with movers the laboratory and office moves.
4. Collaborate with B1250 technical staff the merging and organization of laboratories and offices.

Performance Standards and Evaluation Criteria

Meets:

Move completed by Aug. 1, 2005.

Exceeds:

Move completed by July 1, 2005.

Subtask 18.0: Incorporate software, electronics and mechanical modifications identified during the PAVE mission into DACOM/DLH and test.

Deliverables

Verification and test results of all modifications.

Performance Standards and Evaluation Criteria

Meets:

Submit test results by Dec. 31, 2005.

Exceeds:

Submit test results by Dec. 1, 2005.

*****End R7 block addition*****

Government Furnished Items:

1. The DACOM and DLH 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 oscilloscopes).
2. Laboratory facilities for instrument checkout are available in rooms R5123 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:

Begin R5 block update

R6Travel: Deployment schedule calendars for the DC-8 operations will soon be available at the PAVE site URL:http://cloud1.arc.nasa.gov

End R5 block update

R7***In order to perform the task in a timely manner, it may occasionally be necessary for the Contractor to purchase material items.***

Safety: All personnel must have a current *Laser Eye Safety Certification* from LaRC.

5. Security clearance required for performance of work:

None required.

6. Period of Performance:

Planned start date: R5~~January 2, 2003~~ Completion date: R1~~June 30, 2003~~

	[R6]~~May 1, 2004~~ Nov. 1, 2004	[R2]~~September 30, 2003~~ [R3]~~October 31, 2003~~ [R4]~~December 31, 2003~~ [R5]~~February 29, 2004~~ [R6]~~February 28, 2005~~ [R7]~~August 15, 2005~~ ***December 31, 2005***
7.	**NASA Technical Monitors**: [R5]Glen Sachse and Glenn Diskin M/S: 468 Phone: [R5]41566 (Sachse) and 46268 (Diskin) NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*	

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 38RAA Revision: 1.1 Date of Revision: 7/30/04

Title: **Launch Vehicle Design and Analysis to Support Vehicle Analysis Branch**

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

The Vehicle Analysis Branch (VAB) of the Aerospace Systems Concepts and Analysis Competency (ASCAC) has a long history at NASA of providing concept development and assessment work supporting a variety of programs and strategic initiatives at both the center and agency levels. Currently, VAB has significant roles in supporting the Next Generation Launch Technology (NGLT) Program and the Orbital Space Plane (OSP) Program, two key parts of the agency's new Integrated Space Transportation Program (ISTP). Of the many roles it will serve, VAB will perform systems analysis of concepts and architectures for near-term, mid-term, and far-term system and technologies in support of the NGLT Program's [R1]***Systems Analysis Project (SAP)***. Tasks will include conceptual and preliminary vehicle design for various rocket powered and air-breathing powered vehicles, definition of system-level requirements for given concepts and architectures, support technology integration and assessment at the system-level and provide independent assessment of contractor proposed concepts and systems.

Revision 0.2: Extends the period of performance in response to a Contractor-initiated change to account for delays in receipt of government provided information and NASA priorities in "return-to-flight" (see [R0.02]below).

Revision 1: Extends the period of performance four months to September 30, 2004, in continuation of NASA's support with some requirements redefined for the new period of performance, and updates other info (see [R1]above and below).

> Change 1: Extends the period of performance two months to November 30, 2004, in response to a Contractor-initiated change to account for delays in receipt of government provided information and NASA priorities in Mach 10 Hyper-X analytical work (see [R1.1]below).

2. Description of the Work to be Performed:

2.1. This task provides VAB with support in multiple disciplines on the conceptual design and analysis of subscale flight experiment vehicles intended to test a hydrogen fueled scramjet at various flight conditions ranging from Mach 10 to 15 in support of the X-43D flight demonstration. X-43D is a flight research project supporting the NGLT roadmap for Far-Term SSTO concepts and addresses some critical technology drivers for this vehicle class. Duties will include development of aerodynamic and aerothermodynamic databases, computational fluid dynamics analysis, thermal analysis, vehicle packaging/layout while providing design solutions that satisfy the current state-of-the-art technology constraint. Contractor will work as team members on an integrated task team which includes other support contractors, industry, and government civil service. Information and data related to the X-43D concepts are at a minimum ITAR and some are classified as SECRET.

2.1.1. SCOPE

2.1.1.1. Contractor shall support development of aerodynamic and aero-thermal loads databases for inlet open and closed vehicle configurations utilizing the appropriate tools and methods given the scope and schedule for this task.

2.1.1.2. Contractor shall support performance of 3-D computation fluid dynamics (CFD) analysis of the vehicle fore-body and nozzle to support airframe-propulsion integration.

2.1.1.3. Contractor shall support performance of CFD analysis on vehicle scramjet injectors and combustor to assess mixing and combustion efficiency and provide improved design solutions.

2.1.1.4. Contractor shall support analysis and development of thermal protection system design solutions for the engine and airframe including passive acreage regions, leading edge concepts, hot structures and actively-cooled panels and active-cooling system requirements.

2.1.1.5. Contractor shall support performance of complete vehicle thermal balance utilizing the appropriate tools and methods given the scope and schedule of this task.

2.1.1.6. Contractor shall support performance of a complete vehicle packaging including all major subsystems and provide design solutions to meet vehicle weight and balance requirements.

2.1.2. DELIVERABLES

2.1.2.1. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.2.2. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.2.3. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.2.4. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.2.5. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.2.6. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. Electronic files of technical data shall be made available as appropriate.

2.1.3. SCHEDULE

2.1.3.1. Documentation due 30 days after completion of technical subtask.
2.1.3.2. Documentation due 30 days after completion of technical subtask.
2.1.3.3. Documentation due 30 days after completion of technical subtask.
2.1.3.4. Documentation due 30 days after completion of technical subtask.
2.1.3.5. Documentation due 30 days after completion of technical subtask.
2.1.3.6. Documentation due 30 days after completion of technical subtask.

2.1.4. METRICS FOR DELIVERABLES

2.1.4.1. Meet schedule and cost.
2.1.4.2. Results documented in Contractor Report and/or meeting papers.

2.1.5. EXCEEDS MINIMUM REQUIREMENTS

2.1.5.1. Perform effort such that a reduction of schedule and cost is achieved.
2.1.5.2. Solutions/analysis consistent with standard NASA/Industry procedures and calibration/validation procedures.
2.1.5.3. Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

****Begin R1 block redefinition*****

2.2. This task provides VAB with support in multiple disciplines on the conceptual design and analysis of Two-Stage-To-Orbit (TSTO) Hypersonic Airbreathing launch vehicles in support of NGLT/SAP Architecture Team C. Requirements will include airbreathing flowpath design and performance analysis, development of aerodynamic and aerothermodynamic databases and loads models, computational fluid dynamics analysis, TPS (thermal protection system)/thermal analysis, vehicle packaging/layout vehicle sizing/closure and support tool integration into the AML environment. Contractor will work as team members on an integrated task team which includes other support contractors, industry, and government civil service. Information and data related to the concepts are at a minimum ITAR and some are classified as SECRET.

2.2.1. SCOPE

2.2.1.1. Contractor shall support development of aerodynamic and aero-thermal loads databases for the ascent segment of the mission for the mated configuration utilizing the appropriate tools and methods given the scope and schedule for this task.
2.2.1.2. Contractor shall conduct airbreathing flowpath design and performance analysis on the first stage of this two stage system. This vehicle will initially be designed to stage at Mach 6. Other staging Mach numbers shall be investigated within the 5 to 8 range to determine potential payoff versus design/technology challenge.
2.2.1.3. The Contractor shall create/modify/evaluate software processes and methods for TSTO, TBCC (turbine-based combination cycle), and rocket

configurations with the Adaptive Modeling Language (TechnoSoft, Inc.) This includes internal component/subsystems/packaging geometry as well as outer mold line geometry.

2.2.1.4. The Contractor shall support analysis and development of thermal protection system design solutions for the airbreathing first stage and the rocket powered second stage of this TSTO system. The first stage vehicle entails engine and airframe TPS including passive acreage regions, leading edge concepts, hot structures and actively cooled panels. The second stage entails airframe TPS including passive acreage regions and leading edge concepts.

*****End R1 block redefinition*****

2.2.2. DELIVERABLES

2.2.2.1. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. R1***Electronic files of technical data shall be made available as appropriate***.

2.2.2.2. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. R1***Electronic files of technical data shall be made available as appropriate***.

2.2.2.3. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. R1***Electronic files of technical data shall be made available as appropriate***.

2.2.2.4. The Contractor shall document all significant findings and results employing a standard NASA reporting mechanism. R1***Electronic files of technical data shall be made available as appropriate***.

2.2.3. SCHEDULE

2.2.3.1. Documentation due 30 days after completion of technical subtask.

2.2.3.2. Documentation due 30 days after completion of technical subtask.

2.2.3.3. Documentation due 30 days after completion of technical subtask.

2.2.3.4. Documentation due 30 days after completion of technical subtask.

2.2.4. METRICS FOR DELIVERABLES

2.2.4.1. Meet schedule and cost.

2.2.4.2. Results documented in Contractor Report and/or meeting papers.

2.2.5. EXCEEDS MINIMUM REQUIREMENTS

2.2.5.1. Perform effort such that a reduction of schedule and cost is achieved.

2.2.5.2. Solutions/analysis consistent with standard NASA/Industry procedures and calibration/validation procedures.

2.2.5.3. Results archived in refereed NASA Contractor Reports or other refereed documents (subject to NASA release procedures).

3. **Government Furnished Items:**

3.1. Specialized Computer Resources:

- Suns, SGI workstations, [R1]***and PC's*** on secure and open networks

3.2. Available Specialized Software:

- GASP 2.2	- GASP 4.0	- GRIDGEN	- TECPLOT	- GRIDTOOLS	- SHIP3D
- SRGULL	- SCRAM3L	- VULCAN	- USM3D	- PARAFLOW	- POST
- APAS	- PATRAN	- PRO-E	- UG	- SINDA85	- SAM3D
- MSCNASTRAN		- AML			
- MSCTHERMAL		- HYPERSIZER	- XESS	- I3G	- ACAD

3.3. Special Items:

- Safes for storage of classified material.

4. **Other information needed for performance of task:**

4.1. Estimated Travel requirements:

Performance of these tasks may require travel to: Marshall Space Flight Center; Kennedy Space Center; Glenn Research Center; Boeing North American, Seal Beach and Long Beach, CA and St. Louis, MO; Pratt & Whitney, West Palm Beach, FL; Technosoft, Cincinnati, OH; and participation in JANNAF Propulsion meetings, and appropriate international forums.

5. **Security clearance required for performance of work:**

5.1. Much of the work performed on this work order requires a **DOD SECRET** clearance.
5.2. United States Citizenship is also required.
5.3. Contractor shall be responsible for the securing of classified computing areas and the protection of classified documents according to NASA regulations.

6. **Period of Performance:**

Planned start date: [R1]~~Jan 1, 2003~~ ***Feb 1, 2004***

Completion date: [R0.2]~~Dec 31, 2003~~ [R1]~~May 15, 2004~~ [R1.1]~~September 30, 2004~~ ***November 30, 2004***

7. **NASA TECHNICAL MONITOR:**

John G. Martin M/S: 365 Phone: 757-864-3755

NASA TM ALTERNATE:

Jeffrey S. Robinson M/S: 365 Phone: 757-864-3782

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2 Statement of Work

Task Order Number: 38RBH Revision: 1 Date of Revision: 7/8/02

Title: Wind Tunnel Test of NASA SLI Identical Vehicle Launch System (IVLS) Configuration

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

The NASA Langley Research Center Aerothermodynamics Branch (AB) provides support to in-house and contractor vehicle development under the Space Launch Initiative (SLI) and Architectural development under NRA 8-30 Government Task Agreement.

The general purpose of this task is to test a NASA SLI Identical Vehicle Launch System (IVLS) configuration in the Vigyan wind tunnel to determine the approach/landing characteristics.

Revision 1: Extends the completion date to September 13, 2002 to accommodate greater than anticipated time in model design request/preparation (see R1 below).

2. Description of the Work to be Performed:

The Contractor shall conduct up to one (1) week (5 days) of testing on a NASA IVLS configuration. The test shall include configuration buildup and design study parametrics.

1. The Contractor shall provide standard force and moment data in hard copy and electronic format by R1 ~~19 July 02~~ ***13 September 02***. They shall include 6-component force and moment data, 2-8 base pressures, model attitude and tunnel flow conditions.
2. The Contractor shall conduct model installation, instrumentation checkout, test, and data acquisition. The Contractor shall provide data plots for run-to-run analysis during the tests.
3. The parametric test matrix will consist of; at a minimum, angles of attack from –2° to 24°, angles of sideslip of –8°, to 8°, grit-type boundary layer trips on/off as well as model configuration changes.
4. Flow visualization of either oil flow or micro-tufts will likely be required.

Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays beyond Contractor's control.

Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional test runs as requested by customer to supplement agreed upon data.

3. Government Furnished Items:

The Government will furnish the test article, test matrix and a strain gage balance.

4. Other information needed for performance of task: N/A

	Task Order Number: 38RBH Revision: 1 Date of Revision: 7/8/02 Title: Wind Tunnel Test of NASA SLI Identical Vehicle Launch System (IVLS) Configuration

5.	**Security clearance required for performance of work:** N/A
6.	**Period of Performance:** Planned start date:15 July 02 Completion date: R1 ~~19 July 02~~ ***13 September 02***
7.	**NASA Technical Monitor:** W.I. Scallion M/S: 408A Phone: 757-864-5235 **NASA Competency Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 38RDO Revision: 1 Date of Revision: 5/6/04

Title: Small Aircraft Transportation System Higher Volume Operations (SATS-HVO)

1.	**Purpose, Objective or Background of Work to be Performed:** **1. Purpose:** The purpose of the task is to provide data analysis and data visualization support for Small Aircraft Transportation System Higher Volume Operations (SATS-HVO) element. This support is required to facilitate various research activities that include piloted simulation and flight test experiments designed to support goals defined in the SATS-HVO project plan. **2. Background** The goals of the High Volume Operations (HVO) element of the SATS project are to conduct research, development and demonstration of reliable airborne automation and procedural concepts that enable high volume, small aircraft operations at non-towered, non-radar airports that support seamless integration with the National Airspace System (NAS) for near all-weather conditions. Research products will reduce pilot workload by efficiently managing aircraft-to-aircraft interactions in crowded airspace, and increase safety by providing guidance and tools for collaborative decision making during complex multiple aircraft operations, including likely non-normal situations. Functional capabilities will include collaborative decision making between vehicles for sequencing and separation, conflict detection & resolution, and hazardous weather avoidance for both en route and at non-radar/non-towered facilities. In addition, this technology will include approach paths that dynamically account for known weather, traffic, terrain/obstacles, NOTAMs, and airspace restrictions while providing efficient path guidance to the destination runway. Flight Information Services (FIS) and Air Traffic Management (ATM) functions required to support the above capabilities, for compatibility with the future NAS, and to minimize the need for voice communication are also included. Revision 1: Shortens the period of performance eight months to May 7, 2004, documents the earlier change in Technical Monitor, and annotates the deliverables as Completed (see [R1] below).
2.	**Description of the Work to be Performed:** The Contractor's shall provide support to the SATS-HVO element as detailed in the work breakdown elements described below. Their prioritizing and scheduling vary with research and programmatic developments and require the Contractor to coordinate detailed support with the Technical Monitor as the developments occur. All of these subtasks are intended to adapt and build upon the functionality already contained within the SVSAT data analysis program previously developed for the Synthetic Vision Systems General Aviation (SVS-GA) element under task order 21RDE. NASA will provide specific requirements documents to support each of these tasks. **Task 1:** *Statistical Data Analysis Support* – The Contractor shall provide software tools to facilitate post-processing of real-time simulation and flight-data into statistical quantities. Batch processing of large groups of real-time data files is required. Commercially available statistical analysis programs, like SPSS, are intended to be used to analyze the converted data.

Task 2: *Real-time data visualization* – The Contractor shall provide for real-time data visualization in support of research conducted in the NASA Air Traffic Operations Lab (ATOL). Electronic strip-chart presentation of various parameters will greatly facilitate research operations.

Task 3: *Post-run scorecard* – The Contractor shall provide the capability for a post-run scorecard to facilitate administration of qualitative measures (such as Cooper-Harper). The post-run scorecard shall accurately reflect the pilot's performance immediately following each data run.

Deliverables:
Deliverables shall be provided in accordance with the following schedule:

Deliverables and Schedule

No.	Description	Date Required*
1	Statistical data analysis capability for HVO-1/SSS flight test.	1/31/04
2	Real-time data visualization for the HVO-2 simulation experiment	3/31/04
3	Statistical data analysis capability for HVO-2 simulation experiment	4/30/04
4	Statistical data analysis capability for HVO-2 flight test	6/30/04

*Required dates may change based on progress of other related activities and will be specified by the NASA Technical Monitor as the changes occur, with as much advance notice as possible for the new due dates. [R1]***All work considered complete as of 5/7/04.***

Metrics for Deliverables:
Meets criteria if formal documents are delivered on time.

Exceeds criteria if formal documents and deliverables are delivered more than one week ahead of schedule.

Technical Performance: Technical Performance will be based on a qualitative assessment of both the technical and grammatical soundness of the formal documents delivered.

Meets criteria if qualitative assessment rating is good.
Exceeds criteria if qualitative assessment rating is very good or excellent.

3. Government Furnished Items:

Office space, furniture, specialized automation and supplies as required and approved by NASA technical monitor.

4. Other information needed for performance of task:
Ownership of and Rights to Use: The government shall have all rights of ownership of

Task Order Number: 38RDO Revision: 1 Date of Revision: 5/6/04

Title: Small Aircraft Transportation System Higher Volume Operations (SATS-HVO)

	and rights to use of the data. *Travel:*
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** **Planned start date:** 12/01/2003 **Completion date:** R1 ~~12/30/2004~~ ***5/7/2004***
7.	**NASA Technical Monitor:** R1 ***Dion Ramiscal*** M/S: 152 Phone: 757-864-***5689*** NASA Competency/Other Technical Coordinator: M/S: Phone:

Task Order Number: 38RFF Revision: 1 Date of Revision: 1/7/04
Title: Morphing Wing Concept Development.

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

Provide Engineering design and development of test hardware in support of Langley's Aircraft Morphing wing design tasks. The specific objectives of the work to be performed under the present task are to support the design and concept evaluation of various morphing wings. Evaluation of the concepts will require actuation and sensing capabilities. Initial work will develop prototype hardware for an articulated wing concept. Several iterations of the concept are anticipated to improve on the concept and to solve issues discover with prototype hardware.

Note: *The design, development, and test support is by its research nature, indefinite delivery and indefinite quantity (IDIQ). As each specific support requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask. In turn, the Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)*

Revision 1: Extends the period of performance one year to December 31, 2004, in continuation of NASA's support and adds/updates requirements for the new period of performance (see [R1] below).

2. **Description of the Work to be Performed:**

2.1 The Contractor shall design and oversee the fabrication of R&D of articulated wing concept. The Contractor shall also support continuing design and development of test fixtures for various wing concepts. 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 shall deliver final fixture assemblies, coordinate the integration of these assemblies into the component test apparatus and/or structural test-beds and participate in the testing of the specimens.

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 2.2.1, 2.2.2, 2.2.3, 2.2.4, and the following criteria:

2.1.1. Ability to meet delivery schedules for all mechanical 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 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.

2.1.2. Manufacturability of designed components per Contractor-generated engineering detail drawings

2.1.3. 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.

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

2.2.1 **(NOR item) Design and development of initial articulated wing.** The Contractor is to develop prototype designs for down selection by the LaRC Principal Investigator for fabrication. The Contractor shall oversee fabrication of the selected design, support mechanism, and fixtures and instrumentation-mounting hardware for evaluations. It is recommended that the design be conducted in stages where at least two models are constructed with increased levels of complexity. The initial wing model should address the structure joint design and kinematics. After successfully completing the first model a more representative model shall be fabricated using LaRC provided loads.

*****Begin R1 block addition*****

1.0 Further develop the existing single bay prototype articulated morphing wing structure to incorporate strut-locking devices to facilitate loads testing in a fixed position. Refine the design to demonstrate articulation by means of manually operated struts and vendor actuator driven struts, selected by NASA, where possible. The contractor shall design the necessary loading fixtures and components to facilitate all testing of the wing structures. Presented concept designs to the task Technical Monitor for review. Selection to be based on funding constraints for materials, fabrication, and assembly resources.

2.0 Further expand the existing multiple bay prototype articulated morphing wing structure design to incorporate strut-locking devices to facilitate loads testing in a fixed position. Refine the design to demonstrate articulation by means of manually operated struts and actuator driven struts, designed by the contractor. The design shall demonstrate articulation by means of actuators integrated in the wing structure. NASA will specify the actuator/strut range of motion as the design evolves and as their analysis dictates. Present concept designs to the task Technical Monitor for review. Selection to be based on funding constraints for materials, fabrication, and assembly resources.

3.0 Design a prototype system to attach a skin structure to the above mentioned wing structures or a newly designed structure that affords a better platform for this initiative. The Skin Wing prototype system shall be designed that simulates the geometry and functionality of an articulated morphing wing structure. This design shall demonstrate strut articulation with the added dimension of a wing structure with a skin material attachment. Design mounting hardware fittings that induce minimal structure constraints. Wing structures shall be designed to a positive safety margin when the loads specified by NASA are applied. Present design concepts to the task Technical Monitor for review. Selection to be based on funding constraints for materials, fabrication, and assembly resources.

4.0 The Contractor shall provide fabrication drawing for all components and oversee the fabrication/integration and testing of the wing structures, test fixtures and instrumentation mounting hardware required for performing articulation tests of all Phases of the Morphing Wing Project. The contractor shall provide liaison support to purchase all necessary hardware to support these tests including vendor component searches when appropriate. The Contractor shall provide liaison support for the fabrication, assembly, and integration of the tests supporting apparatus. The required effort will include support to technicians during the integration of fixtures, measurement devices, and specimen testing.

DELIVERABLES AND SCHEDULE

1.0 Morphing Wing- Single Bay Prototype Design upgrade Feb. 15, 2004

2.0 Morphing Wing- Multiple Bays Prototype Design upgrade April 15, 2004

3.0 Morphing Wing- Skin Wing Prototype Design July 30, 2004

4.0 Fabrication and Testing Support Sept. 30, 2004

*****End R1 block addition*****

PERFORMANCE METRIC:

2.2.1.1 The prototype structure shall simulate (within funding constraints for material and fabrication resources established by the Technical monitor) the geometry and functionality of articulated morphing wing structure. The design shall be developed in consultation with the LaRC personnel.

2.2.1.2 Initial articulation should demonstrate wing motion using manual operation but with the goal that a final design will integrate actuators into the wing structure. Range of motion shall be within 10 % of predicted values provided by LaRC personnel.

2.2.1.3 Design shall incorporate skin materials and mounting hardware features that do not significantly increase inputs required to articulate the system. A factor of 3 increase in input required with and without skin is considered appropriate.

2.2.1.4 The Morphing wing design shall be capable of wing loading (load per unit wing area) comparable to conventional wings. Typical wing loading ranges from 20-160 lbs/ft^2

3. **Government Furnished Items:**

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

4. **Other information needed for performance of task**:

None

5. **Security clearance required for performance of work**:

None

6. **Period of Performance**:

Planned start date: Feb. 15, 2003 Completion date: R1 ~~December 31, 2003~~

December 31, 2004

7. **NASA Technical Monitor**: William M. Berrios

M/S: 432 Phone: 757-864-7183

NASA Competency/Other Technical Coordinator: TBD

M/S: TBD Competency: SEC Phone: 757-864-nnnn

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 2 Statement of Work
Task Order Number: 39RBB Revision: ___ Date of Revision: Title: SLI Stage Separation CFD	

1.	**<u>Purpose, Objective or Background of Work to be Performed</u>:** Computational Fluid Dynamics (CFD) is expected to provide essential input to the evaluation of stage separation and abort aerodynamics for NASA Space Launch Initiative (SLI) (also known as 2nd Generation Reusable Launch Vehicle) configurations. The purpose of this work is to perform CFD analyses of several configurations and compare results with available wind tunnel data.
2.	**Description of the Work to be Performed:** The contractor shall use the overset grid CFD approach, with the OVERFLOW flow solver. Grids for the Langley Glide-Back Booster (LGBB) and Boeing SLI4 will be provided. The contractor shall use the PEGASUS 5 software to assemble the grids for static mated or proximity cases, and OVERFLOW-D (OVERFLOW 2.0 if available) to run unsteady separation cases. CFD solutions are to be provided for subsonic, transonic, supersonic and hypersonic flow regimes. Comparisons will be made with NASA Marshall 14" wind tunnel data, and Langley 16ft, Unitary, and 20" Mach 6 wind tunnel data. For the Boeing geometry, configurations to be run will consist of the booster alone, the orbiter plus payload container, and the mated configuration with booster, orbiter and payload container. Deliverables: 1. Informal monthly technical progress reports. 2. 12 CFD solutions for Boeing booster alone. 3. 12 CFD solutions for Boeing orbiter plus payload container. 4. Plots of CFD forces and moments, comparing with wind tunnel data where available. (CFD solution deliverables include grid system, flow solution, convergence history, and final forces and moments.) Minimum acceptable performance: 24 CFD solutions of Boeing configurations at specified flow conditions. Exceeds minimum performance: Additional CFD solutions of the Boeing mated configuration.
3.	**<u>Government Furnished Items</u>:** Office space, phone, desktop workstation with special graphics capability, access to PC clusters sufficient for completing calculations, all CFD software necessary to complete task, and near-body grids to resolve configuration geometry.
4.	**<u>Other information needed for performance of task</u>:** No travel requirements are anticipated.
5.	**<u>Security clearance required for performance of work</u>:** Contractor must be a U.S. citizen or Permanent Resident, as work requires access to restricted software. This task requires access to proprietary data, and may necessitate the Contractor signing a non-disclosure agreement.
6.	**<u>Period of Performance</u>:**

Task Order Number: 39RBB Revision: ___ Date of Revision:

Title: SLI Stage Separation CFD

	Planned start date: 1 June 2002 **Completion date:** 31 Oct 2002
7.	**NASA Technical Monitor:** Pieter G. Buning M/S: 499 Phone: 757-864-3093 **NASA Competency Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 39RDE   Revision: 2   Date of Revision: 8/24/04

Title: WSI InFlight System Functionality for AWIN Lab

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

As part of the Aviation Safety Program, Weather Accident Prevention Project, Aviation Weather Information (AWIN) Element, a WSI InFlight data-link cockpit weather information system is being installed in NASA Langley's Cessna 206 to support TAMDAR (Tropospheric Airborne Meteorological Data Reporting) experiments. The NASA Langley AWIN project is procuring a WSI InFlight system and subscription for use in a laboratory environment to support new presentation development and testing.

Revision 1: Extends the period of performance one month to August 31, 2004 to allow for some of the technical uncertainties mentioned in the initial task plan (see [R1] below).
Revision 2: Extends the period of performance to October 15, 2004, to accommodate additional requirements (see [R2] below).

2. Description of the Work to be Performed:

Generally, this task requires that the Contractor shall develop an installation plan, and install the WSI InFlight system and necessary peripherals and subscriptions such that the system: 1) reliably acquires weather information and presents this information on three different display units, both singly and simultaneously, and 2) records weather information available and as accessed by a human operator for all three display units. Finally, the Contractor must develop a system such that the saved record of weather information as accessed by the human operator is viewable through "playback" software on a laptop PC.

Implementation Plan:

The Contractor shall develop an implementation plan for the requirements as specified elsewhere in this document. For each task (except 2.2) in section 2, this implementation plan shall describe the hardware and software required for the requisite implementation, and shall describe personnel resources and any contractual agreements required. The plan shall also include itemized cost estimates for accomplishing implementation for each of these tasks. The implementation plan shall describe any task risks and suggest risk mitigation strategies. Finally, the implementation plan shall describe and cost implementation of alternative display options, specifically as a risk mitigation for MX-20 implementation as an option that is ready for transition to flight testing as a panel mount display.

Implementation and Data Presentation:

The WSI InFlight system shall be installed such that all the weather information available for the Aviator subscription that NASA purchases is presented appropriately and, for 95% of any 3-hour period, at the intended update rate of the data (every 5 minutes). The weather information presented by WSI for the Aviator subscription includes:

- WSI NOWrad 2km Dopplar Radar Mosaic
- WSI Graphic METAR
- Textual METARs
- WSI Graphic TAFs
- Textual TAFs
- WSI EchoTops
- WSI Graphic AirMETs and SigMETs
- Textual AirMETs and SigMETs

The presentation of this information shall meet this specification for each of the three display options: PC Laptop (Windows OS), Handheld PC, and MX-20 display unit. Information shall be able to be presented simultaneously to any combination of these three display units.

Data Recording:

The data recording shall include all weather products that are made available to the WSI InFlight system in files labeled with a time and date format. The data recording shall include an event file that is labeled with the same time and date format. The event file shall be a tab-delimited file that includes, for each event, the time stamp, the current display context, the event type (user-key, incoming data, system presentation or mode change onset) an event label, and if the event is associated with a new product having become available, the filename of that file.
This recording feature shall be functional for all three displays.

Data Playback:
The contractor shall develop playback software capable of reading the data files and driving a PC Laptop display to simulate a time-synched reproduction of what the WSI user saw during exercise of the equipment. During this playback, the simulation shall provide a window that allows the experimenter to see simulated time being executed. The playback software shall allow the experimenter to pause, rewind, fast forward, stop and place a text comment as another column in a playback comment file at a stopped point. Segments of the playback files should be able to be extracted and played back for demonstration purposes. This software shall be able to be run as an executable on a PC using Microsoft Windows 2000 OS with unlimited distribution.

*****Begin R2 block addition*****

GPS Integration:

The results of this task will be used to demonstrate WSI Inflight to subject pilots. To maximally demonstrate these features, an aircraft symbol will be presented and "flown" via GPS (e.g., GX60) connected to the WSI-hosting PC or avionics system (i.e., MX20). The prior task description required storing and playing back of weather received by the WSI system as well as user inputs to present certain views of this weather.

As an extension to this task, we require a means by which to store and play back the aircraft position. This interface should be developed such that the requirement can be met by GPS systems using alternate forms of output (e.g., NMEA and Aviation Standards) and will be able to interface to MS Flightsim and Elite Simulator GPS out in the case where their output is compatible with the weather displays.

*****End R2 block addition*****

The Contractor shall perform the following requirements/subtasks

2.1 WSI InFlight system installed with PC laptop,

2.1.1 Deliverable date: May 7, 2004.

2.1.2 Metrics: All features and functions available on WSI InFlight work and system reliably captures and presents all data available to system on PC Laptop.

2.2 Implementation Plan

2.2.1 Deliverable date: May 21, 2004

2.2.2 Metrics: Implementation plan specifies required hardware, software, personnel, contracts, and facility adaptations for accomplishing the other tasks described in this section. Costs and sources are provided for additional procurements that will be required. Risks are identified and risk mitigation solutions are fully described, in particular for identifying a panel-mounted display option that will afford transition to flight testing.

2.3 WSI InFlight data collection implemented on PC laptop,

2.3.1 Deliverable date: June 4 2004.

2.3.2 Metrics: Data record feature as described above is demonstrated for saving up to 3 hours of data using Laptop PC system.

2.4 Replay of data collection as operator experiences it from laptop display and replayed on laptop,

2.4.1 Deliverable date: June 25 2004.

2.4.2 Metrics: Presentation replay feature demonstrated in real-time mode and using the interface controls described above using Laptop PC system.

2.5 **Documentation of installations, data collection settings, and replay functionality for laptop installation – Initial Draft**,

2.5.1 Deliverable date: July 2 2004.

2.5.2 Metrics: Completeness of documentation: 1) ability for someone else to repeat installation from documentation, 2) ability for someone to initiate and modulate data collection based on documentation, 3) ability to replay data and interpret data correctly based on documentation.

2.6 WSI InFlight system installed with Handheld PC,

2.6.1 Deliverable date: May 21 2004.

2.6.2 Metrics: All features and functions available on WSI InFlight work and system reliably captures and presents all data available to system on Handheld PC.

2.7 WSI InFlight system installed with MX-20,

2.7.1 Deliverable date: May 28 2004.

2.7.2 Metrics: All features and functions available on WSI InFlight work and system reliably captures and presents all data available to system on MX-20

2.8 WSI InFlight data collection implemented on Handheld PC,

2.8.1 Deliverable date: May 28 2004.

2.8.2 Metrics: Data record feature as described above is demonstrated for saving up to 3 hours of data using Handheld PC system and replayed on laptop system.

2.9 WSI InFlight data collection implemented on MX-20,

2.9.1 Deliverable date: July 2 2004

2.9.2 Metrics: Data record feature as described above is demonstrated for saving up to 3 hours of data using MX-20 system and replayed on laptop system..

2.10 Documentation of installations, data collection settings, and replay functionality for all three installations – Initial Draft,

2.10.1 Deliverable date: July 16 2004.

2.10.2 Metrics: Completeness of documentation: 1) ability for someone else to repeat installation from documentation, 2) ability for someone to initiate and modulate data collection based on documentation, 3) ability to replay data and interpret data correctly based on documentation.

*****Begin R2 block addition*****

2.11 Integration of GPS information to drive aircraft symbol on display and to save GPS information.

2.11.1 Deliverable date: September 10, 2004

2.11.2 Metrics: Changes requested by Technical Monitor made, additions included.

*****End R2 block addition*****

2.12 Documentation of installations, data collection settings, and replay functionality for all three installations – Final Draft,

2.12.1 Deliverable date: R1 ~~July 23 2004~~ ***October 15, 2004.***

2.12.2 Metrics: Changes requested by Technical Monitor made, additions included.

3.	Government Furnished Items: • WSI InFlight system • WSI InFlight subscription • PC Laptop • Handheld PC • MX-20 display unit
4.	**Other information needed for performance of task:** Understanding of WSI InFlight software engineering and data compression and formatting.
5.	**Security clearance required for performance of work:** No
6.	**Period of Performance:** Planned start date: April 16, 2004 Completion date: R1 ~~July 30, 2004~~ R2 ~~August 31, 2004~~ ***October 15, 2004***
7.	**NASA Technical Monitor:** Kara Latorella, Crew Systems Branch M/S: 152 Phone: 757-864-2030 NASA Competency/Other Technical Coordinator (*above branch level*): M/S: 162 Phone:

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Statement of Work

Task Order Number: 39RFJ Revision: 1 Chge 2 Date of Revision: November 2, 2004

Title: Diode Laser Hygrometer for New Aircraft Platforms

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

NASA Langley's JumpStart Program is sponsoring the development of a new version of the Diode Laser Hygrometer for use aboard new atmospheric science aircraft platforms. The success of the DLH on the NASA Dryden DC-8 and the desire to utilize smaller, more cost-effective platforms are among the reasons for this support.

The Laser and Electro-Optics Branch of the Systems Engineering Competency will direct the development of the DLH-UAV. This instrument will provide high-accuracy and -precision, fast response, *in situ* measurements of water vapor in the atmosphere from the Proteus and/or other available platforms. Personnel are required to support this effort in the areas of electronic and optical design and fabrication, system integration, calibration, and performance testing, flight-testing, maintenance, and data handling.

This task will cover the initial design and development of the DLH-UAV, including travel to aircraft home for investigation of mounting/installation sites on aircraft, discussions of aircraft operational requirements, etc.

Revision 1: Adds Subtasks 7.0 and 8.0 which describe the migration of the DLH-UAV developments to the existing DC-8 DLH and a newer version of the DLH for the P-3B aircraft. The combined goal of these developments is that the DLH and its derivatives will be autonomous high-accuracy, high-precision water vapor sensors capable of deployment on a number of airborne platforms. Also, extends period of perfomance two months to Nov. 30, 2004. (See [R1] below.)

Change 1: Adjusts deliverables schedule to NASA's priorities (see [R1.1] below).

Change 2: Further adjusts deliverables schedule to NASA's priorities (see [R1.2] below).

2. **The Contractor shall perform the following requirements:**

Subtask 1.0: Investigate potential operation aircraft to determine suitable locations for DLH-UAV. Consider available pathlength, solar exposure, and environmental factors.

Deliverables

1. Recommendations for instrument mounting, including transceiver and reflector locations.
2. Document aircraft requirements/constraints, including available power, weight, volume.

Performance Standards and Evaluation Criteria

Meets:

1. At least one available site recommended for primary aircraft, including sketches.
2. Written document containing aircraft requirements/constraints for primary aircraft.

Exceeds:

1. At least one available sites recommended for all aircraft, including sketches.
2. Written document containing aircraft requirements/constraints for all aircraft.

Subtask 2.0: Design of optical subsystem consistent with findings in Subtask 1.0. Subsystem must be capable of transmitting and collecting sufficient light and rejecting solar and other interferences.

Deliverables

1. Optical design.
2. List of required components.

Performance Standards and Evaluation Criteria

Meets:

1. Design completed by [R1.1]~~Feb. 2, 2004~~ [R1.2]~~Sep. 30, 2004~~ ***November 30, 2004,*** including 3-D model of optical subsystem and list of required components.

Exceeds:

1. Design completed by [R1.1]~~Jan. 20, 2004~~ [R1.2]~~Sep. 15, 2004~~ ***November 15, 2004,*** including 3-D model of optical subsystem and list of required components.

Subtask 3.0: Design of laser control subsystem consistent with findings in Subtask 1.0. Subsystem must be capable of providing DC, modulation, and feedback current signals to laser, plus DC and feedback temperature signals to thermoelectric cooler. Subsystem shall be able to operate laser in a stable, wavelength-modulated mode suitable for high-precision spectroscopic measurements.

Deliverables

1. Design of electronic laser control subsystem.
2. List of required components.

Performance Standards and Evaluation Criteria

Meets:

1. Design completed by [R1.1]~~Feb. 27, 2004~~ [R1.2]~~Oct 29, 2004~~ ***November 30, 2004***, including

list of required components.

Exceeds:
1. Design completed by R1.1~~Feb. 13, 2004~~ R1.2~~Oct 14, 2004~~ ***November 15, 2004***, including list of required components.

Subtask 4.0: Construction of optical subsystem consistent with findings in Subtask 2.0. Subsystem includes transmission, collection and filtering optics, alignment and measurement lasers, shutter and detector. Subsystem housing should be compatible with dry gas purging.

Deliverables
1. Optical subsystem.

Performance Standards and Evaluation Criteria
Meets:
1. Subsystem completed by R1.1~~Aug. 27, 2004~~ R1.2~~Oct 29, 2004~~ ***November 30, 2004***.

Exceeds:
1. Subsystem completed by R1.1~~Aug. 6, 2004~~ R1.2~~Oct 8, 2004~~ ***November 9, 2004***.

Subtask 5.0: Construction of electronic subsystem consistent with findings in Subtask 3.0. Subsystem includes provisions for control, modulation and stabilization of laser wavelength, control and stabilization of laser temperature, variation of modulation depth, unlocking and relocking, shutter control, and detector gain control. Subsystem housing should be compatible with rack mounting on aircraft subsequent to constraints detailed in Subtask 1.0.

Deliverables
1. Electronic subsystem.

Performance Standards and Evaluation Criteria
Meets:
1. Subsystem completed by R1.1~~Aug. 27, 2004~~ R1.2~~Oct 29, 2004~~ ***November 30, 2004***.

Exceeds:
1. Subsystem completed by R1.1~~Aug. 6, 2004~~ R1.2~~Oct 8, 2004~~ ***November 9, 2004***.

Subtask 6.0: Development of computer data acquisition and control subsystem consistent with hardware developed in Subtasks 4.0 and 5.0. Subsystem includes provisions for generation of modulation and offset inputs, digital demodulation of detector signals, and generation of timing and self-calibration check inputs. In addition, subsystem should calculate water vapor concentration from demodulated data, record all relevant data to disk, and obtain inputs from aircraft data stream as required. Subsystem housing should be compatible with rack mounting on aircraft subsequent to constraints detailed in Subtask 1.0.

Deliverables

1. Data acquisition and control subsystem.

Performance Standards and Evaluation Criteria

Meets:

1. Subsystem completed by R1.1~~Sep. 24, 2004~~ R1.2~~Nov. 15, 2004~~ ***November 30, 2004***.

Exceeds:

1. Subsystem completed by R1.1~~Sep. 10, 2004~~ R1.2~~Nov. 1, 2004~~ ***November 16, 2004***.

*****Begin R1 block addition*****

Subtask 7.0: Modification of DC-8 DLH hardware, incorporating DLH-UAV elements. The DC-8 hardware shall be modified to incorporate ongoing developments from subtasks 1.0 through 6.0, as feasible and appropriate.

Deliverables

1. Modified optical, electronic, and data acquisition and control subsystems for the DC-8 DLH.

Performance Standards and Evaluation Criteria

Meets:

1. Modifications complete prior to INTEX-NA field campaign DC-8 upload, May 25, 2004.

Exceeds:

1. Modifications complete by May 1, 2004.

Subtask 8.0: Design of P-3B DLH hardware, incorporating DLH-UAV elements. The P-3B hardware shall be designed to incorporate ongoing developments from subtasks 1.0 through 6.0, as feasible and appropriate.

Deliverables

	1. Design of optical, electronic, and data acquisition and control subsystems for the P-3B DLH. Performance Standards and Evaluation Criteria Meets: 1. Design complete by November 30, 2004. Exceeds: 1. Design complete by October 31, 2004. *****End R1 block addition*****
3.	**Government Furnished Items:** 1. The laser(s) as well as supporting instrumentation, flight racks, hardware, software, and manuals. Access will be available to standard tools and lab test equipment (e.g. meters and oscilloscopes). 2. Laboratory facilities for instrument checkout are available in rooms 123 and 124 of Building 1202. 3. Government to furnish existing documentation, including notebooks, AutoCAD schematics, etc.
4.	**Other information needed for performance of task:** Travel: Travel will be required to investigate aircraft. Likely aircraft locations include Mojave, CA, and El Mirage, CA. Safety: All personnel must have a current *Laser Eye Safety Certification* from NASA-LaRC 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.
5.	**Security clearance required for performance of work:** None required.
6.	**Period of Performance:** **Planned start date:** December 1, 2003 **Completion date:** R1 ~~September 30, 2004~~ ***November 30, 2004***
7.	**NASA Technical Monitor:** Glenn S. Diskin M/S: 468 Phone: 757-864-6268 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

	Task Order Number: 40RBH Revision: ____ Date of Revision: Title: Wind Tunnel Test of Boeing's SLI Configuration (Latest Version)

1.	**<u>Purpose, Objective or Background of Work to be Performed</u>:** The NASA Langley Research Center Aerothermodynamics Branch (AB) provides aerodynamic support to Boeing's Space Launch Initiative (SLI) Architectural development under NRA 8-30 Government Task Agreement. The general purpose of this task is to test *the latest version of* Boeing's SLI configuration in the Vigyan tunnel to determine approach/landing characteristics *as a follow-on to Task Order 23RBH*. Revision 1: Broadens the window of performance due to scheduling uncertainty without increasing the technical requirements (see R1 below).
2.	**<u>Description of the Work to be Performed</u>:** The Contractor shall conduct up to 2 weeks (10 days) of testing on the Boeing SLI configuration. The test shall be composed of configuration build up and design study parametrics. 1. The Contractor shall provide standard force and moment data in an electronic format R1~~by September 2, 2002~~ ***within one week of test completion***. These measured items shall include: 6-component force and moment data, 2-8 base pressures, model attitude, and tunnel flow conditions. 2. The Contractor shall conduct model installation, instrumentation checkout, test, and data acquisition. 3. The parametric test matrix shall consist of, at a minimum, angles of attack from –2 to 20, angles of sideslip from –10 to 10, grit-type boundary layer trips on/off, as well as model configuration changes. 4. Flow visualization runs of either oil flow or micro-tufts will likely be requested. Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays not under Contractor's control. Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional runs as requested by customer to supplement agreed upon data.
3.	**<u>Government Furnished Items</u>:** The government will furnish test article and force and moment balance.
4.	**<u>Other information needed for performance of task</u>:** The Boeing configuration and test data is considered proprietary and should be handled as such. Contractor needs to sign Non-Disclosure Certification.
5.	**<u>Security clearance required for performance of work</u>:** N/A
6.	**<u>Period of Performance</u>:** Planned start date: August 12, 2002 Completion date: R1~~August 23~~ ***December 15***, 2002

	Task Order Number: 40RBH Revision: ____ Date of Revision: Title: Wind Tunnel Test of Boeing's SLI Configuration (Latest Version)

7.	NASA Technical Monitor: Greg Brauckmann M/S: 408A Phone: 757-864-5234 NASA Competency/Other Technical Coordinator: M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 40RDO Revision: 2 Date of Revision: 12/6/04

Title: Data-link Cockpit Weather Information System for use in the NASA C-206

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

1.1 Through the Aviation Safety Program, Weather Accident Prevention (WxAP) Project, NASA is developing technologies for the presentation and use of weather information in the cockpit of airplanes in flight. Initial research and development utilized cooperative research agreements with industry to develop prototype end-to-end systems and specific technologies for data-link cockpit weather information systems. Such systems are now available on the commercial market from multiple vendors. Recent research and development has focused on more effective presentation of weather information to crews in flight and provision of decision aids to facilitate safe and efficient avoidance of hazardous weather. This work will culminate in 2005 with flight evaluations of these next generation technologies.

1.2 The next generation presentation and decision-aiding technologies for general aviation pilots will be evaluated using simulation facilities and the NASA Langley Cessna 206 single-engine airplane. A NASA-acquired eye tracker is being incorporated into a simulation facility and on the NASA C-206 research airplane. The eye tracker system records where test subjects are looking and can be used to analyze gaze point fixation locations and durations on data-link cockpit weather information system displays. The airplane has been equipped with an onboard data system and TAMDAR (Tropospheric Airborne Meteorological Data Reporting) in situ weather sensor as a step towards implementing a prototype data-link cockpit weather information system for the GA flight experiment planned for the spring of 2005.

1.3 For experiments, weather data and products available to, and as accessed by, a data-link cockpit weather information system (as well as preflight and during-flight weather from other sources) will need to be captured and stored for replay in scenarios. For simulation experiments and flight experiments, hardware and software need to be developed for transforming stored weather data and products into researcher-defined display formats. For flight experiments, hardware and software need to be developed for transforming weather data and products delivered to the airplane via ground-to-air and air-to-air digital links into researcher-defined display formats. For post-test analysis, the aviation weather information system must capture in a time-stamped file structure and be able to replay both 1) all the information available to a subject and 2) the information that the subject chose to display through his control inputs to the interface.

1.4 This task includes working with NASA Crew Systems researchers and Flight Research Services personnel to define such a capability for the NASA C-206 that can be utilized for the spring 2005 flight experiment. This task requires extensive technical knowledge of, familiarity with, and experience in developing data-link cockpit weather information systems for GA airplanes (including programming the display unit contents as well as interfacing these systems to an aircraft) and knowledge of the NASA Weather Accident Prevention Project in order to determine system hardware and software components that will best meet the research needs in an efficacious manner.

Revision 1: Extends the period of performance two months to December 15, 2004 to accommodate known schedule uncertainties (see R1 below).
Revision 2: Extends the period of performance four months to April 23, 2005, in continuation of NASA's support with added requirements (see R2 below).

2. **Description of the Work to be Performed:**

2.1 The Contractor shall design a system (hardware and software) for transforming weather data and products delivered to the NASA C-206 airplane via ground-to-air and air-to-air digital links into textual and graphic color displays having researcher-defined display formats. The system design shall provide visual and aural alerting capability. Currently, it is envisioned that the weather data and products shall include (but not be limited to) WSI products delivered to the airplane via a Universal Access Transceiver (UAT) data link being fielded by the Federal Aviation Administration (FAA) as part of an east-coast network. The system design shall include the capability to ingest, via portable media, and use flight-plan and preflight weather briefing information derived from a flight-planning source such as the FAA Direct User Access Terminal System (DUATS). The system shall be designed to interface with a TAMDAR sensor for presentation and transmission of in situ weather observations. Hardware and software may be commercial-off-the-shelf (COTS) products, derivatives of COTS products, purpose-made products, or a combination of these that meet research needs and NASA requirements for use onboard the research aircraft. System design and components shall address the ability to share functionality or use on the NASA C-206 with the NASA synthetic vision (SV) research system. The AWIN (Aviation Weather Information) display shall be located in the "radio stack" in the center of the instrument panel of the C-206. The design shall include system architecture, identification of hardware and software components, definition of component interfaces, sources for hardware and software components, estimated cost of components and software, and a schedule for development and checkout of the system. The design, cost estimate and schedule shall consider compliance with Langley Management System (LMS) process requirements such as LMS-CP-0909 "Processing Experimental Systems Work Requests (ESWR)" and LMS-CP-0960 "Conducting Simulator and Aircraft Service Activity Experiments" where applicable.

2.2 The system design shall enable researcher-defined concepts for the presentation, alerting and trending of weather information to be readily incorporated into the data-link cockpit weather information system and displays along with GPS-derived airplane location, airspace boundaries, significant terrain and obstacles, airports, and navigation aids. These displays will be the subject of flight experiments in the spring of 2005. System functions and display products shall include:
2.2.1 A user interface for selecting active functions and display presentation;
2.2.2 Text and graphic display of Aviation Routine Weather Reports (METAR's), Special Aviation Reports (SPECI's), Terminal Area Forecasts (TAF's) and their amendments,

Significant Meteorological Information (SIGMET's), Convective SIGMET's, Airman's Meteorological Information (AIRMET's), Pilot Reports (PIREP's) both urgent and routine, and Severe Weather Forecast Alerts (AWW's) issued by the FAA or National Weather Service (NWS);
2.2.3 Graphic display of NEXRAD, including a graphic "looping" display of NEXRAD incorporating findings from NASA NEXRAD looping experiments being conducted in 2004;
2.2.4 The ability for a user to define, via an interactive display, airplane, airspace, pilot and weather operational limitations that will be used by the system in processing and presenting weather information;
2.2.5 Textual and graphic display of destination airport weather;
2.2.6 Textual and graphic display of alternate airport weather;
2.2.7 Display of a vertical profile depiction of weather along the planned flight path;
2.2.8 Trending and display of ceiling and visibility with alerting based on user-defined limitations;
2.2.9 Comparison and display of weather trends with forecasts;
2.2.10 Display of location of nearest good weather based on user-defined limitations;
2.2.11 Display of TAMDAR sensor reports, both from an onboard sensor and from reports received via data-link;
2.2.12 The ability to zoom the display "in" and "out" so as to decrease or increase the display scale;
2.2.13 The ability to combine multiple display elements or products on a single display "page";
2.2.14 The ability to utilize internet-based products such as the experimental weather products on the Aviation Digital Data Service (ADDS) web site;
2.2.15 A voice interface; and
2.2.16 An indication of proper system function and data reception.

****Begin R2 block addition*****
2.3 Complete system design also requires consideration of data integrity checking, offloading from the airplane, coordination, archiving, and analysis. The Contractor shall assist in the COWABUNGA experiment for these tasks to gain insight and design improved methods and formatting tools for the spring 2005 test.

2.4 To gain experience with running subjects and developing materials and procedures for data collection, the Contractor shall assist in pre-experiment development flights and discussions and possibly some data collection days in the COWABUNGA experiment.
****End R2 block addition*****

2.5 Deliverables and schedule shall consist of the following items:

2.5.1 A preliminary system design shall be presented to NASA at a Preliminary Design Review to be conducted 8 weeks after task initiation (July 9, 2004);

2.5.2 The final design, incorporating guidance and revisions from the Preliminary Design

Review, shall be presented to NASA at a Final Design Review 12 weeks after task initiation (August 20, 2004);

R2***2.5.3 Data archiving and analysis methodologies and templates for coordinating COWABUNGA flight test data (January 16, 2005).***

2.5.3 A final report suitable for publication as a NASA CR documenting the system design shall be delivered to NASA R1~~20 weeks after task initiation~~ (R1~~October~~ R2~~December 15, 2004~~ ***April 23, 2005***); and

2.5.4 Monthly written progress reports showing accomplishments and expenditures versus the plan shall be provided to NASA.

2.6 Metrics and Standards: Contractor performance will be assessed by progress made toward including the above specifications in the design.

2.6.1 Contractor will be considered to meet the requirements if all functionality described is addressed within the estimated cost and prescribed schedule.

2.6.2 Contractor will be considered to exceed the requirements if additional functionality is addressed, special innovativeness is evident, or work is completed ahead of prescribed schedule within estimated cost.

3. Government Furnished Items:

Office space and personal computer negotiable if necessary to allow timely performance.

4. Other information needed for performance of task:

May require up to six domestic trips to various vendor sites or vendor conferences, NASA Glenn Research Center, or WxAP meetings.

R2***No additional travel is required for this extension (from December 15, 2004 to April 23, 2005).***

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date: May 3, 2004 Completion date: R1~~October 15, 2004~~ R2~~December 15, 2004~~ ***April 23, 2005***

7. NASA Technical Monitor: Paul Stough, AirSC/RDO
M/S: 152 Phone: 757-864-3860

NASA Competency/Other Technical Coordinator (*above branch level*):
M/S: Phone: 757-864-

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 4 Statement of Work

Task Order Number: 40RFJ   Revision: 3   Date of Revision: 12/22/04

Title: Advanced Etalon Technologies Measurement and Instrument Support

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

A calibrated spectrometer system is required for a new project funded under Code R "Advanced Etalon Technologies" program. The project aims to record and analyze the fluorescent signal from plant and mineral targets in the field through use of novel etalon-based interferometers. A powerful, but challenging, measurement technique known as Fraunhofer Line Discrimination (FLD) will be applied.

A field instrument will be constructed using COTS components and controlled by a portable computer. Before constructing the actual field instrument, extensive studies of the fluorescent signals expected from the targets is required. The techniques and instrumentation required to conduct these tests are highly specialized and only partially available at LaRC.

Assembly and test of the etalon instrument requires extensive knowledge of both the fluorescence science and the etalon characteristics. The project thus requires the assistance of a person with experience in analyzing fluorescence emissions, assembling/using etalon optics, and with immediate access to laboratory fluorescence measurement equipment for the studies of the expected signals.

> **Note**: Some of the required support is by its research nature indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. As these specific detailed requirements become defined and are ready for the Contractor to perform, the Contractor shall provide an electronic notice of requirement(s) (NOR) and similar notification upon completion of the NOR to the COTR. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval. The NORs will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Adds new requirements as subtasks 3 and 4 (see [R1] below).
Revision 2: Extends the period of performance five months to February 28, 2005 and updates the schedule to accommodate the volume of technical accomplishment (see [R2] below).
    Change 1: Contractor-initiated for schedule in Subtask 2.0 to accommodate hardware problems and external procurement delays (see [R2.1] below).
Revision 3: Extends the period of performance 4 months to June 30, 2005 and updates the schedule to accommodate the volume of technical accomplishment (see [R3] below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following requirements/subtasks:

1. Measure the fluorescence signal emitted by certain targets (common household chemicals, inorganic minerals, and various types of common vegetation) under a variety of excitation conditions. The excitation wavelengths used to generate the samples' fluorescence shall be produced at approximately 20 nanometer intervals for excitation wavelengths between 350 nm and 600 nm. The fluorescence spectrum for the samples shall be measured from 400 nm to 750 nm in steps of 5 nm with a spectral resolution better than 5 nm.

   Deliverables: digital (ASCII or some other suitable format) versions of the measured spectra. Written report on experimental conditions/parameters for each spectrum delivered.

   Schedule: variable, most vegetation measurements performed early in the project, followed by measurements on minerals and eventually on the household chemicals. Spectra and reports are due two weeks after samples are provided to the Contractor.

2. The Contractor shall perform on-site at LaRC the assembly and optical alignment of the prototype Fabry-Perot instrument, and conduct laboratory tests to verify the performance of the instrument (spectral resolution, S/N measurements, other standard spectral properties.) The Contractor shall also assist NASA personnel in the design of the operating software algorithm.

   Deliverables: working prototype, laboratory test results in written report.

   Schedule: Optical hardware for the prototype assembled by R2.1~~August 31, 2004~~ November 30, 2004 and test results delivered by R2.1~~September 30, 2004~~ R3~~December 31, 2004~~ ***March 30, 2005***.

Begin R1 block addition

3. The Contractor shall assemble, align and measure the performance of prototype and brassboard (as applicable) optical sub-systems incorporated into new Fabry-Perot and grating spectrometers under development at NASA LaRC. The performance measurements shall include tests to quantify spectral and spatial resolution, wavelength calibration, instrument field-of-view, radiometric throughput, optical-component and optical-mounting.

Deliverables: A report containing the measurement data that includes the spectral and spatial characteristics of these sub-systems.

Schedule: variable, 4/16/2004 to R2 ~~9/30/2004~~ R3 ~~2/28/2005~~ ***6/30/2005***

4. The Contractor shall assist NASA personnel and other contractors in conceptual design of optical systems (such as telescopes and test/calibration systems) for prototype spectrometers. The Contractor shall also assist with construction of components (as needed) required to develop these systems, and shall assemble, align and operate these optical systems.

   Deliverables: Reports describing the conceptual systems and components required for their construction. In addition, an informal "operators manual" is to be delivered for components where deemed applicable by the technical monitor.

   Schedule: variable, 4/16/2004 to R2 ~~9/30/2004~~ R3 ~~2/28/2005~~ ***6/30/2005***

End R1 block addition

Performance Standards (for each subtask):

MEETS:

- Quality of data generated for each NOR (electronic data in ASCII format; can be downloaded into Excel spreadsheets)
- NORs completed by requested due date (accounting for complexity and competing requests)
- Quality of reports
- Performance of prototype Fabry-Perot device
- Cost

EXCEEDS:

- NORs completed ahead of requested due date
- "rush" NORs designated by the task monitor expedited
- Completion under cost

Task Order Number: 40RFJ Revision: 3 Date of Revision: 12/22/04

Title: Advanced Etalon Technologies Measurement and Instrument Support

	Government Furnished Items: Equipment, materials and laboratory space sufficient to perform the Fabry-Perot instrument construction and testing will be provided by NASA in building 1202 at Langley. Samples for the fluorescence studies to be conducted at Contractor's facility will be provided by NASA. For field deployments (if any) transportation and travel expenses will be provided by NASA. Field deployments (if any) will be local.
4.	**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.
5.	**Security clearance required for performance of work:** None
6.	**Period of Performance:** Planned start date: February 15, 2004 Completion date: R2 ~~September 30, 2004~~ R3 ~~February 28, 2005~~ ***June 30, 2005*** (This project is tentatively funded for 3 additional years, and plans are to extend the work described here when FY'05 money becomes available.)
7.	**NASA Technical Monitor:** Dr. William B. Cook M/S: 468 Phone: 757-864-8331 NASA Competency/Other Technical Coordinator (*above branch level*): M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 41RBB Revision: 2 Date of Revision: 10/21/02
Title: Wind Tunnel Test of PAVE Tilt-Nacelle Configuration

1. **Purpose, Objective or Background of Work to be Performed:**
The NASA Langley Research Center's Configuration Aerodynamics Branch (CAB) leads the aerodynamic analysis of conceptual configurations designed for Personal Air Vehicle Exploration (PAVE) under the Revolutionary Airframe Concepts Research (RACR) program. The general purpose of this task is to test a PAVE Tilt-Nacelle concept in the Vigyan tunnel to determine the first order aerodynamic performance effects, with simulated propulsion.
Revision 1: Increases test duration (days) and period of performance to accommodate additional need for data, delays in model delivery, and unanticipated complexity in model preparation, and acknowledges possible need for small hardware purchase. (see [R1] below).
Revision 2: Extends the period of performance to accommodate wind tunnel scheduling, data acquisition software modifications, and model repair/modification (see [R2] below).

2. **Description of the Work to be Performed:**
The Contractor shall conduct up to [R1]~~3~~ 5 weeks (~~15~~ 25 days) of testing on the PAVE Tilt-Nacelle configuration. The test shall be composed of propulsion calibration, configuration build up and analysis.
   1. The Contractor shall provide standard force and moment data in an electronic format by [R1]~~October 1~~ [R2]~~November 15,~~ ***December 31***, 2002. These measured items shall include: 6-component force and moment data, model pressures, model attitude, propulsion rpm and temperatures, canard and tail deflection angles and tunnel flow conditions.
   2. The Contractor shall conduct model installation, instrumentation checkout, test, data acquisition, and corrections for the removal of propulsion effects and standard tunnel corrections.
   3. The parametric test matrix shall consist of, at a minimum, angles of attack from –6 to 20, angles of sideslip from –10 to 10, and model configuration changes.
   4. Flow visualization runs of either oil flow or micro-tufts will likely be requested.
   5. Simulated ground effects using a height adjustable ground board will likely be requested.

Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays not under Contractor's control.
Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional runs if needed to supplement agreed upon data.

3. **Government Furnished Items:**
The government will furnish test article and force and moment balance, propulsion calibration rig, and hardware for remote operation of control surfaces.

4. **Other information needed for performance of task:**
Contractor shall coordinate with government and model makers to develop a control interface for remote operation of propulsion simulators. [R1]Some small hardware purchase may be necessary not to exceed $2500.

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

6. **Period of Performance:**

	Task Order Number: 41RBB Revision: 2 Date of Revision: 10/21/02 Title: Wind Tunnel Test of PAVE Tilt-Nacelle Configuration

	Planned start date: August 12, 2002 Completion date: R1~~October 1~~ R2~~November 15,~~ ***December 31***, 2002
7.	NASA Technical Monitor: Bryan A. Campbell M/S: 286 Phone: 757-864-5069 NASA Competency/Other Technical Coordinator: AAAC / Zachary Applin M/S: 286 Phone: 757-864-5062

Task Order Number: 42RBH Revision: ____ Date of Revision:

Title: Wind Tunnel Test of X-43A/Pegasus Launch Vehicle Configuration (HXLV)

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

The NASA Langley Research Center (LaRC), along with NASA Dryden Flight Research Center (DFRC) and Orbital Sciences Corporation (OSC), is participating in the X-43A Return-to-Flight (RTF) activity per direction of the NASA-appointed mishap investigation board. One of the goals of the activity is to mitigate risks prior to the next scheduled launch of the X-43A on its Pegasus booster vehicle.

The general purpose of this task is to test the X-43A/Pegasus launch vehicle configuration (also known as the HXLV) to assess the aerodynamic characteristics of the vehicle at extreme settings of the control surfaces on the Pegasus booster in the local flowfield of the B-52B carrier aircraft.

2. **Description of the Work to be Performed**:

The Contractor shall conduct up to five (5) days of testing on the HXLV configuration. The test shall be composed of angle of attack polars, with and without sideslip, on the full vehicle configuration with various control surface deflection settings, as well as angle of sideslip polars at various angles of attack. Similar runs will also be performed with the HXLV model proximate to an equally scaled model of a section of the NASA Dryden B-52B carrier aircraft.

1. The Contractor shall provide standard force and moment data in an electronic format by 21 October 2002. These measured items shall include: 6-component force and moment data in both body and stability axes, 2-4 base pressures (inclusive of sting-cavity pressure measurements), model attitude, and wind tunnel flow conditions.
2. The Contractor shall conduct model installation, instrumentation checkout, test, and data acquisition.
3. The parametric test matrix shall consist of, at a minimum, angles of attack from –10 to +10 degrees, angles of sideslip from –5 to +5 degrees, and deflections of the three control surfaces on the HXLV model from –51 to +51 degrees.
4. Grit-type boundary layer trips will be used on the nose, wing, and control surfaces of both the HXLV model and the B-52.

Meets Standard: Complete test matrix and acquired data within the prescribed schedule, allowing for delays not under Contractor's control.

Exceeds Standard: Complete agreed-upon test matrix before end of test period and complete additional runs as requested by customer to supplement agreed-upon data.

3. **Government Furnished Items**:

Task Order Number: 42RBH Revision: ____ Date of Revision:

Title: Wind Tunnel Test of X-43A/Pegasus Launch Vehicle Configuration (HXLV)

	The government will furnish test article, force and moment balance, and sting support.
4.	**Other information needed for performance of task**: The model configuration and data are ITAR Restricted and should be handled as such.
5.	**Security clearance required for performance of work**: N/A
6.	**Period of Performance**: Planned start date: 7 October 2002 Completion date: 1 November 2002
7.	**NASA Technical Monitor**: Matthew N. Rhode M/S: 408A Phone: 757-864-5252 **NASA Competency Coordinator:** Robert K. Hedgepeth M/S: 285 Phone: 757-864-8265

Task Order Number: 43RBL Revision: 7 Date of Revision: 3/29/05

Title: Experimental Hardware Development and Process Improvement

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

[R5]The Aeronautics Systems Engineering Branch (ASEB) develops model [R5]concepts, systems and technology for a wide variety of experimental hardware research needs used in LaRC aerospace testing facilities and selected flight research experiments off center. These model system structures are constructed using composites and/or metallic aerospace materials. The model system configurations typically involve complex geometry, extensive instrumentation, high dimensional precision and stringent structural loading performance. The [R5]ASEB team develops a concept design by documenting the specifications and performance requirements for the research hardware. The [R5]ASEB team consults with the research customer and the fabrication activities throughout the detail design to ensure that the model systems meets the research needs and takes advantage of efficient fabrication techniques. If insufficient specification or performance is not defined, the [R5]ASEB team executes feasibility studies and/or sensitivity analyses to provide a basis upon which the research requirements can be defined more explicitly. The design may involve new technology that is immature and necessitates risk reduction strategies such as; proof-of-concept development, material testing/characterizations and structural verification tests. The [R5]ASEB team uses Pro/Engineer computer aided engineering software to develop and document the model system. In addition, The [R5]ASEB team uses Microsoft Office software tools to develop, document and share the design development with the research requestor and the fabrication activity.

Note: The model and project support in this task is driven by its research nature and is indefinite delivery and indefinite quantity (IDIQ). As each specific model and project requirement becomes defined, the Technical Monitor will provide a notice of requirement(s) (NOR) to the Contractor through the automated task order system implemented for the contract. Each NOR will require the same concurrence and/or approvals as the rest of the task order flow process and will become part of the official task requirements and records relating to a respective subtask.

The requirements described below represent a revision of previous task order 09RBL. This revision extends the period of performance one year in continuation of NASA's support with a redefinition/update of requirements and change in title and number for the new period of performance.

Revision 1: Adds new requirements as Subtask 4 (see [R1] below).
Revision 2: Extends the period of performance one year in continuation of NASA's support with some updated requirements and info and two new Technical Monitors for the new period of performance. Also the title is updated to exclude CY association. (See [R2]above and below.)
Revision 3: Adds new requirements as Subtask 5 (see [R3] below).
Revision 4: Adds requirements to Subtasks 3 and 4 and new Subtask 6 (see [R4] below).
Revision 5: Extends the period of performance one year in continuation of NASA's support with some updated requirements and info and a new Technical Monitor for the new period of performance. Also, Subtask 6 is acknowledged as complete. (See [R5] above and below.)
Revision 6: Directs Subtask 4 to be completed by 2/28/05 (see [R6] below).

Revision 7: Terminates Subtask 2 (see [R7] below).

2. Description of the Work to be Performed:

Subtask 1:[R5]Concepts shall be created in support of the Transonic Shock Mitigation Active Bump team that is developing large and small deformation concepts for aerodynamic testing. Down-select concepts will be further developed, as determined by the Government, into test articles for wind tunnel use or other dynamic testing.

- Working with the team develop conceptual designs of large [R5]and small deformation concepts
- Generate input for planning, budgeting and scheduling for concept development and further detail development of down-selected concept
- Execute detail design including documentation in compliance with our in-house ISO 9001 processes [R5]LAPR1710.15 and CP-508. They can be found on the LaRC LMS website.

Deliverables:
- [R5]~~Development of one or more concepts of the HECS configuration~~.
- [R2]Development of one or more concepts of the Bumps configuration.
- Detail design drawings, CAD geometry definitions and fabrication liaison on down selected concept
- Documentation of innovative materials, actuation concepts, structural concepts and sensors incorporated into concepts.

Schedule of Deliverables:
- Conceptual design, CAD geometry definition, detail design shall be delivered as defined by the model task schedule.
- Documentation deliverables are due [R2]~~December 31, 2003~~ [R5]~~December 31, 2004~~ December 31, 2005.

Metrics for Deliverables:

Minimum performance

Development of one to two conceptual designs of [R5]~~HECS~~~~[R2] and~~ Bumps configuration.

Exceeding minimum performance

Contractor would exceed the minimum performance with one of the concepts chosen for detail design for future testing under aerodynamic load conditions. Detail design documentation is compliant with [R5]LAPR 1710.15

Subtask 2: [R7]***Terminated*** ~~The Contractor will perform engineering studies and design activities of advanced configurations. Perform research testing when required to determine proof of~~

~~concept approaches.~~
- ~~Develop one to two composite models for advanced vehicle concepts~~

- ~~Perform iterative engineering studies with research staff to determine engineering requirements from research objectives for composite model systems.~~

~~**Deliverables:**~~
- ~~Concepts design of composite model concepts.~~
- ~~Detail design drawings, CAD geometry definitions and fabrication liaison on down selected concepts~~
- ~~Recommendations (Lessons Learned) for process improvements to engineering and fabrication functions.~~

~~**Schedule of Deliverables:**~~
- ~~Deliver iterative engineering studies by agreed scheduled~~
- ~~Deliver detail designs and concepts that meet research objectives by agreed schedule.~~
- ~~Deliver lessons learned report by [R2]December 31, 2003 [R5]December 31, 2004 December 31, 2005~~

~~**Metrics for Deliverables:**~~
~~**Minimum Performance:**~~
~~Detail design documentation shall be compliant with ISO9001 processes [R5]LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned documented.~~

~~**Exceeding Minimum Performance:**~~
~~Detail design documentation shall be compliant with ISO9001 processes [R5]LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned document provides recommendations for improvements in model development process.~~

Subtask 3:
Force balances are structural instruments that measure the 6 components of aerodynamic loads on wind tunnel models during testing. In that capacity balances designs are optimized for structural strength, minimization of interactions between the six components of measure and increased sensitivity to increase accuracy of the force measurement. Because of these opposing design constraints the balance is a highly stressed structural component. Due to these high stresses, desire to increase the aerodynamic limits of wind tunnel testing and to ensure no structural failure of wind tunnel model systems, a more thorough analysis is required of each balance that will be tested in mandatory facilities under [R5]LAPR 1710.15. In [R5]LAPR 1710.15

balance requirements exist that require finite element models, fatigue and fracture analysis to be performed on balances that are highly stressed and don't have the appropriate factor of safety.

- Develop finite element models for structural analysis of force balances
- Perform structural analysis of balances.
- Analyze overloads that may be requested by aerodynamic testing organization
- Perform Fatigue and Fracture Analysis as determined by [R5]LAPR 1710.15

Deliverables:

- Finite element models of balances scheduled for use in aerodynamic tests.
- Structural analysis of each balance and fatigue and fracture analysis when required.
- Recommendations on improvements to balance designs to increase aerodynamic load capacity, structural integrity and increased accuracy

Schedule of Deliverables:

- Finite element models, structural analysis, fatigue and fracture analysis of balances delivered as determined by requirements and schedule.
- Recommendations on improvements to balance designs to increase aerodynamic load capacity, ensure structural integrity and increased accuracy by [R2]~~December 31, 2003~~ [R5]~~December 31, 2004~~ December 31, 2005
- .
- [R2]Document analyses and recommendations in an AIAA paper and present it at the Aerospace Sciences Meeting in Reno, Nevada, January, 2004.
- [R4]Document updated analyses and recommendations in a paper and present at the 4th International Symposium on Strain-Gauge Balances in San Diego, California, May, 2004.

Metrics for Deliverables:

Minimum performance

Detail analysis documentation shall be compliant with ISO9001 processes [R5]LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity.

Exceeding minimum performance

Contractor would exceed the minimum performance with suggestions of improvements to balance design to increase aerodynamic load capacity, ensure structural integrity and increased accuracy. Perform work in a more rapid manner than the original schedule and time estimate (at least one week earlier than specified date of completion).

Begin [R1] block addition

Subtask 4: [R6]Subtask to be completed on 2/28/05. The Contractor shall perform engineering and detail design for the Blended Wing Body Free Flight [R4]and Drop Models. In addition, the Contractor shall perform research testing when required to determine proof of design concept approaches.

Deliverables:

- Detail design drawings, CAD geometry definitions R4~~and fabrication liaison~~ on down selected concepts
- R4Design inputs and engineering analysis for Drop Model feasibility report
- Recommendations (Lessons Learned) for process improvements to engineering and fabrication functions.

Schedule of Deliverables:

- Deliver detail designs R4and feasibility report documentation that meet research objectives by R6***2/28/05***.

R2~~Deliver lessons learned report by Sept 30, 2003~~

Metrics for Deliverables:

Minimum Performance:

Detail design documentation shall be compliant with ISO9001 processes R5LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned documented.

Exceeding Minimum Performance:

Detail design documentation shall be compliant with ISO9001 processes R5LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned document provides recommendations for improvements in model development process.

End R1 block addition

**Begin R3 Block addition

Subtask 5: The Contractor shall perform conceptual and detailed design along with consultation for the acoustics related research and development activities within the Jet Noise Lab, Low Speed Aeroacoustic Wind Tunnel and Anechoic Noise Facility.

1) Consultation and mechanical design to support facility modification. The Anechoic Noise Facility will undergo enhancement to build an experimental flow duct for acoustic testing. The Contractor shall perform conceptual and detailed design for the following elements:

a. a 90-degree elbow with turning vanes to mate with the 30" diameter outlet flange of the existing air delivery system,

b. a transition from 30" diameter to 6"x15" duct,

c. 5 pieces of duct, 6"x15"x36",

d. test section duct, 24"x15"x60" with 6"x15" flange at a fixed location on the inlet and provision to offset the 6"x15" flange on the discharge,

e. anechoic termination,

f. duct support framework that facilitates moving of pieces for change out and access,

g. test section designed to accommodate both straight and curved lined sections,

h. duct designed to be expandable to 6"x30".

Mechanical design shall include analysis of the thickness, material type, and other design characteristics of the various components of the duct. Consultation shall include literature searching to identify and analyze appropriate off-the-shelf items such as the turning vanes as well as suggestions to make the design more efficient.

2) The Contractor shall perform conceptual and detailed design for two distributed exhaust nozzle (DEN) concepts including stress analysis and build-to-print drawings for fabrication. The DEN nozzles are stereolithography, but require a mechanical flange interface to mate with the facility.

3) The Contractor shall perform conceptual and detailed design of 2-3 high temperature air injection nozzle concepts for the Low Speed Aeroacoustic Wind Tunnel including stress analysis and build-to-print drawings for fabrication.

4) The Contractor shall design a high temperature charging station module with serviceable pressure and temperature rakes for use in the jet engine simulator.

5) The Contractor shall continue development of design plans for upgrades to the Small Anechoic Jet Facility to improve the exhaust and upgrade to dual stream flow.

Deliverables:
- Detail design drawings, CAD geometry definitions and fabrication liaison on down selected concepts for items 1, 2, and 3
- Conceptual designs for items 4 and 5 are acceptable; detailed designs are preferred.
- Recommendations (Lessons Learned) for process improvements to engineering and fabrication functions.

Schedule of Deliverables:
- Deliver detail designs that meet research objectives by agreed schedule.

Metrics for Deliverables:
Minimum Performance:
Detail design documentation shall be compliant with ISO9001 processes R5LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned documented.

Exceeding Minimum Performance:
Detail design documentation shall be compliant with ISO9001 processes R5LAPR 1710.15 and CP-508 and be delivered within the schedule and time estimate provided by the Contractor for the design activity. Lessons learned document provides recommendations for improvements in model development process.
End R3 block addition

Begin R4 block addition
Subtask 6: R5Completed.

	End R4 block addition
3.	**Government Furnished Items**: Mechanical design software Pro/EngineerOffice space Structural, Fatigue and Fracture analysis software CAD/CAM/CAE Workstation Selected training in process improvement on an as needed basis.
4.	**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.
5.	**Security clearance required for performance of work**: Secret Clearance required for subtask2.
6.	**Period of Performance**: Planned start date: R2 ~~1/01/03~~ R5 ~~1/01/04~~ 1/01/05 Completion date: R2 ~~12/31/03~~ R5 ~~12/31/04~~ 12/31/05
7.	**NASA Technical Monitor:** R5 Michael Mitchell M/S: 238 Phone: 757-864-4815 NASA Alternate Technical Monitor: R2 Mark Cagle M/S: 238 Phone: 757-864-7140

<table>
<tr><td colspan="2">SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order</td><td>Page 1 of 1</td></tr>
<tr><td></td><td colspan="2">Task Order Number: 44RBB Revision: 1 Date of Revision: 11/14/03
Title: Test Advanced Aerodynamic Concepts in the VIGYAN Subsonic Wind Tunnel</td></tr>
</table>

1.	Purpose, Objective or Background of Work to be Performed: ***Test advanced aerodynamic concepts in the VIGYAN subsonic wind tunnel.*** Revision 1: Extends the period of performance to February 29, 2004, to enable testing of model in the Unitary Plan Wind Tunnel and to accommodate scheduling difficulties associated with its impending shut down (see R1 below).
2.	Description of the Work to be Performed: The Contractor shall conduct 3 weeks (15 days) of testing on the supplied model. 1. The Contractor shall provide standard force and moment data in an electronic format by R1 ~~10/1/03~~ ***2/29/04***. The measured data shall include 6-component force and moment data, model surface static pressures, model attitude and tunnel flow conditions. 2. The Contractor shall conduct model buildup, installation, instrumentation, checkout, test, data acquisition, and test corrections. 3. The test matrix shall consist of model changes, angle of attack sweeps between –6 to 20 degrees and angle of sideslip from –10 to 10 degrees. 4. Flow visualization data of oil flow and micro/mini tufts shall be obtained Meets Standard: Completes agreed to test matrix and obtain data within schedule Exceeds Standard: Completes agreed to test matrix and obtain data ahead of schedule
3.	Government Furnished Items: The government shall furnish test article and balance.
4.	Other information needed for performance of task: The Contractor shall coordinate with the government.
5.	Security clearance required for performance of work: *NA.*
6.	Period of Performance: Planned start date:8/1/03 Completion date: ~~10/1/03~~ ***2/29/04***
7.	NASA Technical Monitor: *Rick Wood* M/S: *280* Phone: 757-864-*6174* NASA Competency/Other Technical Coordinator NA M/S: *nnn* Phone: 757-864-*nnnn*

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order

Task Order Number: 45RBH Revision: ____ Date of Revision:

Title: Wind Tunnel Test of Boeing's OSP Configuration

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

The NASA Langley Research Center Aerothermodynamics Branch (AB) provides aerodynamic support to Boeing's OSP (orbital space plane) Architectural development.

The general purpose of this task is to test Boeing's OSP configuration in the Vigyan tunnel to determine approach/landing characteristics.

2. Description of the Work to be Performed:

1. The Contractor shall conduct 2 weeks (10 days) of testing on the Boeing OSP configuration. The test will be composed of configuration build up and design study parametrics. Complete parametrics will be defined later. Probable angles of attack will be from -4 to 20, and sideslip angles from -8 to 8.

2. The Contractor shall provide standard force and moment data in an electronic format within one week after test completion.

3. The Contractor shall furnish technicians for model work to include installing the balance, model, pressure instrumentation, and transition grit (if used), as well as make most model changes. If flow visualization is used, the technicians shall paint the model, apply the oil and/or tufts, and setup the lights and camera equipment.

Meets Standard: Complete test matrix and acquired data within the prescribed 10-day schedule, allowing for delays not under Contractor's control.
Exceeds Standard: Complete agreed upon test matrix before end of test period and complete additional runs as requested by customer to supplement agreed upon data.

3. Government Furnished Items:

The government will furnish the test article and force and moment balance.

4. Other information needed for performance of task:

Contractor personnel will also be responsible for the operation of the tunnel, and data reduction.

5. Security clearance required for performance of work:

The Boeing configuration and test data is considered propriety and should be handled as such. Contractor needs to sign Non-Disclosure Certification.

6. Period of Performance:

Planned start date: October 20, 2003 Completion date: December 31, 2003

Note: It is anticipated that including deliverables schedule, no more than 10-15 working days will be required. The extended period of performance is set to accommodate

	unanticipated wind tunnel scheduling and/or technical problems.
7.	**NASA Technical Monitor:** Greg Brauckmann M/S: 408A Phone: 757-864-5234 NASA Competency/Other Technical Coordinator (*above branch level*): M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 46RBC   Revision: 1   Date of Revision: 7/16/04

Title: Mars Science Laboratory Parachute Test Gondola

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

Accurate estimates of the aerodynamic characteristics of the Mars Science Laboratory parachute test gondola are needed to isolate the drag of the parachute and to determine the static stability characteristics of the gondola for later multi-body dynamic analysis. The length of the total head probe required to reduce installation effects to an acceptable engineering level and the corrections to the static pressure on the leeward side of the gondola are needed for analysis of the parachute test results.

Revision 1: Extends the period of performance two months to September 30, 2004, with added requirements (see ^{R1} below).

2. **Description of the Work to be Performed:**

The Contractor shall perform the following requirements/subtasks:

Description: Design and fabricate a scaled wind tunnel model of the gondola. Incorporate all features of the gondola that will have a measurable influence on the aerodynamic data, including the stiffeners on the gondola petals and the structure for the parachute canister. Select instrumentation to provide a drag coefficient accuracy of 0.005. Incorporate instrumentation to measure the longitudinal force and moment coefficients of the gondola, the static pressure on the leeward side of the gondola, and the total pressure on the windward side of the gondola. Provide two scaled impact cushions for the windward side of the model for testing. The model shall be fabricated out of sheet metal, foam, plastic, and/or wood using techniques to assure that the components will not fail at the planned test conditions.

Provide instrumentation to measure the model angle of attack, the model forces and moments, the model total and static pressures, and the tunnel test conditions (static pressure, total pressure, and dynamic pressure).

Provide tunnel time, tunnel operator/technicians, instrumentation, data acquisition, and data reduction technicians, and a test engineer to complete the wind tunnel tests. Install the model in the tunnel. Test three model configurations: model without the impact cushion, model with a 6" thick (full scale) impact cushion, and the model with a 12" thick (full scale) impact cushion. Each configuration will be tested with 4 different total probe extensions. Each impact cushion/probe extension combination will be tested over the angle of attack range 3 times at the baseline roll angle and 3 times at the alternate roll angle. A single dynamic pressure should be selected to generate near maximum axial force on the balance at $\alpha=0^{\circ}$. The Reynolds number based on the gondola diameter should be about 0.6×10^{6}. The angle of attack should be varied from -20° to $+20^{\circ}$ in 2^{o} increments. Each test configuration should be documented with at least 2 different photographs (either electronic or conventional film) of the tunnel installation.

Reduce all force and moment data to coefficient form and provide both a hard copy and electronic version of all test data.

*****Begin ^{R1}block addition*****

Modify the petals of the gondola to reduce the outer diameter to 7.90 inches (model scale).

Task Order Number: 46RBC Revision: 1 Date of Revision: 7/16/04

Title: Mars Science Laboratory Parachute Test Gondola

Provide tunnel time, tunnel operator/technicians, instrumentation, data acquisition, and data reduction technicians, and a test engineer to complete the following additional wind tunnel tests using the same test techniques, test conditions, and procedures from the tests of the original configuration of the model: (1) test the 2 longest total probe lengths to determine the probe length with minimal interference from the gondola and measure the static pressure on the leeward side of the gondola to determine the correction to free stream static pressure, and (2) test the gondola with all pressure instrumentation removed and the optimum total probe length to determine the forces and moments on the model. Deliver modified model of the gondola, additional photos documenting the modified model configuration, one copy of the wind tunnel run schedule, and one hardcopy and one electronic copy of the wind tunnel test results.
*****End R1 block addition*****

Deliverables: Scale model of gondola, one set of photographs documenting each model configuration, one copy of the wind tunnel run schedule, and one hardcopy and one electronic copy of the wind tunnel test results.

Schedule: Deliver the scale gondola model, photographs, run schedule, and wind tunnel data prior to June 25, 2004. R1 ***Deliver the modified scale gondola model, photographs, run schedule, and wind tunnel data prior to September 10, 2004.***

Metrics: Model configurations fabricated to scale from drawings provided. Test documentation describes the procedures and analyses used. Results provided in both hardcopy and electronic form.

Standards (meets, exceeds): Task meets the standard of performance if the model configurations are designed, fabricated, and tested and the results provided by June 25, 2004. Task exceeds the standard if the same items are provided prior to June 2, 2004. R1 ***Extended task meets the standard of performance if the model configurations are designed, fabricated, and tested and the results provided by September 10, 2004. Task exceeds the standard if the same items are provided prior to August 9, 2004***

3. Government Furnished Items:

The government will provide drawings of the gondola, including the location of the static pressure probes on the lee side of the gondola and the location and length of the total pressure probes on the windward side of the gondola. The government will list the desired uncertainties in the model longitudinal aerodynamic coefficients, model moment reference center location, model reference area and the model reference length. A suggested model scale factor and strain gauge balance to obtain the desired uncertainties will be provided. The government will provide an estimate of the expected loads based on the best available existing data. The government will supply a suitable strain gauge balance, subject to availability.

Task Order Number: 46RBC Revision: 1 Date of Revision: 7/16/04

Title: Mars Science Laboratory Parachute Test Gondola

4.	**Other information needed for performance of task:** None.
5.	**Security clearance required for performance of work:** Unclassified. All model information as well as the data generated during the performance of the task are unclassified. All test results are the property of the U.S. Government and are not to be released to any other party.
6.	**Period of Performance:** Planned start date: April 15, 2004 Completion date: R1 ~~July 30, 2004~~ ***September 30, 2004***
7.	**NASA Technical Monitor*:** Raymond E. Mineck M/S: 286 Phone: 757-864-2879 NASA Competency/Other Technical Coordinator: Robert K. Hedgepeth M/S: Phone: 757-864-8265

Task Order Number: 01A4 Revision: ____ Date of Revision:

Title: ETDPO Program and Project Planning and Control Support

1.	**Purpose, Objective or Background of Work to be Performed**: The focus of this task is to provide program and project planning and control, including earned value analysis, support to the NASA Exploration Technology Development Program Office (ETDPO).
2.	**Description of the Work to be Performed**: **General Requirements** **Description**: Unless otherwise specified, the Contractor shall coordinate with ETDP POC on the development of work breakdown structures at levels established by program management. The Contractor shall develop and maintain the Integrated Master Schedule (IMS) for ETDPO. The Contractor shall also coordinate, develop, and maintain, as required, detailed schedules for the projects in ETDP. Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate program/project point of contact (POC). The Contractor shall alert the POC should any discrepancies arise, involving major milestones and/or deliverables. The critical path and the resource critical path (if the schedule is resource constrained) shall be identified within the IMS as required by the ETDP POC. The Contractor shall assist the projects within ETDP in developing Monthly Status Reports (MSR) and assist in compiling these reports in to a program level MSR. The Contractor shall assist in preparing Quarterly Status Reports (QSR) for the program. The Contractor shall provide consulting and expert advice on schedules to the program or project management as requested. The Contractor shall provide program or project with earned value data and analysis and schedule risk assessment as required. **Deliverables**: The Contractor shall develop an integrated master schedule; maintain master and detail schedules; support projects in development of schedules; produce and deliver reports; and provide consultation and expert schedule advice as requested by ETDPO. Although the requirements for deliverables may be modified from time to time, the following is a generic list of planning and schedule management products required: ▪ graphic reports Network Diagrams, Gantt charts, resource histograms ▪ management reports ▪ analytical reports and "white papers" ▪ management bullet/presentation charts ▪ WBS dictionary and/or hierarchical graphs ▪ Schedule Management Plan required to provide unique analysis or report formats (Primavera, Microsoft Project, etc.) **Metrics:** Minimum performance standards are to deliver all products on time with the following requirements: a) Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis

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requirements shall be documented in the Schedule Management Plan for each project.

b) Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports. For this reason, schedules shall be distributed electronically only in either Adobe or Microsoft PowerPoint formats.

c) Once a baseline has been established, 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, shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation. A record of approved baseline changes shall be maintained in a Change Control Log.

d) For new schedule requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation. This assessment and planning activity shall be documented in the Schedule Management Plan.

e) The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.

f) Once a baseline master schedule has been approved, the Contractor shall maintain historical plan/actual data as part of the schedule database. The data shall include original duration/actual duration at completion and actual start/actual finish and baseline start and baseline finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects.

g) The schedule shall follow the guidelines established in "NASA Procedural Requirement (NPR) 7120.5C, and the standards established by the Project Management Institute (PMI).

Standard 1: Support the development of Monthly Status Reports (MSR) for all projects and the program. Support the development of Quarterly Management Reports (QSR) for the Program. The Program MSR/QSR follows the program Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis, and Schedule Trend Charts.

CUSTOMER SERVICE/RATING:

Excellent: The MSRs/QSR are delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MSRs/QSR to review the reports.
Very Good: The MSRs/QSR are delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MSRs/QSR with project management in a timely manner.
Satisfactory: The MSRs/QSR are delivered to the customer on the specified due date with minimum errors. Analyst reviews MSRs/QSR with project management.
Poor: The MSRs/QSR do not meet requirements of following the WBS. The MSRs/QSR are

not delivered on the specified date and is not reviewed with the project management.
Unsatisfactory: No MSRs/QSR are delivered to the customer, and the customer has given no waiver.

Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and analytical reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update reports, Delinquency Reports

CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis.
Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate.
Satisfactory: Analyst is requested by project management to provide schedule reports/plots and does so on a regular basis.
Poor/Unsatisfactory: No schedule reports/plots are recommended or provided.

Standard 3: Produce and deliver accurate ad hoc reports in support of CPMC and/or management reviews.

CUSTOMER SERVICE/RATING:
Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission.
Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

Standard 4: Provide consultation and expert schedule advice to projects identified in the task order as subtasks. This consultation may be in the form of reports (Trend Analysis, Schedule Risk Assessments, Critical Path or Resource Critical Path Analysis, Earned Value Analysis) or schedule management recommendations.

CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.

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	Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request. Poor/Unsatisfactory: When requested, no recommendations are provided to the project management.
3.	**<u>Government Furnished Items</u>:**
4.	**<u>Other information needed for performance of task</u>:** ETDPO will provide funds to cover travel costs. Expected travel would include trips to various centers approximately 4 times a year and trips to NASA Headquarters aaproximately 2 times a year. ETDPO will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NAS1-00135.
5.	**<u>Security clearance required for performance of work</u>:** As defined at the subtask level.
6.	**<u>Period of Performance</u>:** **Planned start date:** April 1, 2006 **Completion date:** December 31, 2006
7.	**NASA Technical Monitor:** Richard C. Law, Jr M/S: 178 Phone: 757-864-2184 **NASA Competency/Other Technical Coor** M/S: *nnn* Phone: 757-864

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task

Deleted: 4/3/2006

Task Order Number: 01E1A Revision: 1 Date: 8/3/05 .

Title: Programs/Projects Schedules Management and Reporting for ARD

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

Note: This work includes follow-on for some work previously performed under Task Order 01OJ.

The Langley Non-NASA work is managed in full compliance with NASA Procedures and Guidelines 7120.5C which defines the requirements for formulating, approving, implementing, and evaluating Programs and Projects. Effective mechanisms for tracking and maintaining successful performance have been established and include earned value, schedule, and configuration management.

Revision 1: Extends the period of performance nine months to September 30, 2006 with no changes in detailed requirements (see [R1] below).

2. Description of the Work to be Performed:

General Requirements

Subtask 1 – Vehicle Systems Program (VSP) - The Contractor, using Vehicle Systems Program (VSP) approved scheduling software, shall be responsible to develop and integrate the detailed schedules for the major projects in VSP as well as a rolled-up, level I program schedule. This would include interfacing with NASA HQ and other NASA centers to integrate their portion of the work on a monthly basis. The Contractor shall also integrate and maintain an overall VSP master schedule containing all tasks and milestones for each of the VSP projects. The Contractor shall establish and maintain baselines for each of these products. The Contractor shall establish logic networks and identify the critical path between the projects and the program. The Contractor shall, as requested, document resource loading at the task level. Contractor shall work to maintain data integrity between the master schedules and presentation materials for the projects and program. The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the VSP Program, upon request, such requests should be for the sole purpose of subsequent benefits to the VSP Program.

Deliverables:

- Monthly - Management Reports
- As Needed – Update the VSP Schedule Documents
- As Needed - Deliver hardcopy of logic network plots and/or gantt charts as needed
- As Needed - Project Plan schedules showing the level II, III, and IV milestones for each project and color-coded to show lower-level roll-ups following the schema provided
- As Needed - Program Plan schedules showing level I, II, and III milestones
- As Needed - Update Resources Utilization and Schedule Report
- Monthly - Provide color copies of all deliverables to each Project Manager and the Program Manager
- As Needed - Post all deliverables on identified web based sight for the Projects and Program

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- As Needed - Attendance for weekly and monthly meetings and teleconferences; and planning team scheduled meetings

Subtask 2 – Langley Non-NASA Work - The Contractor, using Project approved scheduling software, shall be responsible to develop and integrate a master schedule containing tasks and milestones for Langley Non-NASA work. The Contractor shall establish and maintain baselines for each area of work and status the database on a monthly basis. If needed, the Contractor shall resource load the schedule at the task level and provide Earned Value Management (EVM) of the database. The Contractor shall work to maintain data integrity between the master schedule and presentation materials for the project. The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the Manager, upon request, such requests should be for the sole purpose of subsequent benefits to the Manager.

Deliverables:
- Monthly - Management Report
- As Needed - Deliver hardcopy of logic network plots and/or gantt charts
- As Needed - Update Resources Utilization and Schedule Report
- As Needed – Provide Earned Value Management of the database
- Monthly - Provide color copies of all deliverables
- As Needed - Post all deliverables on identified web based sight for the Project
- As Needed - Attendance for weekly and monthly meetings and teleconferences

Subtask 3 – Efficient Aircraft Spacing (EAS) - The Contractor, using Project approved scheduling software, shall be responsible to develop and integrate the detailed schedules containing all tasks and milestones for the major sub-projects under EAS. The Contractor shall establish and maintain baselines for each of these sub-projects. The Contractor shall establish logic networks and identify the critical path for each sub-project. The Contractor shall resource load the schedule at the task level and provide Earned Value Management (EVM) of the database. The Contractor shall work to maintain data integrity between the master schedules and presentation materials for the project. The Contractor is expected to transfer all products and results, including databases, of all activities, described herein to the EAS Project, upon request, such requests should be for the sole purpose of subsequent benefits to the EAS Project.

Deliverables:
- Monthly - Management Report
- As Needed – Create and update the EAS Schedule Documents
- As Needed - Deliver hardcopy of logic network plots and/or gantt charts as needed
- As Needed - Project Plan schedules showing the level II, III, and IV milestones for each project and color-coded to show lower-level roll-ups following the schema provided
- As Needed - Program Plan schedules showing level I, II, and III milestones

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- As Needed - Update Resources Utilization and Schedule Report
- As Needed – Provide Earned Value Management of the database
- Monthly - Provide color copies of all deliverables to each Sub-project Manager, Deputy Project Manager and the Project Manager
- As Needed - Post all deliverables on identified web based sight for the Project
- As Needed - Attendance for weekly and monthly meetings and teleconferences

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

- Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements.
- Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports.
- Once a baseline has been established, changes to the master database shall be under a controlled database change process. Working copies of the database or reports generated from a database that has not been baselined shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation.
- For new database requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation.
- Once a baseline master schedule has been approved, maintain historical plan/actual data including duration/remaining duration/actual duration at complete and start/finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects will be maintained as part of the schedule database.
- The schedule follows the guidelines established in NPG 7120.5C.

Standard 1: Develop and deliver Monthly Management Report (MMR). The Project/Program MMR follows the project Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis and/or Delinquency Report, and Schedule Status Charts.
<u>CUSTOMER SERVICE/RATING:</u>

Excellent: The MRR is delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MMR to review the report.

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Very Good: The MMR is delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MMR with project management in a timely manner.
Satisfactory: The MMR is delivered to the customer on the specified due date with minimum errors. Analyst reviews MMR with project management.
Poor: The MMR does not meet requirements of following the WBS. The MMR is not delivered on the specified date and is not reviewed with the project management.
Unsatisfactory: No MMR is delivered to the customer, and the customer has given no waiver.

Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update reports, Delinquency Reports).
<u>CUSTOMER SERVICE/RATING:</u>

Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis.
Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate.
Satisfactory: Analyst is requested by project management to provide schedule reports/plots and does so on a regular basis.
Poor/Unsatisfactory: No schedule reports/plots are recommended or provided.

Standard 3: Produce and deliver accurate adhoc reports in support of CPMC and/or management reviews.
<u>CUSTOMER SERVICE/RATING:</u>
Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission.
Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

Standard 4: Provide consultation and expert schedule advice to Program/Projects. This consultation may be in the form of reports or schedule management recommendations.
<u>CUSTOMER SERVICE/RATING:</u>

Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.

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	Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request. Poor/Unsatisfactory: When requested, no recommendations are provides to the project management.
3.	**<u>Government Furnished Items</u>:**
4.	**<u>Other information needed for performance of task</u>:** Program/Project will provide funds to cover travel costs. Program/Project will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NAS1-00135B.
5.	**<u>Security clearance required for performance of work</u>:** Work under this Statement of Work is unclassified. Security clearances are not required.
6.	**<u>Period of Performance</u>**: Planned start date: 1 July 05* Completion date: R1 ~~31Dec05~~ ***30Sep05*** * All work should be performed under 01OJ until applicable funding is exhausted.
7.	NASA Technical Monitor: Frances Sabo M/S 254 Phone: 757-864-6512

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Task Order Number: 01G1A Revision: 1 Date of Revision: 11/21/05
Title: R1*Exploration and Flight Projects Directorate (EFPD)*

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

The work described herein replaces several activities performed under SAMS (NAS1-00135) Task Order 01OJ (PARR/MESP Notice of Requirements (NOR) projects and Subtask 26 (Return to Flight).

Note: Subtask 4 (Proposal Teams, New Programs, and Projects) is by its nature, indefinite delivery and indefinite quantity (IDIQ). This work cannot be specified in detail very far in advance of the need because of its dependence upon ongoing intermediate programmatic and research developments. The Contractor shall proceed with performing NORs that are within scope of the work described below without waiting for the COTR's concurrence and/or approval**.** Each NOR will become part of the official task requirements and records relating to a respective subtask. The Contractor will be expected to include a brief tabulated summary of his responding activity in the monthly progress reports. (See NOR designated item(s) below.)

Revision 1: Changes Task Title to Exploration and Flight Projects Directorate (EFPD), adds subtask 5 (general EFPD task) and extends completion date to Dec. 31, 2006.

2. Description of the Work to be Performed:

General Requirements

Description: Unless otherwise specified, the Contractor shall develop and maintain the Integrated Master Schedule (IMS) for programs and projects as described below in subtask detail. The Contractor shall also develop and maintain detailed schedules and shall coordinate the development and integration of schedules and work breakdown structures at levels established by program management. Any discrepancies that arise between the overall master schedules shall be communicated to the appropriate program/project point of contact (POC). The Contractor shall alert the POC should any discrepancies arise involving major milestones and/or deliverables. The critical path and the resource critical path (if the schedule is resource constrained) shall be identified within the IMS. The Contractor shall produce and deliver a monthly management report and provide consulting and expert advice on schedules to the program or project management. When appropriate, provide program or project with earned value data and analysis and schedule risk assessment.

Deliverables: The Contractor shall develop an integrated master schedule; maintain master and detail schedules; produce and deliver reports; and provide consultation and expert schedule advice as specified in the subtask statements of work. Although the requirements for deliverables may be modified from time to time for individual projects, the following is a generic list of planning and schedule management products required:

- graphic reports Network Diagrams, Gantt charts, resource histograms
- management reports
- analytical reports and "white papers"

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- management bullet/presentation charts
- WBS dictionary and/or hierarchical graphs
- Schedule Management Plan required to provide unique analysis or report formats (Primavera, Microsoft Project, etc.)

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

a) Correct codes, attributes, and log for verifying that the data in the databases are accurate, up to date, and can support all management and working level reporting and analysis requirements shall be documented in the Schedule Management Plan for each project.
b) Data integrity in reporting. If data are to be exported from the master database(s) and reformatted for reporting, the integrity of the original schedule data as calculated shall be maintained no matter what graphics or project management software tool is used by the Contractor to produce the reports. For this reason, schedules shall be distributed electronically only in either Adobe or Microsoft PowerPoint formats.
c) Once a baseline has been established, 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, shall be clearly identified. Changes to a baseline schedule will be reviewed and approved by the Government prior to implementation. A record of approved baseline changes shall be maintained in a Change Control Log.
d) For new schedule requirements, the Contractor shall assess specific requirements and provide a plan for completion of a baseline work plan and schedule within one month of task initiation. This assessment and planning activity shall be documented in the Schedule Management Plan.
e) The Contractor shall deliver all deliverables on time. The schedule of deliverables may vary by subtask.
f) Once a baseline master schedule has been approved, the Contractor shall maintain historical plan/actual data as part of the schedule database. The data shall include original duration/actual duration at completion and actual start/actual finish and baseline start and baseline finish dates that can be analyzed to (1) determine the accuracy of original estimates and (2) improve ability to provide accurate estimates for future projects.
g) The schedule shall follow the guidelines established in “NASA Procedural Requirement (NPR) 7120.5C, and the standards established by the Project Management Institute (PMI).

Standard 1: Develop and deliver Monthly Management Report (MMR) for all Subtask Elements. The Project/Program MMR follows the project Work Breakdown Structure, and includes, but is not limited to, Narrative Schedule Analysis, Master Schedule, Critical Path Analysis, and Schedule Trend Charts.

<u>CUSTOMER SERVICE/RATING:</u>

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Excellent: The MRR is delivered to the customer on the specified due date with no errors. Analyst schedules a meeting with appropriate project management upon delivery of the MMR to review the report.
Very Good: The MMR is delivered to the customer on the specified due date with a high degree of accuracy. Analyst reviews MMR with project management in a timely manner.
Satisfactory: The MMR is delivered to the customer on the specified due date with minimum errors. Analyst reviews MMR with project management.
Poor: The MMR does not meet requirements of following the WBS. The MMR is not delivered on the specified date and is not reviewed with the project management.
Unsatisfactory: No MMR is delivered to the customer, and the customer has given no waiver.

Standard 2: Develop and maintain master and/or detail schedules. Anticipate project needs and generate schedules and analytical reports to provide value added to the customer in support of project requirements and team meetings. Reports may include, but are not limited to: WBS Element Schedules, Status Reports (Look Ahead Reports, Update reports, Delinquency Reports

CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate and on a regular basis.
Very Good: Analyst anticipates project needs/requirements and provides schedule reports/plots as appropriate.
Satisfactory: Analyst is requesed by project management to provide schedule reports/plots and does so on a regular basis.
Poor/Unsatisfactory: No schedule reports/plots are recommended or provided.

Standard 3: Produce and deliver accurate adhoc reports in support of CPMC and/or management reviews.

CUSTOMER SERVICE/RATING:
Excellent: Status reports are updated and delivered on or before the date established by the subtask with a high degree of accuracy and are reviewed with the customer upon submission.
Very Good: Status reports are updated and delivered on or before the date established by the subtask with accuracy and are reviewed with the customer.
Satisfactory: Status reports are updated and delivered on or before the date established by the subtask with accuracy.
Poor/Unsatisfactory: Status reports are not updated and/or delivered after the date established.

Standard 4: Provide consultation and expert schedule advice to projects identified in the task order as subtasks. This consultation may be in the form of reports (Trend Analysis, Schedule Risk Assessments, Critical Path or Resource Critical Path Analysis, Earned Value Analysis) or schedule management recommendations.

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CUSTOMER SERVICE/RATING:

Excellent: Analyst anticipates project management requirements and needs and provides schedule consultation on a routine basis and as required.
Very Good: Analyst anticipates project management requirements and needs and provides schedule consultation as required.
Satisfactory: Analyst is requested to provide project management and schedule consultation and does so in support of the request.
Poor/Unsatisfactory: When requested, no recommendations are provided to the project management.

Subtask 1 - Planetary Airplane Risk Reduction (PARR): The Contractor shall provide planning and scheduling support to the PARR project team by developing and managing an integrated master project schedule and other detail schedules as required, using Microsoft Office Project. The creation of the master project schedule shall include assembling the Work Breakdown Structure (WBS). The Contractor shall include elements and data in the master schedule that will allow for tracking real-time costs, workforce tracking, and critical path analysis. If required, the Contractor shall provide Earned Value Management (EVM) reporting. In building and maintaining the schedule, the Contractor shall interact with all Government project participants and private sector contractors. Planning and scheduling support shall be provided during project staff meetings and technical meetings on an as-needed basis. The Contractor shall provide the project manager with professional advice regarding project planning and scheduling.

Subtask 2 - Mars Exploration Supersonic Parachute (MESP): The Contractor shall provide planning and scheduling support to the MESP project team by developing and managing a master project schedule and other detail schedules as required, using Microsoft Office Project. The creation of the master project schedule shall include assembling the Work Breakdown Structure (WBS). The Contractor shall include elements and data in the master schedule that will allow for tracking real-time costs, workforce tracking, and critical path analysis. If required, the Contractor will provide Earned Value Management (EVM) reporting. In building and maintaining the schedule, the Contractor shall interact with all Government project participants and private sector contractors. Planning and scheduling support shall be provided during project staff meetings and technical meetings on an as-needed basis. The Contractor shall provide the project manager with professional advice regarding project planning and scheduling.

Subtask 3 - Space Shuttle Return to Flight/Service Life Extension Program Office
The Contractor shall provide planning and scheduling support to develop and manage an integrated master and detailed project-level schedules for the Space Shuttle Return to Flight (RTF) and Service Life Extension Program (SLEP). Schedules shall be developed in Microsoft

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Project and Milestones Professional. The schedule development and maintenance shall include directing and working with all RTF/SLEP Project, Subproject, Task Managers, the Competencies, and the Orbiter (JSC) and External Tank (MSFC) Project Offices and Space Shuttle Systems Integration Office (JSC), or as required. The schedule shall be integrated to include contractor, NASA led, and Government task agreement schedules, as required.

Deliverables:

- Monthly Management Report—the contractor shall analyze all schedule information submitted by the contract and governments sources and submit a monthly report by the 10th of very month.
- Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary.
- Participate in the RTF/SLEP telecons and meetings as needed.
- Monthly schedule updates to the RTF/SLEP project.
- Provide schedule Gantt Charts for Monthly/Quarterly Reviews
- Analyze schedules for conflicts and issues on a continual basis and document monthly in the management report.
- Maintain updated Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate.
- Advise the management team on development of the critical path and resource-loaded schedules as part of the monthly management report.

Subtask 4 – (NOR item) Proposal Teams, New Programs, and Projects

The Contractor shall provide planning and scheduling support for the Center's new business proposal development activities and for new program/project start-up activities. Since this work emerges throughout the year, the Contractor shall plan to support approximately four new proposal efforts per year and two new start efforts per year which shall require, as a minimum, development of an integrated master schedule and Work Breakdown Structure for the project and expert advice to proposal development teams. Travel in support of the NOR activities may be required.

*****Begin R1 block addition*****
Subtask 5 – Exploration and Flight Projects Directorate (EFPD): The Contractor shall provide planning and scheduling support to develop and manage master and detailed level schedules for the Exploration and Flight Projects Directorate (EFPD). The EFPD is comprised of programs, projects, elements and tasks within the Agency's Exploration Systems Mission Directorate, Science Mission Directorate, and Operations Mission Directorate. The schedule development and maintenance shall include directing and working with all EFPD Project, Subproject, Element, and Task managers from LaRC and other NASA centers as appropriate. The schedules shall be resource loaded, suitable for earned value management, and integrated as appropriate to include contractor, NASA led, proposals, and Government task agreement schedules.

	Deliverables: • Monthly Management Report—the contractor shall analyze all schedule information submitted by the contract and government sources and submit a monthly report by the 15^{th} of every month. • Provide planning and scheduling support for weekly and monthly meetings and teleconferences; attend other program and project meetings as necessary. • Monthly schedule updates. • Post updated master and subproject/element/task schedules to an electronic data storage system by the 15^{th} of every month. • Provide schedule Gantt Charts for Monthly/Quarterly Reviews • Provide monthly and quarterly timeline schedule of major events. • As needed – Analyze schedules for conflicts and issues. • As needed – Project Plan schedules showing Level II, III, and other level milestones as deemed appropriate. • As needed – Advise the management team on development of the critical path and resource-loaded schedules. *****Begin R1 block addition*****
3.	**Government Furnished Items:**
4.	**Other information needed for performance of task:** Each organization, program or project will provide funds to cover travel costs. Each organization, program or project will provide funds for update/maintenance of Contractor-leased or purchased hardware and software required to provide task order specific analysis and/or reports not applicable for use in other task orders on contract NAS1-00135.
5.	**Security clearance required for performance of work:** As defined at the subtask level.
6.	**Period of Performance:** **Planned start date:** August 29, 2005 **Completion date:** R1 ~~December 31, 2005~~ ***December 31, 2006***
7.	**NASA Technical Monitor:** Kathryn C. Ferrare M/S: 437 Phone: 757-864-3776 **NASA Competency/Other Technical Coordinator**: M/S: *nnn* Phone: 757-864-*nnnn*

Task Order Number: 01H1 Revision: ____ Date of Revision:

Title: Creativity and Innovative Research Support

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

This task is to provide support for Creativity and Innovation Research Programs as well as design sessions at Langley. The Creativity and Innovation Initiative was begun at NASA Langley Research Center in an effort to remain a national resource for aeronautical research. Research conducted under the umbrella of the Creativity and Innovation Initiative is directly related to the Center's overall mission to undertake innovative, high-payoff activities beyond the risk limit or capability of commercial enterprises and deliver validated technology, scientific knowledge and understanding of the Earth's atmosphere.

The Creativity and Innovative Research Program supports researchers in the conduct of revolutionary, high risk, high payoff research. The Center's success is measured by the extent to which research results in an improved quality of life for American. Having accepted the risk to engage in new and rewarding work, researchers are needed to accomplish the most ambitious research objectives in the following areas:

1. Access to Space
2. Aerospace Applications
3. Air Travel
4. Atmospheric Sciences
5. Military/Aircraft Supremacy
6. Planetary Exploration

Design sessions are innovative workshops held for the purpose of developing new strategies, projects, processes, or solutions to technical or organization issues. In a design session, a diverse group of people are brought together, and through the help of a facilitator, contribute their knowledge, learn from one another, and collectively design solutions. Effective design sessions often utilize in-front-of-the-group facilitation, as well as, document capture to elicit information from participants, collect, and organize group input and solution design. Design sessions provide LaRC with an independent and informed set of inputs regarding future research, business opportunities, proposal development, and strategic planning.

Description of the Work to be Performed:

1. The Contractor shall provide complete administrative support to the entire Creativity and Innovative Research Program to include:
   a. Maintain the data system for all research and related activities.
   b. Provide a leadership role in planning for and designing the implementation of an established archival system for the Creativity and Innovation Initiative.
   c. Maintain an archival framework that clearly defines its purpose, goals and type of material to be acquired.
   d. Accumulate appropriate records/documents from existing records, organizations or institutions.

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Task Order Number: 01H1 Revision: ____ Date of Revision:

Title: Creativity and Innovative Research Support

e. Ensure intellectual control over archival holdings, knowing what material is available in the archives and its source.

Deliverables for C&I Support:

1. Records of proposals, evaluations and status update shall be provided quarterly in paper or electronic format, Submission dates are March 30, 2006, June 30, 2006, and September 30, 2006, and December 31, 2006
2. Archival records/documents updates provided not later than two (2) months following the selection of C&I Proposals for award.

Metrics: Contractor performance will be evaluated for timeliness, initiative, thoroughness, and quality of work.

Standards: *Meets* minimum acceptable performance will be determined by deliverables on schedule with the appropriate attention to the above metrics. Deliverables earlier than scheduled by at least two weeks or other work metrics better than anticipated will be considered performance that *exceeds* the minimum acceptable standard.

The Contractor shall provide design session support to include:

a. Work with NASA LaRC to jointly determine target attendees for design sessions.
b. Schedule design sessions in appropriate facilities and work with NASA LaRC to establish agendas and desired outcomes.
c. Provide an expert facilitator for design sessions and provide for document capture support.
d. Make arrangements for required design sessions support including audiovisual support and food and beverage support.

Deliverables for design session Support:

1. Attendees list – to be provided not later than seven days prior to design session
2. Agendas – to be provided not later than three days prior to design session
3. Provide Expert Facilitation during design session(s)
4. Design session Documentation– proceedings of a design session are to be provided not later than one (1) month following the session.

Metrics: Contractor performance will be evaluated for timeliness, efficiency, thoroughness, and quality of work.

Standards: *Meets* minimum acceptable performance will be determined by deliverables on schedule with the appropriate attention to the above metrics. Deliverables earlier than scheduled by at least one day (deliverables 1 and 2) or one week (deliverable 4), or other work metrics better than anticipated, or unsolicited relevant positive comments from attendees will be considered performance that *exceeds* the minimum acceptable standard.

<u>Government Furnished Items</u>:

The Government will provide a list of target design session attendee names and addresses, facilities for the design session and documentation support.

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Task Order Number: 01H1 Revision: ____ Date of Revision:

Title: Creativity and Innovative Research Support

4.	**<u>Other information needed for performance of task</u>:** *None*
5.	**<u>Security clearance required for performance of work</u>:** *None*
6.	**<u>Period of Performance</u>:** Planned start date: February 20, 2006 Completion date: December 31, 2006
7.	**NASA Technical Monitor: Sharon S. Welch** M/S: 218 Phone: 757-864-6611 NASA Directorate/Other Technical Coordinator (*above branch level*): Marty Waszak M/S: 218 Phone: 757-864-8314

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Task Order Number: 02D3D Revision: Date of Revision:

Title: Parachute Imaging System Support Fixture

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

Provide Engineering design and development of test hardware in support of Langley's CEV/CLV Parachute Imaging system task. The specific objectives of the work to be performed under the present task are to support the design and development of a imaging hardware support platform system to be used in drop test conducted in conjunction with the Army's test program for model validation of new parachute concepts. The testing will be conducted in the NASA Glenn Plum Brook facility. The fixture will require motorized position control and speed control capabilities. Initial work will develop hardware to support the camera system as part of a controlled drop test. Several iterations of the concept are anticipated to improve on the concept and to solve issues discover with prototype hardware.

Note: *The design, development, and test support is required to be completed by July 1 2006.*

2. **Description of the Work to be Performed:**

2.1 The Contractor shall design and oversee the fabrication of the parachute imaging system test support fixture. The design concepts shall be reviewed and a selection made based on various parameters including cost, safety, portability, functional compatiability with the provided camera system. 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 available from vendors or manufactured by the U.S Government per Contractor specifications. The Contractor shall deliver final fixture assemblies, and support the integration of the fixture as part of a system test to verify mechanical operation and safety.

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 2.2.1, 2.2.2, 2.2.3, 2.2.4, and the following criteria:

2.1.1. Ability to meet delivery schedules for all 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.

2.1.2. Manufacturability of designed components per Contractor-generated engineering detail drawings

2.1.3. 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.

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

2.2.1 **Design and development of support fixture.** The Contractor is to develop prototype designs for down selection by the LaRC Principal Investigator for fabrication. The Contractor shall oversee fabrication of the selected design, support mechanism, and fixtures and instrumentation-mounting hardware for evaluations. It is recommended that the design be conducted in stages where at least two models are constructed with increased levels of complexity.

PERFORMANCE METRIC:

2.2.1.1 The structure shall provide sufficient safety features and redundancy to insure personnel safety while working under the support structure; The design shall be developed in consultation with the LaRC personnel. And require safety review by NASA Plum Brook safety personnel.

2.2.1.2 Be rigid enough to withstand deformation from handling under its own weight;

2.2.1.3 Be portable and transportable and easily assembled without special tools or fittings;

2.2.1.4 Provide the necessary channels and pads to support the imaging hardware and cabling;

2.2.1.5 Be lightweight and stable enough to be lifted in place with a motorized wench;

2.2.1.6 Require a minimum of ground support equipment;

2.2.1.7 Design shall incorporate materials and mounting hardware features that do not significantly increase cost of the system. A factor of 3 load rating is required.

2.2.1.8 Independent support cable shall be load rated to a factor of 2 to support the entire structure, in the event a failure should occur in any or all of the other cables.

3. **Government Furnished Items:**

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

4. **Other information needed for performance of task:**

None

5. **Security clearance required for performance of work:**

None

Task Order Number: 02D3D   Revision: Date of Revision:

Title: Parachute Imaging System Support Fixture

6.	**Period of Performance:** Planned start date: March 6, 2006 Completion date: June 30, 2006
7.	**NASA Technical Monitor**: Thomas Jones M/S: 493 Phone: 757-864-4903 NASA Competency/Other Technical Coordinator: TBD M/S: TBD Competency: SEC Phone: 757-864-nnnn

SAMS (NAS1-00135) Performance Based Contracting (PBC) Task Order	Page 1 of 1
Task Order Number: 03D3P Revision: ____ Date of Revision: Title: Engineering Support for Propulsion Upgrade to NFTP Test Fixture	

1.	**Purpose, Objective or Background of Work to be Performed:** Provide Engineering design and development of a revised electric propulsion system and vehicle configuration modification for NASA Langley's NFTP controls testbed. The NFTP is intended to fly indoors, in a volume enclosed by a cube-shaped net, each of whose edges is 16 feet long. The goal of the work is to provide a design for, and oversee fabrication of, a system of four identical thrusters to be mounted around the periphery of the NFTP to levitate the NFTP and to control its motion. Each thruster is to produce thrust by driving a propeller with an electric motor, and is to have a means of changing the direction and magnitude of the thrust vector. The Contractor shall also design any necessary changes to the existing NFTP hardware to accommodate these thrusters.
2.	**Description of the Work to be Performed:** The Contractor shall design and oversee the fabrication of the system of NFTP thrusters and vehicle configuration modifications. 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 shall support the delivery of final thruster hardware and integration concepts. Particular requirements are: 1. The Contractor is required to provide two recommended combinations of electric motor, propeller, motor controller – including special controller settings as necessary, and battery for the thruster (MPCB), within five weeks of task start. These combinations will be acquired, bench tested, and down-selected by the Government. 2. Because the NFTP may bump into its enclosure net during flight, the thrusters are required to include protective features to strongly discourage the propeller blade tips from coming into contact with the net. 3. The integration of the thrusters onto the NFTP is required to leave 15 inches of diagonal space between the outer rims of opposite thrusters, to leave room for mounting experiments. The overall diagonal measurement of the revised NFTP system (normal to the body z-axis) is required to be no more than 65 inches. 4. The thrusters, when installed on the NFTP, are required to give it a maximum thrust-to-weight ratio of at least 1.2 – it is desirable that the max thrust-to-weight ratio be no less than 1.7. 5. The NFTP's thrusters are required to achieve a thrust-to-weight ratio for the full NFTP of 1.0 with no more than 80% thrust – it is desirable that it do so with no more than 70% thrust. 6. The thruster system and batteries are required to enable NFTP hovering flight for a period of at least 1.3 minutes, when operating the motors from the onboard batteries. It is desirable that this endurance be 5 minutes. 7. The thrusters are to provide a mechanism for changing the magnitude of the thrust vector without changing the speed of the propellers. The roll-off frequency for the response of this mechanism is required to be 80% of that of the mechanism for

changing the thrust direction. It is desirable that it be at least 100% of the latter. Roll-off frequency is a metric for evaluating frequency response, and is the frequency at which the mechanism's response to a sinusoidal command input has attenuated by –3dB, or roughly 15% from its response to a steady input.

8. The frequency response and variability of the thrusters' thrust vectoring mechanisms must be sufficient to stabilize a Government-supplied simulation of the vehicle, in which the dynamic behavior of the thrusters is represented by tabular data and first-order lags, identified from Government-supplied bench tests.
9. The contractor is required to complete a preliminary system design within eight weeks of receiving thruster component and battery bench-test data from the Government. A final design is due within four weeks of receiving a response from the Government on the preliminary design.
10. The Contractor is required to coordinate the fabrication effort to produce the thrusters and integrate them with the rest of the system.

Deliverables:

- Two MPCB recommendations… Start + 5 wks
- Preliminary Design and PDR… Govt MPCB selection + 8 wks
- Final Design… PDR + 4 wks
- Support of fabrication and installation 22 September, 2006

PERFORMANCE:

A rating of "Meets" will be earned by satisfying the requirements listed above (at the "required" level where one is stated) and meeting the deliverables schedule. A rating of exceeds will be earned by either of two means. First, the contractor will earn "Exceeds" by supplying the first three deliverables listed under "deliverables" in 4 weeks, 7 weeks, and 3 weeks, respectively. "Exceeds" may also be earned by achieving the "desired" level of performance in two of the items 4-7 in the requirements list, while meeting the deliverables schedule.

3. **Government Furnished Items:**

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

4. **Other information needed for performance of task:**

None

5. **Security clearance required for performance of work:**

None

6. **Period of Performance:**

Planned start date: March 13, 2006, Completion date: September 30, 2006

7.	**NASA Technical Monitor**: Dan Moerder M/S: 308 Phone: 757-864-6495 NASA Competency/Other Technical Coordinator: TBD M/S: TBD Competency: RTD Phone: 757-864-nnnn

Task Order Number: 04D3R Revision: ____ Date of Revision: ________

Title: Oculometer & Data Archiving Assistance.

1.	**Purpose, Objective or Background of Work to be Performed:** The Integrated Intelligent Flight Deck Technologies project aims to develop technologies for improved operator state assessment in flightdecks. NASA has purchased an ASL 5000 dark pupil oculometer and LaserBird optical headtracker. The CANDAO experiment is an attempt to characterize how attentional sampling is affected by the use of a weather information system in a general aviation aircraft by instrument-rated private pilots. We require the assistance of a person who is highly experience with oculometers and the integration of oculometer data with head-tracking data, and in particular with ASL systems and software. This expert is required to contribute lessons learned from past experience and knowledge of relevant literature towards best practices in the verification and operation of an oculometer, and the analysis of oculometer, eye-head integration, and video data. This task also requires assistance structuring, archiving and accessing resulting experiment data. Expertise with the mass store system and ability to write datafile scripts for searching through and excising data from, directories and files is required.
2.	2.1 Tasks

2.1.1 Contribution to "Best Practices" Document – The contractor shall contribute lessons learned from prior experimentation, or experiences as are referenced in literature, to a paper on best practices in oculometer research for aviation applications, specifically with eye-head integration. The outline of this document and areas of contribution are as follows:

- Selecting an oculometer for aviation applications –dark/light pupil pupil/corneal detection, eye camera selection, scene camera selection,
- Ambient environment challenges & compensations -- lighting, vibration, magnetic interferences, headborne equipment, safety issues (egress, interference
- Oculometer installation & verification – challenges of installation (aircraft physical constraints), procedures for determining the accuracy and reliability of oculometer, head-tracker, and eye-head integration data, data analysis procedures for checking accuracy.
- Subjects for airborne oculometer research – physical characteristics, challenges with personal optics (glasses, contacts, sunglasses) for best subject selection; instructions to, and preparation of subjects for best data collection.
- Calibrating subjects – optimal characteristics of eye image for best calibration, procedures for assessing calibration accuracy, calibration data analysis procedures for assessing calibration accuracy.
- Data collection – procedures for ensuring that assumptions for accurate operation remain true during data collection (e.g., calibration, scene plane definitions, etc.), data analysis procedures for checking these assumptions, video data recording, event marking, data file structuring.
- Data analysis – best practices and caveats for deriving attentional focus,

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coverage (e.g., information access during saccades), and attention reorienting response times using oculometer data; identification of outliers and aberrations in data; statistical treatment of fixation durations, transition matrices, and comparisons with different area-of-interest definitions, averaging data over subjects and flights ; and video data analysis procedures and software applications that support this.

Referenced proceedings, journal, or technical report literature shall be provided in hard or electronic copy to NASA TM.

2.1.2 Oculometer Fitting to Experimental Subjects

- Subjects will be invited to NASA Langley prior to their scheduled flight day to receive training and to be ensure that we can robustly acquire oculometer data. The contractor shall provide personnel experienced in the operation of oculometers to assist in this activity for the 2 preliminary, and first 4 experimental subjects. Duration of this activity is expected to be 45 minutes per subject.
- If additional insights regarding best practices for subject selection, preparation, or calibration are identified, the contractor exceeds if these are contributed towards the "Best Practices" document.

2.1.3 Coordination and Archiving Experimental Data

Data will be available from several sources including coded questionnaire data (excel files), preflight weather images and documents, flight parameter files, WSI InFlight weather information files, oculometer data and video files, flight digital video and digital audio recordings, GPS flight track files, and possibly WSI keystroke files. Tasks associated with coordinating data will be to request data from FRSD staff, download data from each experimental flight from a hard drive and a handheld GPS, store data according to a naming convention and directory structure provided by the PI, check data for anomalies*, maintain a log file of data collected, and create scripts for selecting subsections of data, by time stamp or event key, from various files pertaining to a subject. These scripts will be annotated and provided to NASA as source code, and as executables. It is imperative that the common time-synch of data is preserved. Corrections may be required if failures to achieve synching during the experiment are identified post-data collection. Archived data shall be contained both in a dedicated hard drive (provided by NASA) and on mass store. CDs (provided by NASA) shall be created for each subject as data when the complete data set for that subject is acquired. Assistance will be required to convert digital video tape to digital video files for approximately 6 hours total of video data, of approximately 30 minutes duration from 12 different tapes.

* Note: See attached e-mail addendum to task plan 04D3R-R0C0.doc below.

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2.2 Schedule of Deliverables

SUBTASK	DELIVERABLES	DATE
2.1.1a	Provide input to “Best Practices” Document: *verification, calibration, operation* sections. Format shall be in bulleted list according to the outline described with references. This input shall be presented in electronic format in MS Word.	20 work days after contract award
2.1.1b	Provide input to “Best Practices” Document: *oculometer selection, ambient challenges, subject selection, data analysis* sections. Format shall be in bulleted list according to the outline described with references. This input shall be presented in electronic format in MS Word.	40 work days after contract award
2.1.2a	Oculometer fitting assistance.	Episodically as subjects are scheduled. Anticipated start date is May 22.
2.1.2b	(If identified) Oculometer fitting addendum to best practices	July 30, 2006
2.1.3a	Data coordination and archiving.	Episodically as data is collected. Anticipated start date is May 17.
2.1.3b	Data coordination scripts.	July 30, 2006.

2.3 Metrics

Timeliness and quality are the metrics. Timeliness is addressed in the schedule above, quality is addressed below. All reported items will be provided in MS Word documents.

2.3.1 Subtask 1: Contribute to “Best Practices” Document–
Each section should contain bullet list of at least 3 recommended practices. The contractor exceeds if substantial literature is referenced that contains unique contributions to ‘best practices’ using equipment that is comparable to state of the art in the relevant manner. The contractor exceeds for recommendations regarding improvement in oculometer and/or analysis package design.

2.3.2 Subtask 2 : Oculometer Fitting to Experimental Subjects

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The contractor shall assist in the oculometer fitting (e.g., headset stabilization, monacle adjustment, eye & scene camera thresholding). The contractor exceeds if additional best practices regarding subject selection or calibration process are documented as a result of these activities.

2.3.3 Subtask 3: Data Coordination and Archiving

Metrics pertain to the correctness, completeness of the data archive, the speed with which experimental data, once provided, is included on the archive, and the functionality of inter- and intra-datafile search scripts. The contractor exceeds if the entire data set for a subject is complete within 1 week of data provided. The contractor exceeds if search scripts are implemented in Visual Basic or MATLAB.

3. Government Furnished Items:

The contractor shall have access to the ASL DP-5000, associated equipment, and documentation. The contractor shall be provided with a PC-compatible hard drive for data storage to be returned to NASA. The contractor shall be provided with CDs for data recording as required.

4. 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.

5. Security clearance required for performance of work:

None

6. Period of Performance:

Planned start date: March 16, 2006 Completion date: August 31, 2006

7. NASA Technical Monitor: Kara Latorella

M/S: *152* Phone: 757-864-*2030*

NASA Directorate/Other Technical Coordinator: *Brent Weathered*

M/S: *152* Phone: 757-864-*7145*

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Kara Latorella, 02:10 PM 3/29/2006, Task Plan 04D3R Addendum Memo #060329_01

To: Kara Latorella <k.a.latorella@nasa.gov>
From: Bill Capron <w.r.capron@larc.nasa.gov>
Subject: Task Plan 04D3R Addendum Memo #060329_01
Cc: GLOVER Bob, BURDETTE Dan, WALL Dave
Bcc:
Attached:

Task Plan 04D3R Addendum Memo #060329_01. Date: March 29, 2006

Purpose: Elaboration of Subtask 3 WBS phrase "perform cursory check of data integrity."

Data recorded during the Characterizing AttentioN Distribution in Aircraft Operations (CANDAO) experiment are expected to comply with a Data Recording Specifications and Requirements document provided by the PI. Conformance to specifications and integrity of the resulting data files are the responsibility of the data collection service, presumably by Flight Research Services Directorate (FRSD) staff. Upon retrieval of recorded data files, converted for post-processing as necessary according to specifications, a high-level inspection will be performed to identify non-compliant and missing data, obvious anomalies, time-stamp inconsistencies, and system failure flags within the data that may hamper extraction of selected subsets of data and events by the defined scripts or other identified post-processing software. A summary of problems discovered will be provided to the PI along with suggestions of salvage possibilities, if any, depending on the severity of the problems. In addition, recorded video tapes will be reviewed to an extent necessary to identify problematic losses of camera coverage that may effect subsequent utilization. Identification of ASL system failures and anomalies may require documentation and software tools provided by the manufacturer. Detailed trouble-shooting and data recovery are beyond the scope of this task except for those resolutions that can be coordinated through the data collection staff.

W. R. Capron for R. J. Glover 3/29/06
K Latorella 3/29/06
R. Dan Wall 3/30/06

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Task Order Number: 05D3G Revision: ____ Date of Revision:

Title: Development of Advanced Thermoelectric Materials

1. <u>Purpose, Objective or Background of Work to be Performed</u>:

The purpose of this task is for the contractor to conduct research for new materials and fabrication techniques for advanced thermoelectric (TE) device applications.

Advanced TE materials that offer a high figure of merit (FOM) greater than 4.0 are really needed for high efficiency device coolers and generators. There have been shortcomings in TE material development due largely to the fundamental material issues, such as the increase in electrical conductivity while reducing thermal conductivity of TE materials. Development of new and high FOM TE materials is, accordingly, hinged on new approaches away from conventional methods. Therefore, the proposed work is (1) to develop new design of TE materials, (2) to create new approaches for new TE material fabrication, and (3) to grow or fabricate new and advanced TE materials for high FOM.

Note: Continues work previously performed under an expiring BPA.

2. <u>Description of the Work to be Performed</u>:

The Contractor shall perform the following requirements/subtasks:

1. Develop new techniques for fabrication of advanced TE materials.
   Deliverables: Fabrication technique for advanced TE materials.
   Schedule: As developed
   Metrics: Technique describes process that can be duplicated.
   Standards (meets, exceeds): Meets

2. Synthesize TE materials with advanced epitaxial technology.
   Deliverables: TE materials produced with advanced epitaxial technology.
   Schedule: As developed
   Metrics: Description of new advanced TE material
   Standards (meets, exceeds): Meets

3. Characterize the synthesized TE materials for electromagnetic properties.
   Deliverables: Characterization data
   Schedule:
   Metrics: Data describes the characterized material sufficiently to distinguish it from existing TE materials.
   Standards (meets, exceeds): Meets

4. Prepare and submit quarterly and final reports.
   Deliverables: Quarterly and Final Reports
   Schedule: Quarterly and end of contract
   Metrics: Reports descriptive of work performed
   Standards (meets, exceeds): Meets

Task Order Number: 05D3G Revision: ____ Date of Revision:

Title: Development of Advanced Thermoelectric Materials

3.	**Government Furnished Items:** Research shall be conducted on site at NASA LaRC throughout the period of performance. The Government will provide the following base support: Government-controlled working space, material and equipment. The Government will furnish or make available to the contractor any documentation deemed necessary by the Government to accomplish this task.
4.	**Other information needed for performance of task:** TRAVEL: Two trips shall be included, as necessary, for presenting research results at conferences or for collaborative efforts to advance the research being performed. The trips shall be within the United States, and be funded for one east coast and one west coast trip, each lasting the length of the conference/event including travel time. The Contracting Officer or a designated Government official will approve reimbursable travel in advance. The Contractor shall provide documentation with each invoice that travel and per diem invoiced is in accordance with the items and rates allowable under the Federal Travel Regulation (FTR) for reimbursement to Federal employees and in accordance with FAR 31.205-46. INFORMATION TECHNOLOGY (IT): All information technology resources are provided by the government and approved by the assigned government official in accordance with government procedure. All IT resources provided are Y2K compliant, as required by government policy.
5.	**Security clearance required for performance of work:** A DD 254 is not required for this requirement.
6.	**Period of Performance:** Planned start date: April 7, 2006 Completion date: December 31, 2006
7.	**NASA Technical Monitor:** Glen King M/S: 188D Phone: 757-864-4123

SAMS (NAS1-00135B) Performance Based Contracting (PBC) Task Order

Task Order Number: 06D3T Revision: ____ Date of Revision: 05/15/06

Title: Real-Time Software Development for SAFETI Lab

1.	**Purpose, Objective or Background of Work to be Performed**: Research conducted under the Integrated Vehicle Health Management Program and the Aviation Safety Program requires an analytical and experimental environment to conduct fault tolerance assessments of advanced critical flight computers in the context of system functionality, implementation and performance assessments of fault/malfunction/failure detection and mitigation strategies, and implementation and assessment of advanced robust adaptive control methods. As part of the Airborne Systems Research capability, which is being cultivated to support NASA's Aviation Safety Program, the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) Laboratory is being developed to provide the capability to integrate variable fidelity aircraft simulation with 'in-the-loop' fault/error testing of avionics hardware. This research capability will be utilized to promote the validation of developed advanced technologies under adverse conditions, and to processes for compliance demonstrations of complex integrated critical systems to certification requirements for operation in electromagnetic environments (EME), such as lightning and High Intensity Radiated Fields, [R2]to radiation environments such as atmospheric neutrons, and to requirements for fault containment that would ensure continued safe flight and landing of commercial aircraft. Fundamental to this research is the ability to operate the Equipment Under Test (EUT) in closed loop with a computer simulation of the aircraft, sensors, actuators, and engines in flight with atmospheric conditions. This task provides engineering support in these areas for research conducted under these programs.
2.	**Description of the Work to be Performed**: The Contractor shall perform the following requirements/subtasks: 1. Develop, update and maintain software applications required for investigations utilizing the Systems and Airframe Failure Emulation Testing and Integration (SAFETI) laboratory to find solutions to critical problems involving design, development, verification and certification of complex interconnected fault tolerant digital avionics systems, including an application which integrates operation and control of a closed-loop, real-time flight simulation with various avionics hardware subsystems including (i) the Honeywell Distributed Flight Controls System Testbed (DFCS), (ii) the Honeywell Recoverable Computer System (RCS), (iii) Honeywell MD-10 cockpit avionics subsystems, (iv) the Honeywell Versatile Integrated Avionics (VIA) system, and other assigned hardware subsystems including VME-based analog and discrete interface signals, PC-based Out-The-Window (OTW) graphics display systems and SCRAMNet network. The Contractor shall verify all systems integration software for accuracy and fidelity after modifications are made. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for integration and real-time, closed-loop operation of the following components (i) MD-10 simulation, (ii) the Honeywell DFCS Hardware, (iii) the Honeywell VIA system, (iv) the Out-The-Window video graphics system, (v) the VME-based analog and discrete I/O concentrator, and (vi) the SCRAMNet shared-memory network.

Schedule: Integration and operations software to be modified, updated, and maintained through 12/31/06.

Metrics: (Satisfactory Effort) Integration and operations software demonstrated to update SCRAMNet memory with specified ARINC 429 receive/transmit parameters.
(Exceeds) Out-The-Window video graphics system demonstrated in Vehicle Emulation Lab's (VEL) cockpit.

2. Design, develop and maintain, real-time, data distribution applications, utilizing existing SCRAMNet network systems, supporting linking SAFETI Lab to internal and external research support facilities. The Contractor shall verify all data display software for accuracy and fidelity after development. All software shall be developed, controlled, and documented in accordance with the Langley Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for the integration and display, in SAFETI Lab, of SCRAMNet network data collected from other NASA LaRC facilities and external facilities.

Schedule: SAFETI Lab linked-lab SCRAMNet software to be designed, developed, and maintained through 12/31/06.

Metrics: (Satisfactory Effort) SCRAMNet data shall be received in SAFETI Lab from one NASA LaRC facility linked to B1220 with fiber optic cable, and displayed on SAFETI lab computer systems. SAFETI Lab data shall be transmitted, via SCRAMNet, to one NASA LaRC facility linked to B1220 with fiber optic cable.
(Exceeds) Real-time (data transfer latency no greater than 250 ms), duplex data transfer between SAFETI lab and a facility external to NASA LaRC shall be demonstrated

3. Design, develop and maintain, data distribution applications, utilizing existing SAFETI Lab Satellite Communications Systems hardware. The Contractor shall develop and demonstrate software required for data, voice and video transfer to and from SAFETI Lab via SAFETI Lab satellite communications system hardware. The Contractor shall verify all simulation software for accuracy and fidelity after installation is completed. All software shall be developed, controlled, and documented in accordance with the Langley

Management System for the level defined by the Lead Test Engineer.

Deliverable: Software required for the integration and display, in SAFETI Lab, of data, voice and video transferred to and from SAFETI Lab via the SAFETI Lab satellite communications system hardware.

Schedule: Integration and display software to be installed and demonstrated by 12/31/06.

Metrics: (Satisfactory Effort) Demonstrate reception, in SAFETI Lab, of test data transferred from the SAFETI Lab satellite communications system.
(Exceeds) Demonstrate reception, in SAFETI Lab, of test data, voice and video transferred from the SAFETI Lab satellite communications system.

4. The Contractor shall provide documentation and tutorial information on all software applications developed for SAFETI Lab.

Deliverable: Written document with diagrams of hardware/software configuration, interface requirements, and data collection protocol.

Schedule: Written documents to be delivered as assigned by 12/31/06.

Metrics: (Satisfactory Effort) Delivery of assigned documents/tutorials 12/31/06.
(Exceeds) Timely delivery with suggestions or solutions for system improvement.

3. **Government Furnished Items**:

Computer equipment, hardware, software, and equipment associated with the Vehicle Emulation Lab and the SAFETI Lab, and a Desk-Top Workstation will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order. All work shall be performed in NASA Langley Building 1220 on a non-interference basis.

4. **Other information needed for performance of task**:

Manuals, schematics, technical reports, and papers will be made available to the Contractor to enable fulfillment of contract objectives. These items will remain the property of NASA LaRC and will be used solely for the purposes outlined in this task order.

5. **Security clearance required for performance of work**:

Security clearance is not required.

6. **Period of Performance**:

Planned start date: 6/1/06 **Completion date:** 12/31/06

	Task Order Number: 06D3T Revision: ____ Date of Revision: 05/15/06 Title: Real-Time Software Development for SAFETI Lab

7.	**NASA Technical Monitor**: Roger M. Bailey M/S: 130 Phone: 757-864-2007 NASA Directorate/Other Technical Coordinator: M/S: Phone: 757-864-